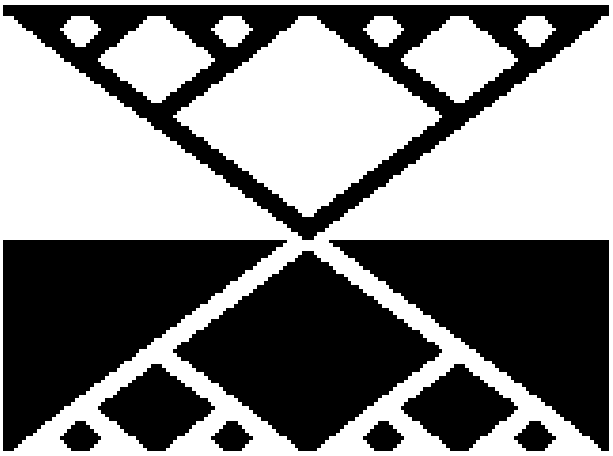
Deterministic World



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Preface

This book is a collection of ideas I've had over the past 3 years (2015-2018), trying my best to make sense of the world with my freshly learned analytical abilities after studying in various schools for 15 years and having passed the Ph.D. qualifying exam, which put me in a position where I could finally limit worrying about exams and start worrying about the bigger picture. These are views of a young scientist, or perhaps natural philosopher, as some of the ideas extend beyond the rigid academic framework of 'science', and might be unproven, unprovable, or even impossible to state in any quantitative terms. Yet this collection of ideas has given me a sense of peace, of having some clue of what is going on, of having a mental compass to focus on the underlying reality. Things are not always as they seem - the enemy might have the moral high ground and the action that feels most proper might be destructive when seen objectively. This book will 'fit' well with those of a certain mindset, a way of seeing and interpreting the world that is similar to the one I have, and chances are that even by now those will know that the rest of the book is of interest; to others it may be boring, pointless, subjective, lacking in rigor, or perhaps too fanciful. For you who will continue, reading this book will affect you, changing your thought patterns and view of the world - recognizing this cause and effect structure within yourself, you may find a recursive consistency with the arguments presented as I explore the nature of self and learning, and I believe such consistency is the only indicator of truth we have. For me, writing this book has been a journey in proving to myself just how little I know or can take for granted, and thus an emotional incineration of all the things I held dear. It has led me through depression and isolation, and hasn't given me much of an enlightenment. Amidst this I've found the need to define myself, not just the character traits I think are important but the specific actions that I should take to be the person I say I am. Turning my analytical and experimental abilities on my self, I learned that 'me' - the person I spend all my life with - is not quite who I thought. So this is a book about the world yet it is also an introspection, an explicit display of my thought process and development, a confrontation of the realities of life.

Introduction

Determinism is the idea that an initial state of a system suffices to determine all subsequent states. Solving the equation of motion of a ball in a gravitational field in high school physics demonstrates this idea: given the ball's height and velocity at time 0, we can find its height and velocity at any other time. The solution fully defines the ball's motion, there is no possible variation, the motion is forever fixed. We can look forward and backward in time and space, in any way we wish. One might say there is no 'free will', but it would be too early to use such complex notions now. Why would I think of a 'deterministic world'? Why would I title this book that way? I think the turning point in my search for answers about the world came when I accepted that physics conclusively shows that actions have their effects, and that specific actions always lead to the same specific effects. It was an acceptance of the perfect exactness of the laws of physics, and thus of the world itself, which if it follows those laws must also be deterministic. That means even this book was 'destined' to be written, and you were 'destined' to read it, and this all could have been foreseen by a powerful enough supercomputer solving equations of motion much more complicated than high school physics. That also means none of this could have ever been otherwise, there is no possible variation. At any point I might have decided to quit working on this book, but the world would not let me. If it is 'meant' for me to publish this book, it doesn't really matter what I do or how much effort I put in, the final result will still occur. Yet I have no idea what I am 'meant' or 'fated' or 'destined' to do, and my best guesses are often wrong. Being in the midst of this world, and experiencing all its sensations and constant ability to choose my course of action (or an illusion of such), it was very difficult for me to come to terms with the notion of a deterministic world. I cannot hope to convey this notion to you in a few sentences, but chances are that the rest of the book will serve to, in some subtle ways; thus I feel 'deterministic world' is an appropriate title.

Looking over my past notes, I am able to separate them by themes: Physics, Society, and Self. They will be presented in this order, as that is largely how my analysis of the world progressed. Physics sounds complicated, but society is in reality more complex (being an emergent result of

countless physical interactions), and understanding the self may even be outside of our ability (can a system ever 'understand' itself? facing these big questions one is left in awe at how we understand anything at all). The change from quantitative to more emotional and 'fuzzy' topics may stem from changes in my self - an emotional maturation, caused by biological and social factors at about the halfway point through writing the notes. As I will argue later, it is stifling to limit physics to only abstract numbers and equations, we are physical beings and we have emotions and feelings, so physics must also be the study of such 'human' phenomena. I will not propose any rigorous frameworks of physics, but rather describe ideas about how a framework could be made, which I refer to as 'theory'. These include information theory, symmetry theory, and exchange theory, further elaborated in the Physics section. From there, I introduce system theory which is useful for understanding many aspects of Society. Finally, I apply earlier physical and societal insights to improving our understanding of the Self, and try to approach the big questions of life and death.

Part I

Physics

1

Models and Theories

main message: question words like "energy" and better understand just what our use of numbers entail, propose that aspects of an underlying physical theory can be learned from the simple fact that math and numbers actually work

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Our understanding of the physical world is based on mental models. What exactly do I mean by a model? It is a mental construct, a lengthy set of intuitive rules that lets us look at a real-world situation using our senses (touch/sight/hearing) and create abstract symbols describing what is going on. With a model we can even make up symbols to describe what 'could be' going on in some imagined situation of interest. The model also prescribes what we are expected to do with these symbols, and how such actions correspond to the real-world situation the symbols represent. Finally, the model prescribes a route for conversion from the symbols to a real-world situation, allowing for predictions or verification. So in the sense of a physical model: I see the moon from where I stand on the earth (my sense experience of the real world), and Newton's model of gravitation says I should represent the earth as a point and the moon as another point (abstract symbols), then based on the distance between the points and a formula and conventional math rules I can alter the points (what to do with the symbols), and finally from these altered points I can predict where I will see the moon next or any other 'thought experiment' this model is capable of (back to sense experience of the world - accurate prediction is most useful/desirable).

What we experience on a human level, the basic feelings/qualia of "what it feels like to see", or "what it feels like to hear", or "what it feels like to move" are also symbolic interpretations of external reality made automatically by our brain, in fact the key constitutive elements of consciousness (this point will be considered later in the discussion on consciousness). Thus

we are all born with a genetically programmed model of the world: what we might call an 'intuitive' understanding. Even with modern technology making a bipedal robot that can walk is beyond 'state-of-the-art', yet we do this task with ease. How? This is because our brains automatically convert information from the senses into abstract symbols (which we experience as seeing/feeling motion/muscle load [1]) and then use these symbols to make some sort of calculation/manipulation to tell what will happen next in the real world, and how the body can be adjusted so that what happens next is what we want to happen next (ie stay upright and move forward/avoid obstacles). Then the brain converts from the symbol-based result of this incredibly complex calculation to real-world actions with the help of the nervous system/muscles. We can (and do!) imagine walking on some strange new terrain and plan out our body movements ahead of time, working wholly in the symbolic/abstract realm of the intuitive model: its 'language' is feelings and qualia rather than numbers and letters on a piece of paper so we cannot communicate or write down the rules in any spoken language, but it is nonetheless an extremely powerful model that would put all our textbook "models" to shame if anyone found a way to write out all the underlying equations. The intuitive model of the world "just works" - we never need to learn any formulas to be able to walk, but only because these formulas are learned automatically and intrinsically by the brain due to the way it is programmed/wired. The brain is also designed to modify the intuitive model to be more accurate by learning new things, but it learns by direct sense experience - for example I can learn how to snowboard or live in zero-g on an intuitive level, but I cannot have an intuition on quantum mechanics or relativity though I will gain an intuition for how and when to apply different written formulas (because I practice writing formulas but can't practice experiencing quantum/relativistic effects).

Our intuitive world model can do tremendous things, but it can also lead us into situations where its predictions do not match the external reality we observe.

A typical "event" in human life terms is about 1ms = 1e-3 seconds. A typical "event" for an atom is about 1fs = 1e-12 seconds. A human lifetime (100y = 3e9 seconds) corresponds to an atom's "life" of 3 seconds. Earth radius is 6.3e6 meters, while Bohr radius is 5.2e-11 meters. Suppose a "human radius" of 1m, then if an atom were human-sized, a human would be 2e10m, or way bigger than the earth; a grain of sand would be the size of the earth to a human-sized atom. But atoms are much more mobile than humans, because in a few seconds they can "explore" a larger area than a

[1] same reason we can look at expressionist or comic-book drawings and easily know what's going on while a computer program would be stumped: the symbols are what is actually represented and this is what we operate with, not the underlying photon receptors in our eyes

grain of sand.

It is 'obvious' that the earth stands still and the stars surround it in a revolving celestial sphere. Yet some stars move in strange ways (planets), and the sun itself shows annual variations unexplained by intuition... careful tracking by means of non-intuitive symbols (letters, numbers) shows that our intuitive view isn't perfect. We like perfection, though, so we make up models that we apply [2] and consciously tailor/modify so that they make accurate predictions even when our intuition is unclear [3].

I have no intuitive idea of what a rocket in space will do, and even if I had an idea I wouldn't be able to clearly or precisely communicate it. By applying laws of physics and mathematics I can use symbols to predict what will happen to the rocket, and by relating causes to effects I can even make a control system to get the rocket to do what I want. I can also communicate this to other people and machines. This is the role of physics models - they have limited applicability (still relying on the huge knowledge base of our intuition to apply to real world) and low computational power (until we invented machines which had these models intrinsically as their modus operandi/consciousness - computers), but they are exact, specific, and can be communicated/commonly agreed on/precise/saying the same thing to all participants. These latter features have allowed physics models their prominent position, because despite their great lack of flexibility and power compared to the intuitive model, they allow shared and specific knowledge as opposed to the private and non-communicable experience of qualia/feelings. By this definition our earliest models were basic spoken language - coordinating group actions, the first beginnings of religion [4] (communal beliefs in how to explain things that intuition cannot, such as when it will rain). [5]

Our abstract models then can be seen as containing both mathemati-

[2] this application of mathematical models is on top of our 'intuitive' model, which is an interesting consideration for what types of mathematical structures we miss just because we don't intuitively think of them

[3] this tailoring/modification, interestingly enough, is intuitive - even if we implement 'meta-models' (models that describe/create models in a rigorous manner) all we can do must point back to our intuition and our senses, a key aspect of "the human condition"

[4] in this light, the physical conflict (excommunication, execution) between church and science is really a conflict between intuitive world models that people operate on, and an established intuitive model is highly resistant to change, causing rage-inducing feelings of frustration and cognitive dissonance, since a tiny change in axioms can mean tremendous mental processing load to create a new working model, especially for one as complex as the human intuitive model. When one feels wronged, one wants to fight back against the attacker, but with a change in the intuitive model it is as if one is wronged by the world as a whole, there is nothing to fight and yet one is attacked from every angle. This is seen on a small scale in bereavement, when the intuitive model must be updated to reflect the loss of a loved one.

[5] the development of both the intuitive model in childhood and the language-based and symbol-based models in human history at large are all caused by the same mental drive,

cal truth and a knowledge/interpretation component. The mathematical truth, to the extent it is verified by experiment, is independent of the way it is interpreted or of the intuitive picture built. The latter is open to interpretation and is what I will focus on in most of this section, while seeking agreement with existing experimental results and connection to existing mathematical statements.

Power in models comes from general applicability and in a fractal manner, such that basic structures are defined once and then can be rapidly used. Consider a video game engine: once having written its code, it becomes possible to make individual games much more rapidly and consistently, by using all the knowledge (and time) that has been put into the engine and re-casting it in a more abstract and impactful manner. Similarly with assemblers and compilers and GUI-design programs: increasingly more power is gained as abstraction is increased and code base is re-used in a logical rigorous scheme. This is what we have in a physical model, a way to describe many real-world phenomena in a reasonably understandable and human-comprehensible manner, by using a single underlying base of knowledge and casting it in different situations. Just as the video game engine places limitations on what type of game can be made which don't exist if programming fully from scratch, having a model places limitations on the sorts of things we can describe (or predict) which don't exist if starting with "no axioms". In any case if the functionality of the available model is insufficient to do what one wants, one must make alterations at the axiom level which may mean tremendous practical effort to create a new model. I try this questioning of axioms from time to time in this text, though the creation of a new model is left for later - this is why there will be very few formulas and mostly metaphysical/philosophical considerations.

We see in the present way of life that the work of most people is far separated from nature by various human inventions. Namely, people who interact directly with nature (miners, farmers) now rely heavily on mechanical aids, but most of the population can work on matters entirely unrelated to nature (administrative work, art, sports). We are capable of making progress because we use increasingly refined materials (metals, plastics, semiconductors), but the extraction of such materials from the natural disordered state enables the construction of new classes of devices and machines - the essence of this consideration is that purifying and rebuilding *materials* (chemicals, molecules, elements, particles) enables the creation

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biologically hardwired and evolutionarily selected: the drive to learn, to keep asking why, to predict - the brain feels most content when it knows exactly what will happen next, it feels least content when it gets surprised (something happens which it did not expect). This element of surprise is inherently negative (painful), to the extent that the brain is forced to create models (consciously or unconsciously) that will make predictions such that there is no more surprise.

of new physical structures previously unattainable. But these materials are extracted from the messy/disordered natural state. Could the same idea apply to knowledge? For instance, from the overall environment of random ideas we have extracted the concept of musical harmony/progression and artistic elements. In math we have extracted the natural numbers, enabling number theory to be constructed. Later, we extracted real numbers, extending the mathematical theory (with accompanying advances in *physical* and engineering abilities!). Are there other 'elementary' structures that need to be extracted? Are numbers really elementary or just the most obvious 'natural' material? Is it possible to purify [6] numbers into underlying constituents that can then be used to solve new classes of problems previously unassailable? What is the role of a structure like set theory, complex/negative numbers, and quantum wave-vector notation? By analyzing the world in terms of specific knowledge-representations/memory structures can we find more insights?

Since numbers are 'obvious' and have been around for the whole history of math, I would argue that they are a 'natural' or messy/unorganized material, like rocks or wood. My claim is *the universe doesn't care about numbers*. Purifying numbers into something more essential, like purifying sand into Si and O2 or water into H2 and O2 would get us closer to a universe-relevant theory and give much greater power to theories (along with a possibility of unleashing more energetic physical structures). The more essential elements might readily explain quantum theory, fractals, iterative processes/'games' (like game of life), and relativity. The nature of physics itself would be encoded in the structure of these elements.

Something that humans often overlook, which comes up as a 'revelation' in physical laws like Newton's mechanics, is the perfect symmetry of the outside world. We see that for the world to operate stably there are strict conservation requirements - every little 'insignificant' thing matters, even when it is most tempting and easy for humans to ignore the small effects. Unless this is true, the universe would not be stable (energetically). Another related concept is that of similitude. Here we need to recognize that in human experience we are essentially never exposed to truly equivalent objects (for we would not distinguish them otherwise). Saying that two objects are equivalent (at least in some aspect) like a=b is only a mathematical statement and does not create a true equivalence for the objects a and b can still be distinguished by their different subscripts or locations on a page of the proof. Being able to create a true equivalency is a very powerful concept for then any operation carried out on the equivalent object

[6] something like prime decomposition, or symmetry operators. Such a decomposition would *not* be evident, just like the chemical elements were not evident to the first proponents of atom theory. Finding it would require careful study of a wide range of experiments and theories.

are equally applied to all possible interpretations of the object - this is the basis of quantum computing, and also mathematical truths and definitions of a system. In algebra the letter 'a' equivalently represents any number so an equation like a=b applies to all numbers, as well as any subsequent operations on a.

What, then, is a number? How much information does one number represent? We might claim that a number represents a single value out of an infinite set of possibilities, and thus reduces ∞ to 1. A binary number would in turn reduce ∞ to $\infty/2$. It is a bit troubling that this represents an infinite amount of information, if the number is real. Another problem we encounter is similar to Zeno's paradox - how can we get, in the real number system, from x to $x + dx$? The only way we interpret this is by quantizing the problem (in the problem itself, or in our method of solving it in our real-time physical world), thus removing the essential feature of real numbers: they are disconnected! So for instance in $x + 1 = x + \lim_{dx\to 0}(1/dx) * dx$ the '1' and the limit work as long as we choose to quantize by some finite dx (and '1' is already quantized). We can only approach a real number, never reach it - for doing so would require the divergent $dx = 0$! We see that real numbers are in fact a 'beast' - they store ∞^2 information if an integer stores ∞ - viewed as an infinite set of integers "after the decimal point" (reversed in digits) for each initial integer with the +- signs canceling out/degeneracy just like with complex numbers which extend this to ∞^4. In fact we could interpret real numbers as ways to deal with multiple scales - the decimal point marks the scale we are most concerned with, then integers on the left of the decimal point specify steps on larger scales while integers on the right specify steps on smaller scales. Then the relevance of real (or real-like) numbers in physics makes at least practical sense in terms of writing down experimental measurements with a given scale-setting unit. We arrive at the myth of the real number "line" as taught in grade school math classes but pervading thinking even in college. On this line, it seems straightforward to move "a bit over". But we see that to arrive at the real number case, we take $\lim_{x\to 0} x + dx = x$ thus it is impossible to "move" to the next real number! There is no connectivity in the real line - it would be more appropriate to consider it an infinitely fine dust. Consider increasingly fine quantization visually:

```
0     1     2     3
-------------------     "Line"
.     .     .     .     Integers
.  .  .  .  .  .  .     Half-integer
.  .  .  .  .  .  .  .  .  .  .     Third-integer
...................     Sixth-integer
```

Taking a limit of the above procedure to infinite quantization produces

the real number "dust". We note the formation of a binary tree in the representation which suggests a scheme for covering ∞ data - each binary digit will reduce the data by 1/2 so we have the sequence ∞, $1/2\infty$, $3/4\infty$, $7/8\infty$, $15/16\infty, ...$ With increasing number of bits. Perhaps then it is not surprising that 32-bit values are sufficient for all sorts of physics calculations, even across scales. From the binary tree 'dust' diagram, we might suggest that a number is represented by an infinite sequence of (say) binary digits, having a beginning but no end. This sequence is unique for each number but is always infinite, even for easy to write numbers like '1' or '2'. Furthermore, it is not possible to change from one sequence to another continuously - this can only be done by interacting with another infinite sequence in a discrete/discontinuous manner. This interaction can be a standard +- type operation or special operations that are equivalent to an infinite sequence (this shows that series can be evaluated to a number). It is nevertheless possible to compare two such sequences in a relative sense - and real world experience shows that usually only a finite length of the sequence is sufficient for such comparisons. This interpretation has some interesting parallels to the nature of information in a physical system - namely persisting in time (since continuous deformation is disallowed) and changing only by interaction with other information from external systems.

One of the "tell-tale signs" of underlying order in the universe, giving hope for an overarching theory, is observing similar phenomena across a multitude of length and time scales. We intuit that such phenomena cannot be an artifact of any specific system and must be properties of the universe as a whole. Consider the notion of momentum. What concerns us at present is not a precise mathematical formulation, but the fact that this notion can yield insights from motions of galaxies (or at least planets) to the smallest sub-atomic particle (or at least electrons). Maybe 'momentum' is not a physical reality but a man-made mathematical object, but nonetheless it proves so useful and ubiquitous that we claim it represents some feature of the universe. Another notion that pervades all scales of measurement is energy, mass, size. And all objects tend to persist in time.

In the above observations we have largely made use of mathematical relations to establish the claims (from $E = mc^2 = hw$ to $M = \Sigma m$) and to make sense of experimental data. We must conclude that, since math is seen to apply so ubiquitously, it must reflect some fundamental property of the universe. Thus studying how/why math (in its present written form) functions will yield insight on actual physical matters. Further taking account the ideas of information theory and supplementing them with math-based observations is akin to using the rich experience of nature (mathematicians) in developing some new idea. We proceed to this, beginning with the notion of the information content of a function (the information content of a number will be addressed later in this chapter). It is easy enough to

write a function like $x = y$ or $y = x^2$, but how much information does this represent? Looking at this as the outcomes of all experiments on the system (function), specifying a function must require an infinite number of points, one $f(x)$ result for each x measurement. And yet we have written it down in only 3-4 characters, which is a similar paradox as that encountered with numbers. What is missing from the physical (finite) 3 characters on paper is the associated human understanding of math that translates $y = x$ into a relation that carries ∞ information. However for a physical model that is not human-centric, we must represent the idea of the system $y = x$ without relying on the human constructs of math, and in a language that the universe "understands". Most directly this would be a physical system where indeed $y = x$ (quantum computer, lever, gears, transformer), and yet we retain hope that a mathematical construct of sufficient richness may be developed. Since we see that even a simple function like $y = x$ carries ∞ information (like the integers), the 'natural' representation or object for such a function must also be a specific kind of infinite sequence with a beginning but no end which can usually be characterized only by the first few terms in the sequence (like claimed with numbers above). We go further and consider the function as a system, in the sense that it provides asymmetry and symmetry relations (implicit from the requisite human understanding of the mathematical construct) though normally no "information" content (piece-wise functions, in the limit of infinitely many pieces, are in a sense entirely information - this perhaps suggests a unity between information and symmetry/asymmetry). Thus "$x = y$" gives an 2-fold asymmetry (x, y) and a 1-fold symmetry (=). As before we are left with 1 degree of freedom which is either one of x or y to fully specify the system. Something like "$x = y^2$" (with real numbers) also has a 2-fold asymmetry but the symmetry is not 1-fold as $(+y)^2 = (-y)^2$. Thus the symmetry only specifies a subset of the system. It is left for the future to determine how the information content of such a system is to be represented, but we note that $x >= 0$ reduces the possible states to 1/2 of the 'unconstrained' $x = y$, with another 1/2 required to determine the sign of $+$-y.

As a final point for the time, of using math to investigate reality, we note the ever-present equal sign (=). This makes usable formulas, that work at all scales and with all known phenomena, by applying the concept of equality, or indistinguishability in a physical system. We conclude that there must be a fundamental "equivalence" symmetry that will help us make sense of natural systems, ie that such a symmetry is a physically real concept.

What is the information content of a number? We seek to establish these things:

- Numbers, as commonly used, are meant as ratios of underlying phys-

ical quantities/phenomena

- Numbers, like any other alphabet as humanly used, carry information that is context and system-dependent (information content can change based on type of number and type of application)

- Thus to establish the information content of a physical system we must use some strict definitions. One might be the maximum number [7] of unique experimental results the system can provide, for any single experiment. This will later be seen to be the total rest-mass energy within the boundaries of the system (a tremendous amount!).

As mentioned earlier, "the universe doesn't care about numbers". Yet in making such a statement we have to justify why the use of numbers in models within sciences and humanities has worked exceptionally well to improve human welfare. This is not just a side effect of their generality (1 can represent an apple, or a meter, or a force) since it is not sufficient to only have logical rules to predict or control a real system. And if we assume the universe is not necessarily simple, this implies that numbers are in fact complex entities that only appear simple to us because of our familiarity (both in learning (school, college) and in being a part of the universe in which numbers are useful). Numbers are commonly used in "models" so we will try the analysis of those as a starting point. We take as an axiom the uniqueness property - namely that a single, specific outcome is the result of a similarly specific cause, and that the two necessarily occur together. This suggests that in physical processes something is conserved - for our purposes the conserved quantity is "information". The concept of conservation applies not only to "data" but also to properties and rules and algorithms (in math, for instance, if a function is composed of sin and cos, its derivative is also made of sin and cos - the property of the oscillation is conserved although the function itself changes when the derivative is taken; there is a "signature" of the sin and cos content with any other conservative operation applied to the function). Thus we reason that some semblance of underlying universal laws is "conserved" and defines the physical world of "big" objects that we can observe. Again by the uniqueness property we can reason that physical laws of our models are based on direct representation of universal laws, and with some thought it may be possible to find the latter from the former (since both also conserve underlying information).

At the same time the more simple definition of information - the results of experiments - is not conserved over time. As will be argued later, "god doesn't know the future" for otherwise there would be no need for the present. Time represents the evolution of potential experimental results according to the universal laws. The uniqueness property then means that in

[7] as a ratio to 1 unique result as suggested

a closed system (that does not exchange information across its boundaries) the observed experimental results will take on a cyclical pattern (like any operation x=f(x) mod n). We postulate that all models conserve information, as a consequence of their development to describe physical processes and the physical processes' operation under the uniqueness principle. Of course the human aspect of providing and analyzing the input/output of the models need not conserve this theoretical aspect of information (the underlying information is conserved always, thought perhaps not in ways useful to us - for instance as heat when a bit is overwritten), but the model's internal operations to get from input to output will be found to be conservative. Before I argued this point based on the practical consequence that a non-conservative model would need to either "make up" or "ignore" input or output to operate. Now I make the same claim from more physical grounds that the model describes (and operates in) an information-conserving world, and seek to provide experimental evidence for this claim.

Mathematics, and mathematical routes to get results in models, are information-conserving. This is seen by the requirement for n equations of n variables, n boundary conditions for n-order differential equation, and n length vector in an n-dimensional space (regardless of Cartesian, radial, cylindrical representations). It is possible to supply inputs that are redundant of insufficient in information for the desired algorithm, which will result in undefined answers like $0 = 0$ or ∞, but this only shows that the mathematical tools will not operate in a way that will not conserve information. To overcome results like ∞ we need to create a new information structure that will enable the information to be conserved (such as cardinal notation for sizes of ∞, imaginary numbers, and even rules like "when the sum of independent functions equals a constant, all the functions are individually constant" [8]).

However, what happens in the case of most computational models - when an extremely large (GBs of data) simulation runs and results in maybe 1 or 2 numbers that are actually useful to the operator? This is similar in principle to a hash function and is an example of a non-conserving operation, suggesting that more efficient computation is possible. Consider Lifshitz theory, in which a spectrum is integrated to obtain a single number - the Hamaker coefficient. A similar example is when a particle's velocity as a function of time is integrated to find its ultimate position. In both cases a continuum is reduced to a number by an appropriate algorithm. This is not an information-conserving process (equivalently it does not follow the uniqueness principle) since multiple (infinitely many) continua map to the same number and given the number it is impossible to return to the con-

[8] this rule uses the information present in the equation that is not otherwise accessible to standard mathematical algorithms

tinuum. However it is possible to invert this step if the analytical integral is carried out. Thus:

$$x_t = \int_0^t v(t)dt \rightarrow \text{irreversible}$$

$$x(t) = \int v(t)dt + x_0 \rightarrow \text{reversible } [9]$$

$$c = a + b \rightarrow \text{irreversible}$$

$$[c, d] = [a + b, a - b] \rightarrow \text{reversible, as is } [c, a] \text{ or } [c, b]$$

Now we note the effect of differentiation is to reduce a function to a number. So $d/dx(x) = 1$. While it is difficult to have an absolute measure of information content, we can take advantage of the equality to say the information content of the two is equivalent. In the reversible configuration we have:

$$[f_0, f(x)] \rightarrow [\int f(x) * dx + f_0] \text{ or } [f(x)] \rightarrow [d/dx f(x), f_0]$$

Combining the two gives

$$[f(x)] \rightarrow [d/dx f(x), f_0] \rightarrow [\int f(x)dx + f_0] = [f(x)]$$

Thus the information is conserved throughout this chain. Since $d/dx(ax+b) = a$, we can say differentiation acts as $[ax + b] \rightarrow [a, b]$

So we have found that the information content of a polynomial function is equivalent to that of its order of numbers along with the (considerable) information of the differentiation algorithm that reduces it to that set of numbers. As reasoned before, the information content of two algorithms that can reduce the same data to a (set of) numbers is equivalent also. Thus for instance the Taylor expansion is a direct example of the equivalence. Yet for sin and cos functions we find the expansions to require infinite sequences of numbers. Are oscillatory functions then more information-dense than polynomials? The issue lies in the algorithm - the polynomial algorithm is not capable of representing sinusoids with finite numbers, but a Fourier transform is - it should be shown that the two algorithms will not reduce the same set of data to a number (unless it is already a number like $f(x) = 0$) so their information content must be different. For now we are happy that it is possible to define the information content of a polynomial function in this way.

Now consider what defines a number. We might start with integers. On a 2D grid we may define a point as [A,B] where A and B are integers. But similarly we may define an algorithm that gives us [A,B] from a single

nonnegative integer C: The algorithm starts at the origin [0,0] and spirals around it C steps until it gets to the desired point [10]. Then we have [C] → [A,B]

```
| <-  .
|  0 ||
->  ->|
```

We can thus map 1 nonnegative integer to n integers in the discrete space. Does this mean we have gained $n\infty$ information from $\infty/2$ starting point? This of course comes at the price of the algorithm - but in the limit of either large n or large numbers of n-sequences (as above we might define 3 integer pairs as [A1,B1], [A2,B2], [A3,B3] or as [C1],[C2],[C3]) it is seen that the algorithm's information content is overshadowed by the reduction of n integers to "1/2". This is the essence of a number - a number can represent 1 unit of "∞" information. Thus a real number is equivalent to an infinitely long series of digits. Indeed we write numbers this way - as a sequence of the integers 0-9. One number specifies a single point in a continuum, and a continuum is a combination of infinitely many numbers, ∞^2. Thus a function like $y = x$, which lies on a plane, ought to be represented by 2 numbers, which is what we get with our earlier construction [ax+b]→[a,b] here $a = 1, b = 0$. So far we have:

```
Number <-> Point <-> Flat line
2 Numbers <-> Tilted line <-> Sine curve <-> Flat plane
3 Numbers <-> Tilted plane <-> Curving (quadratic) line <-> ?
```

In real systems, of course the size (max capacity) of the number is of prime relevance - this was skipped over in defining the number above, and would be worthwhile to return to as it will yield different equivalence relations, ones that arguably make more physical sense than the purely mathematical conclusions above. A final point concerns the powerful tool of "independent" systems - by saying that things which are the same before and after a certain operation, in combination with the uniqueness principle we know that the operation was independent of those things. This makes it possible to make sense of otherwise very complex events, so before:

$$[f(x), f_0] \rightarrow [\int f(x) + f_0]$$

We recognize the more complete version:

[10] a similar method is used in proving that fractions are countable

$$[f(x), f_0, \text{paper, me, integration algorithm, rest of the universe}] \rightarrow$$
$$[\int f(x) + f_0, \text{paper w/writing, my thoughts, integration algorithm, rest of universe}]$$

Namely in this operation the integration algorithm and the rest of the universe did not change as a result - therefore we are assured that the information content of $[f(x), f_0]$ and $[\int f(x) + f_0]$ are actually the same with the assumption that the effect of writing it on paper and thinking about it has not exchanged the 'abstract' information represented by $f(x)$. Now, numerical integration bypasses the integration algorithm and instead repetitively applies an unchanging numerical algorithm - but in the process the *physical state* of the computer changes rather than the nature of $f(x)$. Thus we map a mathematical variable t in $f(t)$ to the *physical* time that the computer executes the algorithm and thus find the answer. Schematically:

$$[f(x), f_0, \text{computer state, algorithm, rest of universe}] \rightarrow$$
$$[f(x), f_0, \text{changed computer state, algorithm, rest of universe}]$$

Something that can take infinite time (or distance if we map x to real length) to do in this way can be done finitely by use of algorithms and numbers - that we can readily handle such powerful entities must not go underappreciated [11].

In a physics curriculum, students are exposed to many conservation principles - conservation of energy, mass, particle number, momentum, angular momentum, entropy/enthalpy/heat, and equal and opposite force reactions. Specifically here I will concentrate on the conservation of energy since "energy" as a concept has some mystique to it - one may ask "what is energy?" similar to "what is time?". It is always on my mind when I hear a statement like "the two chemicals react giving this product and energy". After studying the different manifestations of energy - thermal, gravitational, nuclear, potential/kinetic, electrical/magnetic, chemical - it is my conclusion that "energy" as such is a human-defined construct that does not have an elementary connection to reality. Energy is conserved because energy has been defined to be conserved - if it is found to not be conserved, we either look for other paths for energy flow, or re-define the definition of energy (how thermodynamics came into being - someone realized that a change in temperature required energy). However the fact that *something* is conserved (and now we know enough about "energy"

[11] even "simple" numbers like 0,1,2 or functions like $x + y$

to know the mathematical form of that something) is indeed an elementary physical feature of the universe - this forms the premise and justification for the symmetry theory. But we might already have a hint as to what that something is - and I claim that it is the *momentum* of particles. This is experimentally verified for thermal energy (since thermal conductivity follows predictions of electron motion/phonon transfer, and thermal capacity follows QM rules for allowed vibrations/rotations/degrees of freedom for systems - Bose-Einstein condensate as an extreme example). It is obvious to extend this to moving particles for the concept of kinetic energy. Since gravity affects the speed of particles, a mechanism of action for gravity might be in line with this concept. The trickier part is handling the case of stationary particles storing energy - chemical and nuclear, as well as photon-excited electrons. Momentum is conserved on all known scales (even within QM) so defining conservation will be OK. The difficulty lies in extending a finite momentum to a non-moving particle that has (ie) chemical energy. We should think of the particle as a "self-sustaining" or "warped" wave that can be localized in space despite perpetually moving, or moving in a circle which represents this underlying momentum [12]. I think it is no coincidence that the model of electrons as standing waves on a string surrounding the nucleus had as much success as it did - perhaps electrons really are vibrations that are resonant around the nucleus. Then momentum should include the width of peaks and how rapidly they travel around the nucleus - which will be related to the classical m and v. To escape the nucleus the electron wave must be "unwrapped" which will somehow cause the momentum to fall to the classically observed value (binding energy/work function).

Some examples of "Everyday Numbers" which will hopefully help understand the nature and purpose of numbers:

- Clock-time, date - for dates, numbers are used mostly as labels (as evidenced by the arbitrary month names) and calculations (days between dates) are convoluted; for time the mechanical nature of clocks requires a periodic structure where an increment can be defined along with a reference ("noon")

- Temperature, pressure readouts - these need to give an idea of relative comparisons (inches of mercury) as well as absolute references (0K,

[12] later it will be argued that all movement must be at the speed of light, so the circle diameter is the determinant of stored energy - a smaller circle implies faster motion and faster time evolution. This is in line with the time/energy uncertainty principle as well as the huge energy content of massive particles (and that the more energetic, more massive ones are smaller in size than the less energetic ones: consider electron vs proton). In this sense that small scales equate to big energy, it may be fruitful to remember the relativistic symmetry of v to 1/v.

0bar) and should increment/decrement symmetrically to maintain the zero point - use in formulas like $e^(- k_B * T)$ is found after the fact

- Buttons on a phone - using digits to represent a unique identifier/label, phone numbers do not have mathematical relations (can't add two phone numbers) but it may be convenient to assign the last n digits to one addressee

- Buttons on a remote control (channels) - similar to phone numbers, but here a mapping to frequency as well as to "Ch+" and "Ch-" buttons is possible, though it is ultimately arbitrary except for being symmetric in counting up/down

- Radio frequency readout (AM or FM) - this has some scientific meaning in terms of cycles/second (Hz), and could be used to find wavelength or such. In the radio readout though the primary use is of an identifier and increment/decrement display augment, as opposed to a matrix selection like a '0-9' remote control or phone number.

- Model numbers of items - this is usually arbitrary unique identifier, but a number may be used to show increments (v1 or v2) or encode when/where something was made (which is also an identifier)

- Calories in food - this has some "scientific" definition and is additive (2 packs of food = sum of the calories) which is used to maintain an appropriate calorie intake. This can be thought of as a "counting" number rather than a label.

- Weight of food and other nutritional composition - weights are defined in a physical way so they are additive and can be consistently measured (by comparison to a reference weight and linear extrapolation, such as moving the reference weight along a rod to change resulting moment)

- Voltage/current measurements - voltage and current may add/subtract and is used in Kirchoff laws to analyze a circuit. Thus it is harder to call them "counting" numbers. They still provide a sense of large/small and an absolute reference, so perhaps call them "measurement numbers".

- Page numbers in a book - these serve as an indication of progress in a book, the order of pages, as well as labels in a table of contents. Convention has decided they should increment by 1 (not 0.1 or 10), and they mostly fall under counting numbers.

- Music-tempo numbers - serve as a label, and are fractionally related (4 is twice as fast as 2), however they are still counting numbers, just under a non-linear convention of increment/decrement
- Music-finger/note numbers - labels, here letters/symbols may do just as well. The layout of notes in sheet music already gives a visual indication of low/high notes and note order, with no need for explicit numbers - but this is still counting
- Length measure - this is used in essence to provide relative measurements (in terms of fixed agreed-upon units) without explicit counting (though it may be used, as in laying down a ruler end-to-end) so consider it a measurement number
- Age measure (n years, n or more years) - again a relative comparison, normally the counting number (# of birthdays) suffices but age may be expressed as a measurement number, knowing days in a year and current date as numbers
- Prices of items - used as an additive property, and to calculate tax as percentage. This is still a counting number.
- Computer-timestamp - counting seconds since an agreed date, to make date/time computations mathematically tractable - a counting number
- Computer values of byte[]/ints/floats - this is serving as a label, an interpretation of the underlying data. By keeping interpretations consistent, useful algorithms may be carried out. The use of math may or may not apply depending on what the binary data represents.
- Communication - compressing/transforming input byte[] to output byte[] through some function. By representing diverse data as bits, mathematical operations that apply to "math numbers" (of number theory) can be done on data
- Counting - how many apples, how many pears, how many pieces of gum - required properties are the notion of "none", being able to go up/down by one, and by having the same number of up/down steps to return to the starting point (symmetric)
- Concentrations - weight per volume, miles per hour, miles per gallon, revolutions per minute, volume per area (painting a wall). Math applied to measurement numbers results in a measurement number.

From the preceding we may find some categories:

- Label-arbitrary: such a number represents a non-numeric concept and may as well be replaced by other numbers/letters/symbols or any other uniquely identifying feature. Example: bar codes on food items, part labels in a diagram, phone numbers, patent/grant/form numbers.

- Label-ordered: the number is mostly arbitrary in that it still represents a non-numeric entity, but there is a notion of precedence: any 2 numbers can be compared and put in order consistently to help with searching/sorting/memorizing. It could be changed into letters/symbols as long as this relation is also redefined. Example: version numbers, page numbers (table of contents), library book numbers (consider how to find a book by its number - it is in between the numbers lower and higher than desired one), months (we learn the progression Jan→Feb→Mar... as a dual to the number representation 1→2→3...)/days/years/hours/minutes, sheet music notes (scale A→F may also be written as 0→6), radio channels.

- Counting: these numbers represent a quantity so the numerical nature is directly used, to understand both order and absolute/relative amount. A common reference of 0 is required and a basic increment unit should be defined so as to be symmetric. Mathematical operations of addition and subtraction can be defined. Example: timestamp, number of apples/sheep, price and total price, counting on fingers, # of pages in a book (as opposed to page#), minutes of cooking time (as opposed to minutes in an hour).

- Measurement: these numbers represent a relation in nature, commonly expressed in terms of units: length, voltage, current, speed, temperature, pressure. Operations of division, multiplication, and others may be defined. These numbers ideally represent an infinitely precise relation (thus they are defined as relations between *real* measurements - normally circumvented by using units but then resulting in "counting" rather than measurement numbers). Counting numbers are also indefinitely precise because the minimum increment/"quantum" is well defined, but they can be written in finite space/time because the minimum increment is known. Measurement numbers are what appear as letters in algebra and calculus.

- Mathematical: these numbers are also infinitely precise and come about as the result of relations of mathematical objects - they may or may not be useful in real experiments - and they can be computed without carrying out an experiment/measurement. Example: $\pi, e, \sqrt{2}$

To make use of measurement and mathematical numbers, which are infinitely precise, we convert them into counting numbers - by applying boundaries or a minimum incremental unit (rounding). Thus we might say π => 3.14, length=>1.5km, speed=>30 miles/hr - the true mathematical and measurement numbers can only exist as symbols and physical measurements while the things we write down are necessarily approximate versions.

Of course counting numbers are also infinitely precise - but to store them in finite memory we have to "chop off" both the low end (decimal point) and the high end (overflow) and to use this conversion we have to ensure the measurement/mathematical numbers satisfy our assumptions. These assumptions always exist, whether conscious or not.

Yet there may be some cases in which the mathematical/measurement numbers can be uniquely connected to a counting number equivalent: exact relations of equivalence (unity, 1), discrete quantum states (spin up or down), number of oscillations/beats between harmonic waves (gives an integer). These give the most useful/powerful computational results and account for the popularity of digital technology. How did we even get started with measurement numbers? It will be necessary to refer to the earliest scientific writings to understand the origin, and there a difference in use of numbers may be noted (for one, a lot more emphasis is placed on verbal rather than numerical descriptions).

Theories are a keystone of science and its application to the real world. Yet theories are not all-powerful, and their limitations must be recognized when searching for a new theory or trying to define or explain an experiment. We can't help but think in terms of cause and effect, actions and actors, so theories, especially how they are taught, are often used in these ways. While all the theory says is F=ma, we are led to think of a body acted on by a force and then accelerating, and heavy things accelerating more slowly. The theory made a mathematical prediction (predictive power) and we have assigned to it an explanatory prediction (explanatory power), something believed to describe "how the world works". Good science claims that theories with high predictive power are to be used widely and trusted. Any associated explanatory power is usually a convenience, not a defining factor (one high-profile example is the choice of helio-centric geometry instead of epicycles, because that explanation was more 'elegant'). But it would be flawed to say that the latter has no effect - we are human and like to understand systems intuitively, so we seek explanations from theory, and teach theory more convincingly by offering it as explanation (why is the sky blue? Raman scattering theory...). There are limitations in doing this when the goal is a deep understanding, since much of theory is more-or-less arbitrary (driven by convenience or 'elegance'). For instance, my theory is $V = IR$. I could write it as well like $I = VQ$ where $Q = 1/R$. The math

outcome hasn't changed at all, but the interpretation is different (and perhaps the path to the solution is also different - easier or harder). So, the variables we hold dear in current theories, like mass/energy/momentum, might not be the 'fundamental' variables that nature cares about. They may be particularly useful for us and simplify the math, but should not be taken as defining nature's laws (there is no way to know what those might be, even). Next I could do an experiment that shows in some cases (loop of wire) $V = IR$ doesn't hold! What can I do at this point? I would like to keep the '=' sign, and V and I seem to be consistently measurable. Does V need to be measured differently when across a wire loop? Does the loop change R? Or does my theory not apply to loops? Typically we say the latter - call the loop an inductor and say that it follows different rules. But we could achieve the same math outcomes by saying that R has an L component, making the theory more general (as done for detailed circuit analysis), or by saying that V or I must be measured differently across loops of wire because the measurements were designed for straight wires. These options, equivalent in predictive power, offer quite different explanations of the world and interpretations of what is going on.

So, there is no particular reason to believe that an existing theory actually describes world mechanics, if this is even an achievable goal and not a tautological one. Another limitation of the theory is its limited applicability to experiment [13]. Really, before applying a theory for predictions we must satisfy all of its axioms, but this is rarely done - 'errors' are thrown out as noise. Some theories are so vague they can never be disproved: "you will get better soon". Others require too much information and are impractical to disprove: "your life is determined by the exact star alignment at birth". What of "there can be no perpetual motion machine?" This is also unprovable (while "there can be no traditional machine" is provably false - experimental evidence availability matters) at present, and can only be disproved [14]. So, using such a statement to say "this experiment will not work, stop wasting your time" is bad science just as much as the earlier two statements of fortune-tellers and horoscopes. *Theory cannot be used to disprove experiment*, only to suggest which experiment might be more effective to pursue with limited resources [15]. Theory cannot tell the scientist

[13] Energy, for instance, is what I call "that which is conserved". If we find energy is not conserved experimentally, the first conclusion is that it "went somewhere". But maybe our definition of energy is wrong - or incomplete. Notions like energy should not be taken too literally in regimes where they have not been experimentally proven, and should not be taken as fundamental variables arbitrarily.

[14] I think a theory can be said to be proven if it works exactly as described with axioms it requires being satisfied in real experiments. $F = ma$ has been proven for all objects humans have interacted with.

[15] there is much benefit in experimenting in "the world lab" ie using the ocean/ sky/ planets/ stars to test theories' effectiveness at recreating real natural effects with already

in what ways it is lacking or how it can be improved - only experiment can - so using theory to deny experimental findings is to remain stagnant and unaware of a more complete operation of the world.

I propose a "close approach" hypothesis - this is a hypothesis that is widely used in science but not widely acknowledged. It may be possible to prove in some mathematical contexts, but in physical or philosophical problems this is usually not possible - it is instead assumed to apply. There is an objective fact that a particular theory may predict, for instance $F = ma$. This may or may not correspond to real experimental data, based on which we determine the predictive ability of the theory (commonly referred to as "correctness" or just "validity", as in Einstein's theory surpasses that of Newton). Beyond that, we have subjective feelings about what this theory means about the world and what steps to take to improve the theory (as well as how the author arrived at the theory). This is where the "close approach" hypothesis applies. I first encountered it in grade school with an algorithm to find a number's square root: $n1 = n0 + (x - n0^2)/(2 * n0)$ which iterates by $n1 \rightarrow n0$ until eventually both approach the true solution (where the name "close approach" comes from). The stability of this iteration can be proven mathematically, but I did not know this at the time and thus wondered a lot on whether such iteration is really guaranteed to find the solution. There were similar examples of such non-rigorous iterations later in high school as well, in solving systems of equations, which left me similarly baffled ("you can just do that?"). In the algorithm, there is some starting point n0, and a procedure is applied to get a "better" estimate n1. Let's apply this to theories: there is some starting point (ether theory) and some procedure is applied to find a "better" estimate (Maxwell's laws). It would be impractical to get to our current state of knowledge otherwise - we build on previous experience, "standing on the shoulders of giants", instead of completely starting over each time - a task probably beyond our simple minds. In our teaching, application, and description of theories we accept the "close approach" hypothesis, by saying that we have a better understanding of the world and by framing the world in terms of the theory. Having minds designed evolutionarily to keep track of actors and actions, we can't help but use the theory in our descriptions of the world, cementing its reality: knowing about electrons from the atomic theory we now say electrons flow in wires to represent electricity; when I think about an electron microscope I think of electrons (as individually identifiable "balls") flowing from the filament onto the sample; when I think about gases I imagine billiard balls colliding; when I think of the nucleus I imagine more balls representing protons and neutrons. None of this is really justified or claimed by the theories - which were vetted only because their predictions

known starting conditions and outcomes

were close to experimental results. But it permeates our thinking [16] - even in scientific circles people will talk of electrons and neutrons as if they were "real" and probably ball-like - this is necessary for rapid communication of complex ideas, for intuitive reasoning, but it also implicitly locks us into a cognitive framework which may or may not be a good representation of the world and a path to the "real solution". Coming up with a new theory or modification to existing theory is a highly imaginative and intuitive process (computer learning is a "rigorous" approach - but such "theories" are rather uninteresting to us as they are "meaningless" in what they say about the world), and in this process we must use the tools of intuitive thinking - including the unjustified worldview of existing physical theories (take Einstein's thought experiments as a real example). It is the "close approach" hypothesis that lets us continue on this path while believing that some day we may have a "theory of everything". This is why even now I question numbers, energy, and other deeply ingrained constructs as "artificial".

[16] I found this when thinking about electrons in an accelerator - I realized I was looking at balls! I tried to think about fields instead to align with my field theory but realized this has the exact same problem. It is something we cannot escape but must keep in mind as a limitation of our intuitive abilities.

2

Observers, Objects, and Existence

main message: must be very conscious of what the notion of 'observer' does to the experiment and to theories that may purport to describe it, such requirements lead to some logical necessities for what we call physical laws and how a creator can interact with us

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Scientific experiments - what is meant by experiments? I am not discussing word meanings/ontological concerns (what is art?) but rather a physical basis for what we can definitely call an experiment when seeing it as an independent observer. An experiment is designed to measure something, thus the concepts of experiment and measurement are closely linked, yet an experiment is not just a measurement. It is a series of specially chosen measurements designed to uncover an underlying pattern or rule, or match/refute theoretical findings. Individual measurements can enumerate different properties, which is useful and necessary, but an experiment is designed to find some underlying rule or pattern by which the properties can be compactly explained. In an experiment it is never adequate to have a single measurement - because this makes it impossible to assign an uncertainty to the determined quantity. In an experiment it is also necessary to be able to control the outcome, to prove that changes are due to a proposed mechanism and not random. This interactive nature distinguishes experiment from observation. The goal of the experiment is to provide information that fits within the experimenter's framework of knowledge, so the measured variable must be clearly defined. An experiment is a set of measurements, designed to evaluate a specific aspect of physical processes in a way that can explain why these processes occur. In this set, the influences (variables believed to cause temporal changes) proposed by theory are varied over some range of interest in all their degrees of freedom while the

outcomes (variables of interest to the examiner, at a time after influences have taken effect) are accurately measured as a function of the influences. Generally, we don't know what the influences for a certain outcome are, or even whether the outcome is a logical aspect to be evaluating the influence on. The only way to answer the latter is by appeal to theory and mental frameworks of how we explain the world, so experiments cannot be seen as independent of theory. Theory guides experiment in pointing out the things we can call "outcomes" and suggesting that we can control them via an earlier (temporal) influence. Once we have an idea of an outcome, we can choose among infinite potential influences on said outcome - how are we to continue? Even in misguided efforts, theory determines what influences we test as the potential scale is (again) infinite. The basic underpinning of this whole framework is causality: if a system is set up in a given way at time 0, it will evolve by time 1 to another given state that can be fully predicted from adequate measurements at time 0. If this is not true, we can never claim to observe any cause/effect relations in our experiments, only potential relations - but this gets tedious when science has been so successful when ignoring non-causal influences.

So, once we acknowledge causality and have an idea of an outcome and its influences, the experiment can take place. In an ideal experiment there is a 1:1 mapping of influence and outcome. The measurement process is set up as a low entropy system, which "naturally" increases in entropy and carries the measurement result to the "entropy sink" of the measuring device. So, the measurement itself is an 'automatic' physical process. The art of the experimental measurement is in ensuring the measurement gets only the desired information by consistently setting up the measurement process in a specific way. Thus the 1:1 mapping is specifically between measured variables and varied variables - one must not exceed the other. If there are too many measured variables, some may be affected by the non-varied variables and thus outside the predictive ability. If there are too many varied variables, it will be impossible to separate their effects, or in a better case, there will be unnecessary repetition. Practically, we don't always know enough about either the influence or the outcome to get a 1:1 mapping by design (in fact all of our "new" discoveries come from finding unexpected influences or outcomes and setting about making them into experimental variables - this is how we can now take it for granted that (say) radio waves exist). It took us thousands of years to accept that influences are of a limited and local nature - the temperature of water in a pot depends strongly on the temperature of the pot itself, less so on temperature of air above the water, less so on weather outside, and effectively independent of the moon phase or star alignment. So in the absence of knowledge of possible influences this is a good starting point - what is spatially and temporally 'close' to the outcome? Those things are potential influences.

The rest of the world is not a potential influence. Drawing a sphere around an outcome and tracking what goes in/out will (along with full knowledge of what's inside the sphere) allow us to predict the outcome at time 1 as desired - because a sphere blocks off any spatial influences while the full knowledge of internal contents blocks off any temporal influences. Whether this sphere is explicitly recognized or not, it exists in all experiments beyond the boundary of the influences we can control reasonably, and ideally we would track all influences passing through the boundary but practically we assume that such influences do not exist (or find/set up a situation in which this is true). We must make this assumption because the only way to be sure of no external influences is to measure all possible (infinite) external influences - easier to do if we assume a boundary surface but still a heroic undertaking - and even if we do measure these influences, we have to apply the same strict standards to *those* measurements, and so on requiring eventually knowledge of the whole world. In a more pragmatic sense, the relation between local influences and outcomes is so clearly demonstrated by experiment and so elegantly explained by theory that we effectively take it as a given that with adequate effort all "external influences" can be eliminated from affecting the outcome. [1]

With knowledge of the outcome to measure and all potential influencing variables that affect it, experimental design can proceed. This knowledge is never absolute, imparting an element of luck - experimental success depends on finding the correct influences and outcomes, but such success vindicates the theories that led to the initial determination of the influences and outcomes - whether a hunch or a full-fledged academic work. The goal of the experiment is to 'prove' (in an ideal sense) that the influences control the outcome in a given way - without such a proof the experiment is just a series of measurements without a cogent framework to interpret them (what was kept constant/varied and why? this is already evidence of *some* theory at play). First it must prove that the influences tested are the only cause of the outcome (realistically 'only' changes to 'largest'). Rather than exploring the full space of all influence variables, real experiments place the vast majority of influences as 'control variables' which stay unchanging in all measurements. The distinction between control variables and non-influencing variables is that if control variables change, they will affect the outcome, so they must be kept explicitly constant, not just ignored. Then the small remaining influences are taken as 'independent variables' that are varied over a practical range as the outcome is measured. An effective experiment requires that it be possible to predict the outcome from the

[1] By external influences I don't mean the things we must keep constant - those are influencing variables we choose to keep constant - but rather those happenings outside the experiment sphere that come to interact with it during the experiment beyond our control - neutrinos, gravity, air molecules, god's hand...

independent variable with certainty. Thus the independent variable must be varied and outcome measured multiple times. Practically though, we don't know/can't control all possible influences and to convince ourselves that the measured results are worthy of a theory the experiment should repeat the same independent variable multiple times and ideally show the same outcome - thus "proving" the effectiveness of the causal relation. Second, it must prove that the influences cause a given outcome in a specific manner and consistently. This requires the measurements to have enough descriptive power (taking the above notion of repeatability into account) to be able to distinguish between different influences. So, at the least, an experiment must have a notion of reproducibility, and the spread in 'same-initial-conditions' outcomes must be smaller than the difference in outcome due to an influencing variable variation (that is known/measured). This is a notion of *resolution*. To do better, we should take into account real factors - time, money, and desired knowledge. A good experiment will uncover the most knowledge per (time*money), or some such. Naively taking that knowledge is positively related with number of influencing variables varied (as opposed to kept constant), we want an experiment that can control many variables and make quick measurements, for cheap, with sufficient resolution to make us confident we know what's going on. An advertisement for a hotel claims "it's good to not be home", playing on the usual saying "it's good to be home". Yet if it's good to not be home and it's good to be home, then it's always good, and the whole concept of good loses its meaning; the word is stripped of its descriptive and discriminatory power. The point of a measurement is to be specifically applicable and descriptive, thus it must be precisely defined and only have limited applicability (describing what it is, but also what it is *not*).

The information content of an experiment, its physical reality, is independent of the words/symbols we use to describe it; it just is. Using models helps us explain and find patterns, but models are always open to questioning and reinterpretation as long as they satisfy experimental information. The information we get also depends on what the experiment is designed (consciously or not) to measure. We make progress by finding common/singular points, like "voltage" doesn't depend on type of battery or power supply – effects are same in any case.

Through the earlier examples of reversible mathematical operations and inability to change one real number to another without requiring a second one, I was led to a law of information exchange. Usually statements would not be called laws without significant prior verification, and in that sense my approach is reversed: I will call it a law due to its intellectual elegance and see whether it leads to reasonable physical predictions matching real experiments. As you might see by the end of the book, I think the name ends up being well justified. For now, I will apply the law to scientific

experiments - at first glance an obvious example of unidirectional transfer of information from experiment to experimenter.

Applying the law of information exchange, I reason that all experiments that determine the information in a system must also perturb the system, and furthermore that the more information it is desired to collect, the more the system must be perturbed. Or, any experiment in which an observer gains information about a system (observes the system) will also give the system information about the observer. It is a common physics blunder to "imagine a universe with just two particles", because by just imagining this universe (as a human observer/creator) we have brought in our own biases: a notion of time, distance, discrete particles, and energy for instance. So we have already supplied significant information (including math itself) to this 'simple' model, and we will further supply information when requiring the particles to be at a particular separation to see how they evolve. So, in simulating this toy universe we learn how the particles move, but we had to supply the rules and initial conditions for those particles to move in the first place, so the toy universe also 'knows' about us and what we seek to calculate. We are not as much of a unidirectional observer as it seems at first, in fact becoming an integral part of the toy universe by solving its equations in our own universe and feeding the results back into the toy universe to cause its time evolution.

We can apply the same thoughts to the big picture of our universe: if there is a creator, can we observe it? Can the creator observe us? Consider a creator that knows everything about the universe, being able to observe it at will, unidirectionally. We get back no information about the creator, like standing in front of a 'one-way mirror' (the mirror is of course not truly one way but just seems like it to our eyes - I will maintain that all physical information transfer involves exchanges; the creator on the other hand may have a 'true' one way channel). The creator may use this one-way observation to make alterations to our universe, modify it at will. But as soon as it decides to modify our universe, bidirectional exchange will have occurred, we will be able to observe the modification, and systematically treat it as a law of physics (or their violations). In acting on our universe based on unidirectional observation, information is also transmitted to us about the creator and perhaps its universe, thus we end up with an information exchange.

What if this creator only observes, and takes no measures to modify/alter our universe? Then there is no physical effect of the observation, no reason for us to even think that observation took place. Crucially, even here information exchange ends up being bidirectional. Just as we found that in the system of equations $A * x = y$ we supply the same information in y as we eventually get out in x, the creator which does not in any way alter the universe cannot get any new information out of the universe other

than what it had originally put in. Only the format/the perspective/the interpretation of the underlying information changes as the universe evolves. So we still get information about the creator and its universe in the form of how our universe works and was created. The unidirectional transfer of information has been an illusion, as the creator has already supplied all the information that it may ever expect to observe if it avoids modifying our universe. As soon as it modifies our universe though, another bidirectional exchange of information will occur and we will learn more about the creator, just as it learns more about our universe. If the total amount of information in our universe is postulated to be conserved, then the law of information exchange must also apply to our interaction with a creator.

What does this mean for our scientific experiments? I work in a laboratory testing materials, observing them under a microscope, modifying them through mechanical work and irradiation. I am in a sense the 'creator' of the experiments that these materials undergo, I am all powerful in choosing a method of measurement and examining every feature of the sample, the sample is fully under my control. Or is it? For in the very act of picking a system/controlling variables/adjusting parameters between trials/carrying out multiple trials, I am providing information input (about myself and my goals) to the experiment. The experimenter does not observe a sample, but interacts with it. In setting up my experiments, I am 'asking' my samples for specific information, and the samples provide this information if 'asked' properly. If the samples had a brain they could try to think about why I am asking the things I am and how to reply appropriately, so there has been a bidirectional exchange. But if the exchange is truly bidirectional/symmetric, is there any way to make a distinction between experimenter and experiment? Who is 'in control' here - surely the human experimenter? The obvious view is that the experimenter is in charge, starting/ending the experiments, collecting and publishing the data. But information theory says that my experiment should affect me just as much as I may affect it. In a very real sense, it is the experiment/sample that is in charge of the experimenter, for the data it provides is what the experimenter will publish, and what will determine the experimenter's future course of action. So exchange of information makes it naive to think of any one object as being 'in charge' (even if that object is ourselves), the only absolute controlling certainty is the laws of physics.

At this point we must not go awry by ignoring the fact that all experiments that we can carry out will be carried out within the context of the larger "universe" system. Thus if we want to describe a system like the universe, or even the results of our real experiments, our model must be complex enough to include a universe in which experiments can be carried out. Clearly models we have are not nearly that complex. We must supply *significant* external information, including math itself, into the models

about our universe to get relevant results. And we can only solve time-based problems by using real universe time (a formula on its own won't do anything). However we can learn from the fact that these *very simple* models work:

> Nature has significant symmetries that are a property of the world (that coincidentally shows up in experiments done in this world but is present everywhere even when it is not recognized as an experiment).

In essence the symmetries in a system can be observed uniquely by inhabitants of said system! (suggested but not proven) This is similar to asking if "space is Euclidean or parabolic" - we live in it so our view is warped, but through some means we may be able to tell, such as math relations of measured quantities.

A tool widely used in classroom instruction (and thus passed on to students - who may not critically evaluate it) is that of the thought experiment. Of course this tool had its place in a number of important theoretical discoveries such as Newton's and Einstein's purported thought process leading eventually to their theories. However, we must be very careful in its application, since it inevitably introduces human biases and "intuitive" aspects which are questionable or even completely false. In the units of physics we can see this aspect of models and intuitive reasoning. There are immensely more atoms in the universe than the number of seconds since its supposed inception. This might imply that the universe is very big, but also that a second is a particularly large thing. Indeed, we see that atomic phenomena happen on the scale of femto or pico seconds, so if we talk about atoms we ought to compare to that time scale. But this is so far away from a human's range of perception that it is doubtful we can make any reasonable statement without using mathematics. The mathematics works because underlying symmetries were kept while most of the "intuitive" aspects were eliminated, hopefully. And yet, when we talk about atoms, we imagine them as concrete entities like apples, existing in time like objects we observe. All of this, which is how we interpret our theories (ie which of the two slots does the photon go through?), involves a carrying over of our experience of the world (in m, s, kg, and N) into other, vastly differing scales. This must not be assumed to be accurate.

Another flaw, or introduced external assumption in theories, is the notion of an observer (a human one, at that). A typical statement in a physics classroom might be "imagine a universe with just these two particles..." and we like to think, intuitively, what the two particles will do. But this is very wrong - for by looking into this universe and tracking the particles we have brought our own biases (perhaps those of our universe) - a notion of time, distance, energy, temperature, even the discrete particles themselves. The

mental model is not of two particles in space, but that of two particles being embedded within our universe and observed. I have no idea what a real two-particle universe would do, and if I had a way to make one, I could not observe it to find out, because the observation would change it.[2]

As humans, we have natural access to "human-sized" objects, both in time and space. In the present day, we are able to conquer larger distances, speeds, short and long time scales, and see stars and microorganisms. We have become familiar with many scales outside our natural experience. However this was not always the case. At some point man did not have sharp blades, flat surfaces, or impermeable containers. Man did not have glass nor lenses nor batteries nor vacuum tubes. However, man was able to gradually conquer the different scales of experience required for these exotic objects. How is this possible? How can a sharp blade be made if only dull objects are available? There must exist physical processes, which might be called scale-converting, that have enabled us to access these scales. While we have created a large number with modern technology (like the SEM), there must have existed naturally a sufficient number of these processes to allow us to advance to the modern tech level. Such processes are of great importance and should be explored more thoroughly, as they act as a "gateway" or "impedance match" between the scales we experience and the scales we would like to control/understand. In this sense the process provides a physical symmetry that happens to straddle a range of scales. Note that the application of such processes is uniquely suited for individual beings (or perhaps vice versa), explaining why human intellect can act as a real weapon.

What does an atom "feel"? Inspired by [Lehar] we seek to interpret the atom's actions with some semblance of consciousness given to the atom (since our own consciousness stems from an atomic system). While in a gas we see, for instance, molecules bouncing around, the atoms are very much less aware of this situation. An individual atom might feel its electrons shifting into stable patterns - something we can see is a consequence of atomic bonding. Ignoring this effect for now and assuming a monatomic gas, the atom might feel somewhat like a blindfolded man in the middle of a hockey field - pushed around at random. As it encounters other atoms, all it feels is some increase in force on one of its sides. It remains unaware of what it's interacting with, or what velocity it's traveling at - in our "entropy" discussion, the initial "fast" gas atom would not know that it is fast, nor would any of the atoms it interacts with. Furthermore the atom does not know when or from where a future interaction will take place, nor does it "consciously" exchange velocity information with others (since it does not "know" this) - that exchange happens only insofar as we, external

[2] this will be explored in more detail under Information Theory

observers, can assign velocity information to each atom. To the atoms themselves, such information transfer happens implicitly. In other words, in an expanding gas the atoms do not "seek out" a lower energy state - it just happens from their viewpoint that for a while they are hit more from one side than the other. The emergent effect of "entropy rise" is only from our, external, interpretation. In effect, the atom interacts like a "heavy photon". We note that in a particle-centered relative reference frame, the particle behaves as if it has infinite mass/impossible to accelerate, with other particles bouncing off of it. This is consistent with the particle not knowing its velocity, but on a basic level is just a consequence of forcing the particle to always be at the origin of the reference frame.

What is a bug's view of the world? My first thought would be that its world is messy - it cannot know the larger trends, events outside its control must happen randomly from its viewpoint, and it must find some way to respond to this constantly changing world. I might claim that the bug finds its world a complicated place - few clues about its operation and a wide variety of configurations. Yet this view is illogical - a bug is a simple organism and must find itself in a simpler, more symmetric world. If it used some machines to measure its world, it would just learn about the machine's world - making the conclusion that the two are actually the same requires quite a logical leap (yet it is experimentally supported (such as by effectiveness of medical procedures and predictions of machines about living things) and removes the questionable distinction between machine and creature). The bug sees clear, logical patterns (produced by motion, flowers, scents) and responds in a clear, logical way. Its world is much simpler than a human's, even if we may conclude that the bug has no concept of the world and is completely lost; it is our ability to handle increased levels of imperfection and asymmetry that makes our brains more capable than a bug's. Even simpler must be the world of the electron - even though we require supercomputers and high level math to describe it - the electron can only sense and respond to the world in limited ways, all of which are prescribed fully (as evidenced by strict physical laws that we observe). Its world is one of the clear symmetries seen in TEM diffraction patterns. We make similar flaws of assumption even when interpreting other people's views of the world. When looking at operators in a control room, or aircraft pilots, or musicians, I project my view of the difficulty of finding a proper action and assume that their work must be difficult and thought-intensive. Yet once the initial barrier is overcome and trends in the controls are learned, in a real way the operators are in a much simpler and more logical situation - they know what switch to use and when - than what I portray them to be [3]. This is not to detract from the difficulty of the

[3] to me, there are all sorts of ways to use the switches on a control board; to a trained

associated work, but simply to emphasize that a rudimentary interpretation of complexity (and use of such in a physical theory) is likely to be flawed. Ultimately, complexity and the closely associated "degrees of freedom" [4] are human constructs, so until a better physical definition can be found I will focus on the more readily defined notions of information (results of experiments/information exchange) and information content (how many experiments are needed to uniquely define the system experimented on).

What is an isolated system? The notion of isolation in a physical sense is circular, since a system can only be claimed to be isolated when it is seen to not interact in a certain way with other systems. This is a result of information exchange being blocked or limited, and a s a consequence the information content of the system is not changed and its information is maintained over time (that part of information which cannot be exchanged). For instance, an ideal bearing isolates the rotational motion of two bodies, and thus allows the motion of a rotating body to be maintained. Other exchange mechanisms like air drag eventually result in an equilibrated system but their ability to exchange information is slower than the solid bearing. A similar example of isolation is the use of roads and railways. A difficult trail with terrain and obstacles is physically reduced to a more standardized system, effectively isolating the vehicle's tires from exchanging vertical height information with rough or uneven surfaces. On a microscopic scale an atom can be isolated such as one held in a Penning trap, allowing the isolated one to be cooled down or heated up far from its neighboring atoms' temperature. I claim that a properly isolated atom in an excited state will not decay as usual (just like the bearing example - it still may decay through inadequate isolation eventually, but much slower than normally) because when it is isolated it has no means of 'transferring' its excited state elsewhere. Such a claim would apply to all excited states - radiative, kinetic/potential energy, or radioactivity. The KE/PE examples are readily seen at all scales. An associated question is when would an adequate degree of isolation be attained - we can only define an isolation method's effects by experimental observation, and the above claim does not guarantee that it should be possible to isolate a system sufficiently from all interactions. For instance, at present we have no known way of isolating a system from gravity (does rotational/orbit motion suffice?). An isolated system may still evolve in time (this is another thing which we can't seem to isolate - perhaps at low temperature?). Consider a battery-operated computer that runs a program that replaces existing data with external inputs. In

operator only a small subset is known to be valid/useful, so the choice of possible actions is relatively limited - thus making the system appear less complex

[4] freedom implies some aspect outside the action of the universe so is not consistent with symmetry theory. To make sense of 'freedom' we must define system boundaries, and then a degree of freedom is something where a system can be affected by its surroundings.

isolation from external interactions, we have claimed that the information content does not change - yet the battery voltage drops, and the computer's "memory" is lost. Maintaining the hypothesis as logically plausible means this lost information is transferred elsewhere in the system. In the case of the battery voltage, if it is not reversibly transferred to capacitors/memory bank of the computer, it will result in heat. And if the data is irreversibly overwritten, more heat will result [Claude Shannon's claim in Information Theory]. In a closed isolated system the heat will eventually, however unlikely it is, find its way back to the original starting points of voltage and data. In the meantime all similar energy states will be explored. In fact we have only been able to set the whole experiment in motion by having initial control over the distribution of information within the system, which determines the foregoing transfer of information (internal) through control processes. The concept of isolation can be of use even with large systems like organisms, and is a powerful proof of determinism. If, as some claim, organisms are particularly capable of independent or 'random' action, an isolated organism will not have a predictable response. The consistency of animal (and human) responses to environmental isolation is evidence to the contrary. Another type of isolation is removing a pre-existing limiting or constraining routine and observing the organism's actions. This is in a sense an "inverse" relation where previously the organism could not fully exercise "autonomy" and now is capable, a true random organism might take any appropriate action while a deterministic organism will tend to only behave in its characteristic ways, which should be to a large degree predictable and explainable.

Symmetric Experimental Approaches

If symmetry theory is of relevance to the world's functioning, it is logical to reason that there exist experiments that take advantage of symmetry by designing probing methods that can measure otherwise inaccessible or completely unknown parameters while cancelling out all external effects not of interest to the measured parameters. This is an extremely powerful method that I believe defines most of our scientific knowledge and understanding (one of the first things in an experimental design is to separate studied system and external world on some basis), however at this point my knowledge of the theory is only sufficient to list the most concise and obvious examples of this approach - which I call "symmetric approach". What all of them have in common is that they provide deep insights on what variables are important at "only" the price of accepting the premises of symmetry theory.

1. Differential: if two systems are known to be precisely equivalent, their behavior is also expected to be equivalent. Thus any differences in

behavior between systems (that evolve in truly equivalent conditions) will reveal non-similarities. These effects will grow exponentially (see Information Theory/information exchange in gases) so this is a very powerful method for revealing exceedingly small differences between systems, even though most of the time we can only measure a vanishingly small part of the difference (we don't control all system boundaries) leading to the illusion of information or signal "loss".

2. Equivalence and reversibility: if two systems are equivalent, whatever is done to one must be done to the other to bring them back to equivalent (or alternatively must be undone on the original). This is a way to quickly reveal physically relevant variables (they must be fully conserved if an action is done then undone [5]) and study systems where processes are too fast/inaccessible. An example of the former is thermodynamic heat engines: at time t0 and time t1 the engine is in the same state, so anything done between t0 and t1 must have been undone in the same time - this tells us that physically relevant quantities describing this problem must have no net "flow" (and that entropy is not a fundamental measure but an emergent one since it is not conserved). An example of the latter is a bomb calorimeter - we can't directly measure the chemical energy of a sample, but we can easily measure how much heat is removed from a sample to return it to its original temperature (and if we wish, how much heat+info to put in to get it to its original *state*) - using equivalence and conservation we can equate the chemical and thermal+info quantities. (differential calorimetry uses both this and the above differential concept)

3. Comparison and relative quantities: when the concept being studied is poorly defined, we can make significant progress by measuring relative differences. The existence of this approach stems from the lack of non-conservative fields in the world (if those existed, all relative comparisons would become 'circular'). For instance, when trying to understand what constitutes "information" I considered how one might tell, of two systems, which one had more "information". By iterating on this, I might end up with a definition of information although I didn't start with one. The power of this approach again lies in being able to "remove" the effects of the rest of all other variables when two systems are compared against one another directly.

In a real world experiment, we seek to measure a particular quantity. By measure we mean compare two quantities, and by compare we mean

[5] I used this in the attempt to define the information content of a function - namely when repeated differentiation leads to a set of numbers. This of course assumes that the information content of a number is a more easily understood quantity.

using a minimal-disturbance method to tell whether one is larger than the other. What is it that we actually measure, though? Our experiment interacts with the whole universe, so how do we get any cogent data? We do so by changing the experiment in a known way and carrying it out again (the 'independent variables' of high school science class). What this does in an information theory sense is perform a XOR: result = $(universe + experiment_1)\text{XOR}(universe + experiment_2)$ = change from 1 to 2. The XOR cancels out all identical effects that happened in both experiments. This is not just data processing - but rather how the actual physics of the experiment function, to give us any usable value. The lesson is that we will measure all effects of a given change, so we must be sure that in the measurement,

1. The state of the universe doesn't change as far as it affects the experiment
2. The change we imposed is adequate and sufficient to show the effect we wish to measure but not anything extraneous

We can try to 'prove' 2 with theory (though the theory depends on its own set of experiments to be accepted and interpreted/applied 'properly'), but for 1 we must use averaging, repeatability, and a general hunch that most of the universe in fact has little effect on our experiments - at least on our timescales! This is quite surprising considering the size and energy of the universe, nonetheless universe-centric measurements (which seek instead to eliminate all terrestrial change, result = $universe_1\text{XOR}universe_2$) are some of the most difficult we can carry out (neutrino detectors, Hubble telescope), and the general consistency of terrestrial experiments is further proof of this point.

Consider many common measurements - voltage/current, temperature, pressure. These give just one number, despite the uncountable complexity of the real measured system - all the different electric and atomic motions that always take place. This is because the measurement devices are specially designed to have low sensitivity to every aspect of the system except what is being measured. Although millions of electrons pass through a current transformer, all along unique paths, only the total effect is seen at the output - giving a measure of current. Consider 3 electron paths:



A and B and C start and end at same points, but go through different

sections of a current transformer. Consider A→B a perturbation: its effect on the measurement will be tiny as it stays wholly within the transformer core. If B→C was a perturbation, its effect would be large (exiting the transformer), so the system is designed to disallow this (with the wire insulation keeping an electron from traveling outside the desired path). Consider on the other hand perturbations to electron speed along either A or B: the effect would be large and consistent, as desired. This bears similarity to Feynman's all-paths view, but applies also to 'big' systems and describes why 'complexity-reducing' measurements are possible. Non-measured information here sees either 0% or 100% exchange (this is further elaborated under Information Theory).

In the modern physical theories, the approach inevitably leads to "divide and conquer" - the behavior is explained by splitting up a system into moments, parts, atoms, and particles. Even virtual entities like holes and dislocations play a role. But for a unified theory we should step back and consider the bigger picture. Dislocations are not "real", they don't arise because of some imaginary entropy - that is simply how a crystal structure *is*. We like to think of perfect crystals in simulations (DFT - periodic boundaries) but in reality, when all the quantum interactions between all atoms in a real crystal take place to establish a huge quantum wave representing the whole crystal, the wave will include dislocations. This is how the crystal behaves - instead of seeing a defect as its own feature, we see defects as inextricably linked to crystal structure. In other words there are no real BCC or FCC lattices, there are no real infinite boundary conditions, and we have no intuition for how "perfect" things actually appear - all real things exist as imperfect things because that is how they are in purest form. It is our folly to assume that mathematically perfect things are the underlying blocks. Everything becomes interconnected, and cannot be simply split as in a "divide and conquer" theory - the atom is not independent of the experiment, which is not independent of the experimenter. We only have the direct experience of what it "feels like" to *be* the electrical activity in a human brain [Lehar] but if we had more consideration for what it is like to be other systems, our theories would become more complete.

Based on similarities between models in physics and elsewhere, I propose that a system, in a most general sense, is defined by three components: symmetry, asymmetry, and information. This definition fully defines a system, but such a system may be interpreted in many different ways - the underlying symmetries and information must be conserved. For example:

1. A resistor system, $V = IR$. In this system we start with a 3-fold asymmetry, which makes 3 variables: V, I, R. Then we add a 2-fold symmetry, $V = IR$, which reduces the degrees of freedom/information content from 3 to 2 variables. Finally, the amount of information

required for the system is 2 variables. The third variables is obtained by the symmetry relation.

2. A constant-velocity particle, $x = vt$. By the system construction, we see this is equivalent to the resistor case above; despite the different interpretation results of both systems are interchangeable.

3. A 3-phase motor connector (a, b, c) with motor direction d. There is a 4-fold asymmetry for the variables. Then, we can determine (ie) $c = f(a, b)$ and $d = f(a, b, c) = f(a, b)$ thus a 2-fold symmetry reduces information content to 2. These 2 variables however carry less information (only base 3) compared to above. The direction d is only base 2. This makes us ask what fraction of a degree of freedom is carried by each variable. Knowing d reduces the possibilities by 50%, so maybe $I(d) = 0.5$. Knowing a or b or c makes a full degree, so maybe $I(a) = I(b) = I(c) = 0.5$. Normalizing to 2 variables we have $I(d) = I(a) = I(b) = I(c) = 1$ so any 2 are required to define the system.

4. A balance with two masses $(m1, m2)$ that outputs a reading r that is (-1,1) depending on whether $m1 \geq m2$ or $m1 < m2$. We have a 3-fold asymmetry for $(m1, m2, r)$ but then a symmetry for r which is non-linear. What is $I(r)$ and $I(m)$? The system is fully specified by $m1, m2$ so we take $I(sys) = 2$. Knowing $m1$ and r, we are left with a difference $m1 - m2$ but we know $sign(m1 - m2)$ from r. Thus we have gained 1 bit of information from r. We have reduced ∞ combinations to $\infty/2$, thus we might say $I(r) = 0.5$.

In conclusion, we have assigned 1 degree of freedom for a "real" number, something that will need to be examined later. The information content of a "real" number is a cause for concern, unlike the information in a binary digit which is straightforwardly 1/2. The above descriptions operate on the assumption that information within a system is always conserved. It is plausible to think of a system where this is not the case, such as a hash function - the output depends on all parts of the input but carries much less information. This will be considered in later chapters.

3

Space and Time

main message: it seems that no matter how we approach a physical theory, we cannot get around some notion of space and time. What is required of these in a general sense? Here also introduce the notion of spatially localized information (notion of a surrounding boundary/sphere)

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Space and time tend to scale together: small things move/change quickly and big things move/change slowly. This is particularly surprising if the big things are made up of small things - big things change as a time average of small things (ie atoms+electrons, macro-objects+animals). Might there be a possibility for fractal simulations of phenomena? [1]

Some basic physical observations:

- Persistence: objects tend to exist for long times and reflect a past state (system's "memory")
- Equality: objects can be similar or equivalent to each other, and yet some exclusion principles (such as in space coordinates) also apply
- Information exchange: objects that can be observed (by definition all objects) *exchange* information (ie no information sources or sinks - that have been verified at least) in a similar way to energy conservation, also following arrow of time/causality. In other words all information exchanges are symmetric (as must be energy transfers) [2].

[1] This also happens with temperature, ie cold things move slowly. Coincidentally, Einstein predicts that hot things, having more energy, will be heavier. I predict that hot things move faster in time and thus experience a higher gravitational pull, when gravity is viewed as a "time warp" or "time drag". This can also work with an Entropic Gravity viewpoint or wavefunction-collapse gravity viewpoint.

[2] it will be suggested later that information is accurately represented by mass-energy given our current level of physics knowledge

Nature of space: effect of action decreases with distance; long-distance communication is possible by 'concentrating' action as by an insulator-covered wire which creates a "tunnel" effect for the action and it spreads but spreads in the limited wire area. In any case all the space between 2 points *must be traversed* - no "action at a distance". This is related to entropy: energy will spread wherever it can, and energy can be "converted" whenever it can come in contact with a "coupled" level [3] - for instance where electric and motive potentials are coupled in one level - these devices are necessarily lossless/reversible, it is the spatial spreading out of energy which is irreversible.

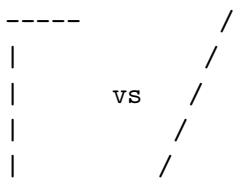
Earlier in this study we have made liberal use of the concepts of big and small (scales, objects), and here we desire to more clearly understand this distinction. If we are to accept causality, then the universe should operate in a sequential manner, with small effects combining over time to result in big effects. This implies that big effects are not elementary but a human construct, a consequence of a number of small effects. Similarly if we ask at what scale the universe operates, maintaining the notion of causality leads us to claim that the universe's laws must operate on the shortest time scale, which is associated with atomic motion/small effects. The laws thus operate at the "far end" of the ∞ information sequence, and over time the effects of these laws show up to us as observable, "bubbling up" the information chain. This means that generally, knowing the laws for a small system allows us to predict the behavior of a larger system, but not the other way. The laws of the universe may be very complex at the lowest level, but what we observe is a cumulative (in time and space) effect. Thus only those aspects of the laws which are additive or otherwise "constructively interfering" and not "averaged out" can be observed in an experiment far removed from the elementary scale of the universal laws. On the other hand, some effects (like gravity) are so small on the atomic scale that we must question how they fit into this model. Another question is how a small particle (an atom falling down towards the earth in its gravitational well, or an electron in SEM column) exchanges information with all other particles that make up the gravitational/electric field affecting the small particle (ie information must be exchanged, but information content of single particle is much less than that of big system, so how does the particle know what part of the system to exchange with?) [4].

The Pythagorean theorem and the circle equations ($C = 2\pi r$) say something about the space of our world. It is odd that going at right angles

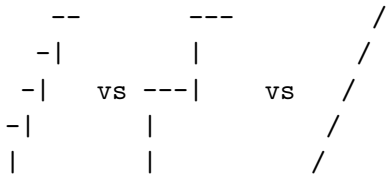
[3] coupled actions are also considered in Information Theory under Couplings and Gearings

[4] this is addressed later with a field theory interpretation of physics

sequentially results in a larger path than doing so simultaneously:



Note that even in the limit of infinitely small spatial discretization, the diagonal line is shorter than the two right-angle lines. Taking any small section of the diagonal line and replacing it with the sides of a triangle necessarily makes the path longer. In other words, the diagonal line is an essentially different entity from two straight lines, which is a weighty argument against a quantized/discretized space (the importance of the spatial property that allows travel along any angle is also considered later under Couplings). Below the first 2 images all have path length equal to two lines, while the 3rd image is a shorter diagonal line.



It is odd that adding forces at right angles leads to a larger sum of forces than in a straight line:



F2+F3 >= F1 although both {F2,F3} <= F1

When things fall in gravity, they feel no acceleration despite being accelerated in our frame. When things are on the ground, they feel an acceleration despite not accelerating in our frame. Things will fall in parabolas with constant distance between them if dropped at the same time, but increase distance if dropped at different times [5], though they will land with

[5] this does not bode well for the trope of the hero jumping out of the window to save a falling person - at least until air drag is significant the distance between the two will steadily increase

the same dt as they were dropped. When an elevator moves up/down at constant velocity, the occupants inside still feel the same acceleration g as on the ground outside.

How do fields propagate in space? What does it mean to move in space? We have to posit 3 dimensions to proceed, and then a notion of distance becomes useful. What is a distance? It is something we could measure in an inertial frame using a light pulse time or a "measuring stick" (ie bound light of characteristic wavelength * number of waves = length). The existence of measuring sticks and propagating light pulses is evident in our observations. What does this require of space? First, it means space cannot be infinite and continuous. If it were, there would be no reference point for any size scale - with same physics laws independent of an absolute scale (infinitely continuous space - no handles/slippery/arbitrary) we should see atoms the size of a galaxy or galaxies the size of an atom, but we do not. Atoms and the associated physics have a characteristic length scale. Even if we assume atoms and galaxies are essentially the same structures just with longer time/space distances and similarly adjusted evolution, there is no way to define anything other than uniform filling of all space (not even a fractal structure) without a notion of some origin. Even an external 'god' could not "get a handle" on an infinitely continuous space. In order to escape from the infinite symmetry of an infinite system [6], we must introduce at least an origin along with a non-uniform matter distribution, both of which require referencing to the boundaries of a finite system (in drawing a Euclidean 'infinite plane' we tacitly make the system finite when choosing to place the origin in the center of our picture/plot). Further, assuming that atoms and galaxies operate under essentially different physics (as opposed to a fractal system) - supported in part by the discrete force regimes (rather than continuous transitions, say from e-field to g-field) - we must have the notion of an *absolute* length scale that determines in what ways physics applies to a given object. This reference is absolute, and may be based on the system's finite boundaries, or may be an explicit discretization of space. One such constant is the speed of light, which seems to hold in all our experiments. A discrete space seems difficult to reconcile with the observed accuracy and usefulness of analytic solutions, but a continuous space in which such solutions are natural has serious difficulties describing interacting/changing/evolving systems because how to continuously change from one solution to another is not clear [7]. For a small enough discretization, the two ideas become indistinguishable, but even then there seems no

[6] then again, maybe there is no such thing as a pure 'infinite' space in the way that we imagine, maybe a 'real' infinite space has just the properties that we observe - see discussion in Ch2

[7] recall the notes on the "real number line/dust"

natural guideline as to how to discretize space - in cubes/pyramids/circles? Radiation (light) propagates in spheres, which is resistant to discretization. And we seem to be able to send/receive light to/from any angle equally well, based on some of our most accurate interferometric experiments (Michelson and others). Of course I cannot resolve this now [8], but at least I will claim an absolute length scale, and thus a finitely-bounded system to reference that to, and thus an absolute origin within this system. A non-uniform matter distribution will also require differences in dimensions, or an absolute orthogonal basis set, identifiable from the boundaries if not within the system.

With a space thus set up, we ask: how can motion be propagated from one instant to another? The physics of the space is defined by the length constant - speed of light - and thus all possible exchanges, evolution, or movements take place at precisely the speed of light. The basic physical process of propagation or exchange - how information gets from one point in space to a neighboring point (or, how a point learns about its neighbors - as required for a local theory (only dependent on neighbors - which are defined by the absolute length scale)) is defined in spacetime and takes place at the speed of light. A moving atom must be viewed as some number of light-like entities bound together for a net zero momentum (which leads to measured mass - note that while 1 photon is massless, 2 oppositely emitted photons are massive [see Reflections on Relativity] and can be interconverted into mass), which can either move in a bound state and evolve (perform computations/timekeeping) or move in a light-like state and not evolve (described as time dilation if we posit time as an actual dimension - which I do not, viewing it instead as a consequence of a self-overwriting process). Then, if we take an instantaneous "snapshot" of a system with moving parts - the only information that is preserved from one moment of time to the next - the moving parts look essentially different from stationary parts even though the snapshot is static. The difference can be visualized with a simple 2-photon particle:

```
 *    stationary particle
~~>   2-photon view
<~~
```

Now accelerate to speed of light towards the right, means the right-traveling photon is blue-shifted to $E = mc^2$ and the left-traveling photon

[8] my view has oscillated between discrete/continuous since high school - initially I was confident space must be discrete because it is impossible to continuously move on a real number line (Zeno's paradox), then I thought that since calculus works in real systems space could be continuous if time is also continuous, now I am leaning more towards the discrete side but with the reservations noted above

is red-shifted to zero:

```
 *
/\/\/>
<-----
```

Yet in the particle's inertial frame the two photons are still equal-energy (as in the first image) and the world appears to be moving towards it.

So a moving particle will have unequal photon energy distributions, making it more light-like in a given direction and less time-like in our rest frame. This smoothly turns the particle into a photon when it is accelerated to the speed of light [9].

```
~~>  ~~>
     <~~
```

External photon accelerates the particle by adding energy to the right-moving photon and subtracting energy from the left-moving photon. In particle reference frame of course both photons remain equal energy.

```
E+  ~~/\/\>  E-
    <~~/\/\
```

Field gradient accelerates the particle (blue shifted right edge and red shifted left edge - in particle reference frame of equal-wavelength this translates to a continuous acceleration to the right)

How does the particle know to accelerate, ie that it is in an energy gradient - how does it explore its surroundings and how far does it look? This is the proposed exchange process above, since particle 'motion' is explained in terms of fields. A potential mechanism for this process is a field 'relaxation' - the field takes on the average-like values of its (characteristic length scale) neighbors [10] at the characteristic time, leading to the constant speed of light. The electric field in its essence must be related to Coulomb repulsion/attraction more so than to light. Light is the propagation of information in the field, but this only occurs because the change in repulsion must be propagated "to the rest of the universe" after motion of a given electron, and this propagation can only take place at the speed of light, leading to Maxwell's laws. We can try attaching clocks to two charged particles, moving them apart, and attaching both to heavy masses so they cannot repel each other. Then at t=1 on particle 2s clock, the particle 2 is released while 1 continues to be attached to a heavy mass. Particle

[9] this is later shown to not be accurate, as a fast particle remains essentially different from a photon

[10] Huygens' principle and the wave equation

1 will not know about the reduced repulsion from particle 2 until a light propagation time (say 1s) at t=2. Saying that the two instances must be simultaneous leads to the "simultaneity plane" notion of special relativity, but here no time axis is required. Forces are not conserved in a global sense:

```
t 0 1 2 3 4
-------\___ F on particle 1
-----\_____ F on particle 2
```

Note here, being attached to a large mass (leading to lower spatial, light-like motion) has led to an increased time delay (more evolution, time-like motion) compared to when particle 1 vs particle 2 believes particle 2 was released, so in a sense particle 1's clock runs fast (but really it is an offset, not a rate change - so this does not contradict Einstein's gravitational time slow down near large masses). Finally, consider the exchange process [11] and the speed of light as a limit on the computational speed (or evolution) of the universe - this is an absolute scale so even to a 'god' the universe's future is not seen until it is actually attained. Namely, the fastest computation we can carry out must be in our rest frame - if we accelerate the computer we can only slow down its computation rate relative to our rest frame. It may be possible to compute faster by sending the problem to a computer in orbit whose clock is faster due to reduced gravity - but this is just saying that our rest frame isn't that inertial. It is possible either to do the computation fast, or to transmit it fast, but not both. This leads to the conclusion that computation is just a series of transmissions, or particularly directed information exchanges. Small computers will always outperform large computers although both are possible, and small-scale phenomena *must* evolve quickly while large scale can have a permanence. [12] This explains the otherwise mysterious relation between length and time scales seen in all fields of science.

Space is a key starting point for all physical theories I can think of. Ideally I could posit a theory that explains space, but this seems still far in the future [13]. At least I can say what we know about space: space is the mechanism which constrains the relationships between points - it makes it impossible to move away from one point while staying close to another; it limits the number of ways to go around a point; it limits the number of mutually equidistant points to 4 (implying 3 dimensions); it makes a spherical shell a fully-enclosing boundary; it makes it so that only

[11] it takes place locally at every (or every discrete) point in the universe

[12] Then, an *optimal* computer may be built such that it is fractal-like, with fast computations made by small chips combined by larger chips which handle more information at once, and larger chips which lead to outputs of motion or electricity. Such fractal systems can be found all around us, in lifeforms and computers and turbulence.

[13] see [From Zero to Infinity]

3 orthogonal thrusters on a rocket can operate without influencing each other; it makes it so that a point source of light leads to a spherically expanding wave (Huygen's principle). For now I take this much as a given. The theory of relativity states that $x^2 + y^2 + z^2 - c^2t^2 = 0$ for light. Now what is t? I say t is defined by light-like phenomena, or say the number of bounces of light in a box of length L:

```
|   ~~>   | Box of length L with mirrors at either end
|   <~~   |
```

In the above box, say n is the number of photon bounces, then time $t = n * L/c$ (c is the speed of light). Then, $x^2 + y^2 + z^2 - c^2(nL/c)^2 = 0 \rightarrow x^2 + y^2 + z^2 = (nL)^2$ or $R^2 = (nL)^2$ or $R = nL$ where R is the radius of a sphere wave emitted from the origin. This radius is equal to the total distance traveled by the light inside the box.

In other words, light always travels at c, whether it is unbounded (sent to probe a distance) or bounded inside a clock. Time is another human construct that is not fundamental. If I measure the time it takes a light pulse to reflect from a distant object, I am really comparing the distance to object and back vs distance back-and-forth within my "clock" and the two must be equal. Then, relativity really says: space is homogeneous and isotropic; information travels at the speed of light; the speed of light is a constant. Information here is that which does not evolve in time. A "photon" cannot change in transit since it travels at the speed of light. If a spaceship travels at nearly the speed of light from here to Mars it will barely change (its travel will be information-like) while our normal slow spaceships will change a lot during the journey (ie crew aging). To further show that time is a construct, note the effect of temperature on evolution. Cold objects will experience less time, due to slow interaction and evolution, compared to warm objects. A winter-hibernating organism, from its point of view, really time-travels to the future by slowing its clock for a while. Our scientific reference clocks are kept at constant temperature, why should we expect that there is an underlying absolute time? Since real clocks are not "light clocks" but use electrons and atoms, we must reason that electrons and atoms also behave like "bouncing light", moving back and forth at speed of light c. It would be more elegant to suppose a circular motion of a light-like entity at speed c back and forth, for an electron, giving rise to a natural notion of spin (and its associated 'quantum' properties). But if all matter is light-like, how can it move much slower than speed of light or remain stationary? This is due to non-coherent motion. Coherent motion preserves system information and moves it as a plane wave at speed of light. Non-coherent motion allows system interaction (evolution/computation) but impedes net motion of the system so it is less

than speed of light. Fast systems evolve more slowly (moving clocks tick slower). As analogy, consider a photon inside a mirror tunnel:

```
----------
 /\  /\  /\
/  \/  \/
----------
```

If the photon takes on near-90deg reflections in the above picture, its motion towards the right will get closer and closer to zero, even while it still moves at the speed of light up and down. So its effective velocity to the right can be set to anything from 0 to c by this mechanism. What about reflections in the direction of motion? It is not enough to have length contraction. It must be that contraction is dependent on light direction: length seen by the photon traveling to the right is longer than that traveling to the left, so a light bouncing back and forth actually travels to the right relative to stationary observer, at a speed $v < c$. This works under the assumption of an underlying photon field and moving walls; these walls then could be of the mechanism shown above, perpendicular to net motion and leading to a net circular motion of the photon-like entities.

```
| ~~> | stationary vs |  ~~>  | moving to the right
| <~~ |               | <~~ |
```

This still requires a definition of v though to determine amount of contraction - so this is not yet self-consistent. However I believe such direction-dependent space "warp" is possible and can explain gravity and inertia [14].

What is meant by "local fields" is: there is no "action at a distance" without something that will transport the action through that distance (meaning this transport must be measurable at each point along the distance), and at each step the transport must satisfy the same laws regardless of what (if anything) is actually being propagated - these laws are physical truths that define the space at all times. This is similar to how finite difference codes work - each point knows only about its nearest neighbors, not the rest of the system nor the boundary conditions. While *we* see the "whole picture", each point sees only its local vicinity and reacts accordingly [15]. The evolution of whatever we simulate in such a system is caused by local-acting fields, and takes place at finite speed. The laws apply equally to each point, so the evolution is a function of the boundary conditions. Physically this is the most coherent way to represent reality, since every

[14] I will later claim this to be due to lag between different interacting field types

[15] after all, what we see is really the insides of our retinas, we just perceive it to be the outside world because each point in space has faithfully propagated the photon information along into our eyes

experiment shows that an action will first affect the closer (in space) parameters and then the farther (in space) ones, and laws must apply at all scales so therefore the small-scale laws can only be a function of nearby (local) effects.

We can apply this to diffraction. One might ask, how can an observer "see" diffracted light? In the diagram below, the observer is not in a straight-line path to the light source. If the slit was made bigger, the observer would *not* see the light, but with the slit small enough the observer does see the light.

```
   . Light source
--- ---  Slit
  /
 /
*  Observer
```

The local field view says the observer "sees" only the local field, and the origin of that field's disturbance as "diffracted light" is all human interpretation nonsense, like energy and numbers. The local field oscillated because its neighbor oscillated, in turn because its neighbor oscillated, and so on back to the source we interpret as a light bulb. This is why Huygens' principle applies to light - at each point, information about the earlier 'source' is lost, only neighbor information remains (and only fleetingly). This explains why we see light from a slit but not from a corner: not because "light that makes it through the slit diffracts" but because "light that is blocked by the slit causes loss of information about wave directionality".

How can we describe our perception of time, and how might it affect the theories and interpretations we provide? One might argue with some degree of certainty that our time perception has evolved to help us succeed in our survival tasks - chasing prey, reacting to weather changes, even capability to plan ahead for the near and far future. Probably the most direct physical basis for our time perception is chasing/evading other animals, as our brain speed is just fast enough for running on a difficult terrain and it seems even robots with faster "brains" would not run faster due to physical/force/stability constraints (as well as the nature of the terrain we evolved for, ie cars of course can be faster). At the same time, our brains clearly operate on multiple time scales, in a physical sense. We can sense kHz with our ears, perceive 100 Hz with our eyes, and the brain's in-cell processing probably runs in the MHz-GHz range. Meanwhile our overall experience is best described in terms of seconds or Hz, about the time over which large animals move. In modern worldview, we have made the assumption that time is something universally present, going off our perception of time, thus using the 'second' as a unit, and defining regular physical

phenomena in terms of that. I would argue that such an extension is not necessarily accurate. Instead it is possible that different objects experience time on different scales. Our only way to interpret time is from how we experience it - it seems mostly constant, and is always present. This is because our brain has an "internal clock" which we reference, and such a time-based view of reality is the only one we experience. Obviously clocks are seen to keep time. My suggestion is that time "exists" or "is carried forward" only in energy-dissipating systems like clocks, or our brains. Then time is a consequence of energy exchange, and objects that do not exchange energy/interact persist "indefinitely" yet do not feel time passing. For instance quantum theory suggests photons interact with individual atoms. I argue that then photons must provide their own "time basis" or "clock", for if they did not they would always be coherent, like sound waves or ripples in a pond - it is not possible to have a "blackbody" sound source since what it emits is always coherent! Then interacting atoms (like atoms undergoing a collision) will form a mutual "clock" to provide a timescale to exchange information. One thing left unanswered is how far-away objects interact (for instance Coulomb repulsion takes place over long time+distance) - then again we define "far" as "long time to travel" so when clocks change the concept might be less useful. My second suggestion might reconcile the idea of time as a continuum (Zeno's paradox). I claim that with different time scales of interaction different physical laws apply, in a way similar to a series summation that is convergent. Thus when claiming there is an "infinite amount" of time in between any two moments (which defines the continuum) we are tempted to say "impossible - then anything could happen within that time!". But the changing nature of the physical laws with time scale ensures that what can happen in a "short" time is consistently less than what happens in a "long" time, even though both intervals are in a sense "infinite".

Time is something kept by clocks. It is curious that we are able to make devices that accumulate the number of repeats of a cyclic phenomenon, though in principle this is similar to the idea of memory, and causality/state is conserved until acted upon (exchanged info with). However, time is arbitrarily defined by humans as a certain number of ticks of a specific clock - maintained at just the right conditions. If we freeze or heat up a common clock (for instance), it will cease to keep time per our standard definition. In other words, in order to keep time the clock mechanism must be specially designed and placed in an appropriate environment. Do systems that are not "clocks" experience time? My view is no - under information theory I view time as the rate [16] at which information is exchanged between

[16] rate is of course a circular reference. I mean relative rate to some other things, which is how we define time at present

particles. Thus cold systems which barely change are argued to have in fact a "slower" clock than hot systems that rapidly exchange information. For instance metals that are hot give off light and can be deformed under load. Then metals at room temperature should give off correspondingly less light and take a correspondingly longer time to deform under the same load (creep), because their clock has been slowed down. At high temperatures objects will decompose - a much faster version of similar decomposition at room temperature, because of a faster local clock. We may consider light bulbs as an example - if the energy put in to heat up a filament to incandescence temperatures were instead used to accelerate (and keep accelerating) the filament, would it give off similar radiation? Mathematically, time is the object that moves the world from one information state to another, in a continuous manner. As reasoned earlier, all numbers are discrete - time is a transformation that can step from one number to the next one continuously, something that we have not comprehended in the standard framework. Physically our present theories only make sense because we can simulate the effect of time by employing time itself, since we live in a time-present world. The theories themselves, and anything they purport to do, are only "snapshots" of what they represent. They rely on the ability of beings like us in a world where time operates to dynamically implement their action using a real physical system set up in a specific way, like our brain or a computer. That is the only way a theory can give an answer or be of use - through interaction with a real (dynamic) physical system that is inherently time-based. I might consider the notion of time as computing power, an essential ingredient of our universe – just writing some equations won't magically create a world, the best we can do is simulate the equations but this is using our real time and would be impossible in a non-time-evolving universe! If a theory could be written directly in terms of its dynamic variables, the answers would be self-evident as the theory itself evolves into the desired structure. This is what is done with traditional experiments.

Why should time run in a given direction, and why are there two directions (forward and backward)? Regardless of how time "runs", a self-consistent theory must ensure the matching of system parameters throughout time (every cause must have a consequence, every consequence must have a cause - the two are mutual/symmetric/inseparable). Extending a view beyond photons, how does an atom "know" of another atom in its vicinity - in order to carry out gravitational attraction/photon exchange/Coulomb interactions? The information content of just atom locations is vast, but including in that all the "connections" between atoms makes it unimaginably larger (consider that we can see stars). One possibility to form this is that matter continuously emanates "feeler" waves that somehow inform the original particle of the location of other particles (a

more basic view is that matter *is* these waves, since we never "actually observe" matter). This poses similar difficulties as photon waves - how does it decide where/when to collapse? How can it store so much information and later discard it? How often/how strongly does matter emit waves and why (what is the driving force)? [17]

Time is based on light-like interactions so relative to my rest frame, if something travels fast it cannot evolve fast - evolution becomes external (moving forward in space) instead of internal (calculations/interactions within the system). [18] A decaying particle in lab frame decays in (say) 1s, while same particle accelerated relative to lab decays in 10s, both in lab time (this phenomenon is experimentally verified in muon decay). But the accelerated particle, in addition to decaying (internal restructuring) travels for 10s (external restructuring). Consider an oscillator (t=lab time, x=lab distance)

```
t -------> -------->    t -------> -------->    t -------> -------->
E 1 2 3 2 1 2 3 2 1     E 1 1 1 1 1 1 1 1 1     E 1 1 2 2 3 3 2 2 1
x 0 0 0 0 0 0 0 0 0     x 0 2 4 6 8 . . . .     x 0 1 2 3 4 5 6 7 8
   at rest                 at speed of light       at fast speed < c
```

So the traveling oscillator slows down its oscillation in E relative to the lab clock. Now compare its clock (number of oscillations of E) with lab:

1. By sending light pulses origin-to-origin
2. By having a detector at every x of lab space that records lab time on receipt of nearby pulse
3. By sending a "calculation command" to a "traveling computer" which does the calculation and sends back the result. The calculation takes a constant time t in lab frame computer

Throwing a stopwatch: imagine a stopwatch counting up being thrown at fast speed in lab frame at lab time 0, then every lab second, the stopwatch displayed time is recorded by a *nearby* lab sensor, and location of sensor

[17] this is taken as another argument for the field view. There are no collapsing wavefunctions but rather consistent information storage in the field. The creation of static $1/r^2$ potentials in the field satisfies the role of the "feeler" waves, and is discussed in future chapters.

[18] this already suggests a constant computation rate rule - information either contributes to a calculation within the system or is transmitted outside the system but it cannot do both at once

is also recorded:

```
t_lab 0 1 2   t_lab 0 1 2   t_lab 0 1 2
x_lab 0 0 0   x_lab 0 1 2   x_lab 0 0.5 1
t_sw  0 1 2   t_sw  0 0 0   t_sw  0 0.5 1
 at rest       at c          at fast v<c
```

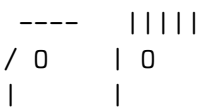
Thus the speed of light sets the "arrow of time" and the speed of time - consider evolution of a "big" system (galaxy) where the $v = c$ stopwatch acts as a clock in its own right. Systems can't travel faster than speed of light or evolve faster than speed of time (also speed of light, as applied to space). Fast travel takes kinetic energy and fast evolution takes potential (thermal, internal) energy - the potential aspect is consistent with gravitational time dilation (far from heavy mass = high potential energy). Cold objects, gravitationally trapped objects, and fast objects all cannot evolve. Stationary objects obviously cannot travel. So there is a minimum (0) and maximum (c) for both travel and evolution (and the *combination* of the two is constant [19]).

Why does a car need a differential? Because one wheel travels a longer path than the other - sure. In fact the car's motion around a turn can be decomposed into a linear motion and a revolution. Going 360deg around a turn of any radius eventually requires the car to complete 1 revolution. The path length difference there is in the radius of the tires - R - and difference in circumference $2\pi R - (2\pi(R + delta))$ is independent of actual radius R. I can try to turn a toy car - with a single axle no differential - in place, and feel the tires dragging on the ground as they are linked. The amount of drag is per revolution - per degree turned - so already we have the nature of the circle defined as changing by a constant amount in circumference (2π) with a change in radius - as explanative of the use of the differential. Are there other topological problems where turning/revolution is of interest? While hiking a loop trail I realized that to return to where I started I had to undertake a (2π) revolution (if I never go backward or cross over my path). With any such path, if I approach it from the inside and go left, I will be going counter-clockwise along any outer side, and vice versa if I go right; or left from the outside. Any such path will fully enclose a 2D region. In reality I can go backwards or over my own path, but I believe this will cause a revolution in spacetime of 2π similar to the 2D case. The direction of momentum will have to rotate by 2π to return to the same point in space;

[19] that is to say, the universal computer speed is a constant. To carry out computations that are useful to us, ourselves being within the universal computer, we must dissipate energy. Without energy dissipation the combination of travel and evolution can be seemingly brought to zero, but this is because the constant time evolution that takes place cannot be used by us without dissipation (it materializes as an object *not* changing).

or perhaps alternatively a full 2π rotation will return to same spacetime, which is impossible, so return only to same space is achieved.

Consider next the turning of a rocket as it flies near a planet:



In case 1, the rocket revolves by a certain angle such that its nose always points in its direction of travel. In case 2, the rocket always faces upwards despite its direction of travel changing. The rocket is assumed to not fire thrusters or use reaction wheels, traveling in a straight line far away from the gravitational body, and moving solely in freefall. Is case 1 or case 2 physically correct? General relativity predicts the bending of light as gravity is an actual warping of space, so there is at least some trend towards case 1. Newtonian gravity might or might not predict such a rotation - any torque must be due to non-equal gravitational attraction of multiple points on the rocket at different levels of gravitational potential. This could be modeled as 2 points rigidly fixed to each other and solved fairly straightforwardly, giving minimal revolution and favoring case 2. Actual measured effects may have interesting implications on space and validity of Newton's gravitation [case 2 is suggested; see gravity-gradient stabilization].

We sometimes talk about infinite objects - infinite lines, planes, even space. But we have no reason to assume such infinities exist - as all we observe is in some way finite and bounded. When looking at the stars it seems a miraculous observation of an infinite space [20], yet what we really "see" is the interactions right on the cornea (already within the eye) - the world is a lot more claustrophobic than typically experienced (a consequence of local interaction requirement). In looking out over a large valley or expanse of land, we interpret the scene as seeing distant objects through a transparent, airy void of space. Whereas really we are getting local signals from the eyeball of e-field oscillations in the eyeball's vicinity, which we then interpret as relating to distant objects (and typically even as the very essence of these objects - what I see is what *is*). And what we interpret as the empty/void/vacuum space really is a substantial element (making up vast majority of the galaxy) in which countless fields and particles interact and evolve. Space is the medium in which evolution takes place - in the absence of g-fields and other influences clocks tick fastest (per general relativity). Evolution takes place sequentially and locally, which ensures constant conservation law applicability. This is the issue with "sci-fi" topics like teleportation: getting an object from point A to point B requires that

[20] see Olbers' paradox: if the universe is infinite why isn't every point of the sky covered in starlight?

all appropriate quantities must be conserved, so how do we deal with (say) the air molecules that are currently in the volume about to be occupied by the object (or other subatomic particles), and how do we deal with fields and potential energy at A vs B, and how do we deal with relative motion, and how do we specify just which atom of the object goes to exactly which location at B? All of this must be answered to move the object and the only way we know how is to let physics do this naturally - the interactions between all atoms of the object constantly localize that object in space, so pulling/pushing the object has the desired consequences and doesn't just tear it apart; energy is conserved in these continuous motions and all outside particles (air molecules) are appropriately handled. This is why the only method we have for getting from point A to B involves continuous motion from A to B along all intermediate points - no teleportation - as such movement ensures conservation of information and all other applicable laws (energy) as required by space evolution [21].

Time evolution itself is an interesting point - typically physics theories introduce a time axis and go from there, as if time can be treated similarly to spatial axes. I think we have no evidence for such an approach - in fact evidence against it - as there are no signs of time travel being a possibility, and no coherent theory that can act in an entropy-reducing world. Having time as an axis of course allows looking both forward and back in time - enabling use of theory not just for description but for prediction/explanation and ultimately control and application to human needs. But a time axis means the world is a 4D object - like a sculpture - of which we see subsequent 3D slices, like a 2D world "evolving" by tracing planes through a 3D structure. This object is static and fully defined, so there is no need nor grounding point/reference for a concept of "now", or for a notion of time evolution. We have no reason/justification to exist or experience time, because this time-axis world is already complete. Seeing as we are physical beings, our experiences and raw feelings must be a feature of physics as much as gravity and forces - the notions of pain/pleasure/color and other experiences must have a physical basis, as must the notion of "now" and living "in the moment". So I think the world has no time axis but instead evolves on a local basis, so time travel is not possible, and so "even god" doesn't know what the world will eventually look like - the only way to find out is to wait for the evolution to take place. Furthermore, this evolution takes place at a finite rate [22] - the "speed of time" - for we experience

[21] a solid object contains a tremendous amount of information and moving it means letting the field handle all the necessary information transfers to get it from one point to the next; in this light teleportation just does not seem feasible - if we could achieve it, it would be indistinguishable from actually moving the object in some way, in this sense an elevator is a 'vertical teleportation' device - and it really does work!

[22] but a rate with regard to what? the rate of time progression is an essential physical

each moment in progression and as taking measurable time, and not all at once/in a flash. As mentioned earlier, the speed of time is in fact what sets the constant speed of light/gravity/information, as it is the fastest allowed evolution for a given spatial (local) interval. All these limits can be seen as a limit on the maximum computational power of a computer we can build - the larger it is, the longer light will take to communicate information [23], and the smaller it is the fewer information-exchange interactions can take place within it in a given time. In a practical sense we are already reaching this limit with modern CPU chips (though the theoretical limit, by applying the most basic field evolution to our goals, is astronomical; the field evolution still takes place whether or not we call it a computer or it is useful to us). Atoms themselves (and their constituents) - as basic physical particles - must operate *at* this limit, the "universal computer", but carrying out computations not useful to us (ie "random"). This sets the speed of evolution of atomic systems, and thus the speed of (atomic) clocks that we use, thus the rate we use to measure time, thus the speed of time.

From the view of Einstein's relativity, there is no absolute universal time, or in other words there is no clock I can point to and say "that's the *correct* time", the best I can do in this sense is point to a clock that is in my reference frame (next to me/moving with me - this defines the 'speed of time'). What of the "universal computer"? If I make a computer simulation of a slice of the universe, I impose my own absolute clock: the simulation clock, the rate at which the simulation changes from one state to another. But the structure of the simulation following relativity is such that its behavior (from its own view) is independent of the simulation clock; this is the elegance in the relativistic equations. I could simulate a moving space in which the clocks inside the simulation run slow with respect to the simulation clock, or I could simulate another space in which the clocks inside the simulation run at the same speed as the simulation clock. When I simulate a clock mechanism and track physical events inside the simulation by the time read on this clock also inside the simulation, I get consistent results no matter at what rate I run the external "absolute" simulation clock. From the view of the simulation, there is no "absolute" simulation clock because it makes no difference to any within-simulation measurements. This means that time must relate to space, because if the two were separate then one could be used to track changes in the other and establish the presence of an "absolute" standard. Because we only track time by spatial motion and

constant, like space, which cannot be defined beyond "it just is"

[23] instant information exchange leads to infinite computational power - since exchange must be instant even inside the transistor/gates thus there can be no rate-limiting step. Infinite computing is also possible if a time loop can be made (transfer of data to an earlier time/time travel).

vice versa, the relation between the two remains consistent regardless of how the "universe computer" might work.

Consider a physical action - the spreading of energy - as an optimization problem/computation. If it is possible to send information back in time, then the spreading can find optima in a much more immediate way than if time only goes forward. In other words, the computation has extra information available to it on which choices to make before making those choices. I think we never observe such super-temporal optimization in nature so the arrow of time is real. Not to mention that sending information back in time can lead to infinite computing power as pointed out above. Consider finding a way through a maze:



One path leads out, the other doesn't. Not knowing beforehand, I would have to try one, then return back (carrying that information with me to the starting point - same requirement if I use a light pulse/robot to check the path for me) and try the other. But with a chance to send info back in time, I can send a message to not go into the first path as it doesn't lead anywhere. Beyond the paradox that once I don't go into that path I couldn't have sent the message in the first place, this means I can navigate any maze in an apparently optimal way, without ever "trying" any non-optimal routes as whenever I find myself on a non-optimal one I send back a message to not go there. This seems physically impossible and not observed in nature. Yet there is no singular moment of time to call now: the experience of time is dependent on the conscious system experiencing it (ie for us it is in Hz, for an atomic clock much faster). Why do I feel time moving forward? All my conscious experiences could be linked to each other by interactions with delayed/memory storage - a temporal vs physical interaction, making my experience able to feel as if I am evolving over time. Logic says I shouldn't be able to tell whether such experiences are "really" all taking place in parallel or even in arbitrary order (since any time I might find myself, I will only have memories of my immediate past as happening just recently), but I have a vivid strong experience of one moment leading to another, so at least for now it is tempting to think of time as the evolution of the 3D spatial world.

Based on above, I might propose some definitions:

- Information: *spatially* bounded, *temporally* conserved → requires space and time

- Space: a construct such that a spherical shell around a volume fully constrains the exchange of information between inside+outside
- Time: the state of information always exchanges with other spatially nearby information, the closer in space the closer in time
- Computational limit/speed of time: information always changes at a constant rate, the speed of time. This change may be distributed between motion in space or evolution in time, seen at either extreme as the stationary clock rate of a light-speed-traveling clock and the speed-of-time clock rate of a stationary clock. This can be viewed as a limit on the computing abilities of a system; reaching this limit means one is using the full power of the "universal computer" towards some useful purpose.
- Encapsulation: as far as an outside observer is concerned, its interaction with a system is fully defined by what happens at the encapsulating 2D boundary/sheet/cage, the 3D volume inside is felt only indirectly [24] - this is explained as any information which does not exit the encapsulating boundary keeps contributing to computation/evolution taking place within the boundary

[24] some semblance is here to the Holographic Principle

4

Fields and Particles

main message: fields play a useful role information-wise by minimizing total information transmitted. They also explain 'mysteries' like macroscopic antennas sending microscopic waves. A field view of matter is proposed. It is emphasized that gravitational acceleration cannot be 'felt'

–

By conservation of information, we reason that when a photon is emitted/received, since the photon is a new particle (ie it is created/destroyed in the process) all information that the photon contains must be equally exchanged with the receiver and the sender. Based on current knowledge we expect that when a photon is emitted the sender will experience a loss of energy dE and a recoil momentum dP. Therefore this information must define a photon (it seems hard to accept this is a full definition though, since there is nothing which states that it is indeed a photon). When a photon is received, the receiver observes a gain in energy dE and a recoil dP. When a photon is reflected (solar sail) the 2dP but not dE are observed.

```
t=0   O  .   particle at left is about to emit photon
t=1  <.  .   momentum not conserved if photon ignored
t=2  <.  O>  particle at right gains dP and dE
```

In the following argument we make strong use of the time dependence of the emission/absorption and associated momentum change, namely that both happen simultaneously. One view might be that the photons are stationary in time, which has the advantages of conserved momentum and speed of light limit. However this is not supported by experiment. Consider

the following:

```
t Sender Receiver
0  ~~>Send photon 1
0.5 ~~>
1  ~~>  <~~ Send photon 2
1.5 <~~ ~~>
2  ()   <~~ Receive photon 1 reflection
2.5 <~~
3  () Receive photon 2 reflection
```

The receiver reflects photons almost immediately (local dt=0) but the sender measures a dt=2 delay. One might argue that the sender's clock is slower but we see that both sender and receiver measure dt=1 between the two photons, which is self-contradictory. Therefore we must conclude that photons indeed *travel through time* (like particles) and can store energy/momentum over time. However this is also problematic; consider the 2-slit experiment:

```
Emitter   Slits Screen
|  /|
=  \|
>  ~~>| --|
=  /|
|  \|
```

Tracking the time progression, at t=0 the emitter emits a photon (detectable locally at the emitter by the associated loss of energy).

```
t=-1 t=0
>>~~>
```

Based on the recoil momentum of the emitter, we know which way the photon went. This has to work to match classical observations. Thus we can tell which slit it is going towards

```
Emitter   Slits Screen
|:  /|
~~>=  \|
>  ~~>| ~~>--|
: =  /|
|  \|
 [dP 0<t<1] [dP 1<t<2] [dE dP t=2]
```

At t=1, the photon reaches the slit. It must transfer some momentum in order to be reflected towards the center of the screen. This dP can also be measured locally.

At t=2 the photon reaches the screen, observed there by dE and dP.

This raises a few questions. When the photon is emitted (t=0) does it already "know" where it will be absorbed? Is the interference pattern a snapshot - if the slits are removed during 0<t<1, will the interference pattern still form? Experiments strongly suggest no - clouds illuminated by the sun don't lag observations by the solar light travel time (8 mins). Therefore the light "decides" whether to form an interference pattern at t=1. By a similar argument, the light "decides" to interact with the receiver at t=2. However, the interference pattern depends on the distance D between the slits and the receiver.

```
Emitter   Slits Screen
|  /|  /|
=  -|  \|
>  ~~>|  :| --|
=  -|  /|
|  \|  \|
<- D -> -->
```

Thus the angle at which the photon may be emitted is also dependent on D. The angle is apparent in the dP measured by the slit. However the dP is measured at t=1 while the photon doesn't "decide" until t=2, and these measurements end up consistent with each other. This forces us to accept that photons not only travel in time but can provide information about the future, that is at t=1 we already have some data on what D might be, although the photon does not reach it until t=2. This is not as uncouth as it first sounds, for it is similarly cavalier to claim that the photon emission can occur at all without a guarantee of its absorption. At this point we need to find a reasonable explanation for how this might work. [1]

Another challenge with the interference pattern is how it is formed. The photon is seen to change momentum between the receiver and the emitter (even by classical means) - this is most reasonably transferred to the slits - and based on the momentum with which it was emitted (based on emitter recoil) we can tell which slit it must have interacted with. Yet the interference forces us to accept there may have been a wave-like pattern. This wave is troubling:

- First, it stores a tremendous amount of information (on which atoms it is allowed to interact with/collapse on, as well as which atoms (slits) it has interacted with), which increases rapidly over time then gets lost in the collapse.

[1] jumping ahead, all these unphysical things are easily resolved by a field model. I keep these arguments to show how a contemporary quantum wavefunction and wave-particle duality don't fit in with information and symmetry principles

- Second, it does not adequately account for 2nd/3rd/.. reflections while preserving probability (on which of the atoms, and at which time, does collapse occur?) - how does it know at which time to collapse such that all possible future paths are not explored?
- Third, when it collapses, it does so instantly across the whole wavefront.
- Fourth, the wave must travel forward in time to avoid "solar shadow lag" (this might be possible to do as a pilot wave that does not need to travel back in time).

We leave these issues for now, to take another look at photon interactions over time. Based on the above, all that we observe externally are not photons themselves but only dE and dP (ie changes in variables, or an unbalance in an underlying symmetry).

```
[figure repeated from above]
t=0   O  .   particle at left is about to emit photon
t=1  <.  .   momentum not conserved if photon ignored
t=2  <.  O>  particle at right gains dP and dE
```

To the left atom, the emission of a photon is equivalent to the absorption of a negative energy photon. To the right atom, the absorption of a [+] photon is equivalent to the emission of a [-] photon. Could it be that [+] photons travel forward in time while [-] photons travel backward in time? In this view, the emission of [+] photons can be viewed as a stimulated emission process (like in a laser) caused by [-] photons, thus ensuring even at t=0 that the photon is emitted in the "right" direction. The photons travel along time-space curves thus changes in experimental setup during photon transfer are accounted for. The issue of the nature of interference pattern is not explained though.

This consideration suggests the view that particles may constantly emit [+] and [-] photons and exchange with others. In this case what we see as light is only an imbalance in the "photon field" leading to energy transfer. This is like air pressure vs wind. We might get an idea of the "photon pressure" by making a photon void (actually seen in the Casimir effect) or also by quantifying how bright a blackbody radiator is in empty space.[2] Suppose [-] photons do arrive from the future. Then self-consistent calculations can be carried out using both [+] and [-] photons - ie *active* emitters and receivers. This is basically what transistor chips perform - they use power to emit photons (signals) but also have actively biased detectors to receive

[2]Will the blackbody brightness be the same for all materials? Will the spectrum be the same at the same temperatures?

photons (emit [-] photons/signals) which allows the carrying out of computations as opposed to remaining in static equilibrium.

It is often tempting in physics and in the real world, to ask questions of the sort: which slit did the photon go through, which photon reached the detector, which atom emitted the photon; and in the more practical real world, which spoon did I get at the restaurant, which piece of sidewalk did I step on, which droplet fell on me in the rain. The question really leads to the more complicated "why": why did that occurrence happen over others? -since a "which" question cannot be answered without considering also why the other combinations did *not* come to pass. I argue that this question is ultimately asking for very detailed information about the world as a whole. Consider the process leading to the selection of a particular object as a hash function. This hash function is as complex as the real-world description of the process, and has tremendous information content that modifies an input (some initial conditions of the objects to be chosen) to an output (choice of an object). For most processes, the possibility of probing the hash function information through its outputs is impossible - there is not enough information output to answer "which one" questions without thoroughly analyzing all real world components. However for experiments that are smaller-scale and use ensembles and symmetry, this hash function may be obtained to some degree (where the use of symmetry obscures underlying features however). We note that the information that determines which object is observed is most easily interpreted as existing in the world and not associated with the object. This may provide a solution to the "information extravagance" of an expanding photon or particle wave. This also suggests how a group of objects, like atom(s), can exhibit interference: it is not a property of the atom but of the world.[3]

How can particles interact gravitationally? How does one particle know the location of others, which it is to attract? If we adopt the axiom of infinitely precise actions, then any 1 particle must be affected by all other particles in the universe. Experimentally we find that the effect is not very complex - the overall effect of gravity on 1 particle can be represented simply by a vector (as opposed to info about all surrounding particles) - the gravitational effect is additive and, for individual particles, acts like a hash function - blurring detailed information about the surrounding universe and yet dependent on it. To handle this scenario, we find it useful to define a "field" which is defined as such a vector at each point in space. This field is still dependent on all particles in the universe and it is not obvious whether a physical relevance exists (it does not "simplify the processing load of the universal computer" [4]). Yet we can gain some insights from working with

[3] this is the field view - information is stored in the field

[4] in retrospect, I am not sure about this

the idea of a gravitational field. A steady state field might look like this \/ $(1/r^2)$ around one particle. Contributions from all particles are summed to get a universe field. What happens if a particle "disappears"? Three possibilities:

- Infinitely fast change `\/ -> --`
- Finite speed change `\/ + /\ -> \-/` then `\---/` till all flat (sharp boundary between central flat and gradient)
- Finite "graviton diffusion" like wavefunction `\/ + /\ -> \/\/` then `\-/--\-/` (smooth boundary between central flat and gradient)

If we are to believe general relativity, and the experimental findings of LIGO, then gravity does not travel infinitely fast, so probability 1 is ruled out. Probability 2 seems a bit clumsy, with a sharp discontinuity perpetuated and no consistent mathematical formulation (how does the wavefunction know to return to 0 after the wavefront? Since it is already 0 behind the wavefront there is no info available on how to handle the wavefront, ie how much to subtract). Probability 3 is one I like because it is similar to ideas of particle wavefunction spreading in QM - in this case the new positive wavefunction exists in all space immediately/infinitely but its spread occurs at finite speed - which causes the observed finite speed of gravity [5]. Further, it suggests that the loss of a particle/mass will create a momentary "repulsive field" - our experience with explosives and $E = mc^2$ confirms this. This view suggests that the synchrony and localization of explosion will create a better repulsive field, and this is generally seen with nuclear weapons (high precision timed explosives help for radiological reasons as well, but under this theory yield will increase also due to the gravitational wave effect). Moving particles will emit a wave of the form `--/|/--` to show their absence on left and presence on right (particle moves to the right). By taking the gradient at 0 as a velocity (or force?) we might recover concepts of inertia (and radial acceleration follows) as well as gravity.

Some wave-particle duality experiments, such as the 2-slit experiment, seem to require contradictory notions of wave and particle. Yet we might explain this with another view - electrons (say) are discrete particles, while photons are simply field oscillations; electrons, under appropriate circumstances, emit field oscillations, and under other appropriate circumstances absorb field oscillations (in fact these circumstances might be similar as

[5] this also suggests that a vanishing particle will create oscillations in the g-field at a frequency that is characteristic of the field itself rather than the particle; this would be an interesting though difficult experiment

suggested by stimulated emission/laser). We can then reduce the field oscillation amplitude at its source through some mechanism until the appropriate circumstances for absorption are rare enough that we claim to see single photons. Yet the field emissions occur throughout - if they lead to no observed absorption, or even more than one absorption (for a single emission/excitation) we have no way to verify this (energy is conserved overall so any macroscopically averaged measurements will not reveal the effect). This is elegant because it carries over into the radio/low frequency domain easily, and can be understood with Maxwell's laws, and does not require "collapse". Yet it is problematic to apply this view to entangled-photon experiments, where it is found that two independent photons ("field oscillations") have related properties *in terms of* absorption - since we claimed absorption would take place only under appropriate circumstances, we have to now claim that such circumstances also become entangled in the case of entangled photons, which seems unrealistic. However we have ignored an effect - if we adopt this view, the original photon that creates the entangled pair never goes away - its field keeps on expanding and can serve as a reference to "synchronize" absorption of the entangled pair so as to cause the observed relationships.

There are some results that may seem surprising on an intuitive level, which are well explained by the field model. The case of diffraction through a slit was already explained above. A similar case is with a diffraction grating:

```
d | *  Detector and light source

______ Mirror
```

Above, detector does not see light from the light source. But now remove sections of the mirror to make a diffraction grating, and the detector sees light:

```
d | *  Detector and light source

-_-_-_ Mirror as diffraction grating
```

By *removing* metal on the mirror, we have *increased* the light on the detector, thus more with less. Again, this is explained as the removed metal causes loss of wave directionality information in the field, so the wave is free to keep spreading backwards toward the detector, whereas with a full mirror part of the reflected wave would have caused destructive interference in that direction.

My view on quantum is that perceived particle-like nature is not intrinsic to photons but to electrons of the measuring apparatus, while fields

describe the photon's passage. Then a "random" process in the detector makes a number of electrons respond to an applied field. But this seems to be disproved by the "delayed quantum eraser" experiment. However if this view is correct, we might see that existing electrons that have a high propensity for absorbing/emitting photons (by this "random" process) will be likely to do so even in otherwise weak fields, but overall energy is conserved because the excess arrives from the detector itself.

```
High field/many photons
/\/\/\>> ___---- E increase after field applied takes
                  minimal "boost" from random process
Low field/few photons
~~>      ___---- E increase by electron can only take
                  place with a large "boost" from random
                  process, so is a rare occurrence
                  (note E of electron is quantized)
```

We go further then and claim that electrons/particles can be represented by higher-dimensional fields where it is allowed to have "warped" or self-sustaining, localized waves as stable entities, and when such waves are destabilized (as in electron emission) they become large entities, made smaller by adding energy, and otherwise causing "electrons" to appear at a detector where an appropriate "random" process can take place. This suggests that with the right detector, non-conservation of particles can be demonstrated (this would require an energy input equivalent to the particle though). [6]

Here I further explore what a world defined by fields might looks like, and how this can be reconciled with existing notions of particles and quantization. The most consistent evidence we have shows that light is a continuous field (e+m field) described by Maxwell's equations. I will then claim that light really is a field, and try to explain why we can see "single photons". The key is in the interaction of the light field with matter - and this is the only way we know of to tell whether light is "really there" - whether a fancy PMT, a camera, or our eyes, light has to interact with matter before we record an experimental result. For me the most telling sign of the field nature of light is that antennas - large physical structures - can radiate as well (or better) than "individual electrons" of atoms, so there is not something "mysterious" about light that requires a quantized transmitter. One oddity though is the emission of light by atoms themselves - atoms are measured as ~1e-9 m in size, while typical visible wavelengths are ~1e-6 m which is way bigger. How could this possibly be explained with photons? Like a grain of sand creating a 'balloon' out of nothing, it is just odd. In

[6] later I retract this viewpoint, since emitted electrons are essentially different from emitted photons; electrons always remain particles and do not get converted to waves.

a field view, though, the radiation is very inefficient but can be simulated and realistically carried out, the same way that a tiny speaker can produce sound waves of wavelength a few orders of magnitude past its size. In the speaker, the efficiency of radiation decreases at longer wavelength, meaning if the speaker oscillates at low frequency it will draw very little energy and very little sound will be heard, despite a large speaker amplitude. At high frequencies, though, sound radiation is effective, so keeping the same amplitude will now take more energy, and a louder sound will be heard. So, if the speaker is given random impetus by some driving mechanism (thermal), it will tend to oscillate silently at low frequencies while quickly emitting the high frequencies. And while the 'sound' of the speaker is high-frequency, its actual vibration motion will be low-frequency dominated.

That is to say, the higher-energy terms have a shorter half-life as speaker oscillations as they quickly turn into air oscillations. This exactly parallels the ever-present observation that more energetic things happen more quickly. In fact I propose that "energy" just like "numbers" is not an elementary universe concept, but an emergent quantity of various field interactions. The universe doesn't care about energy, only we do. The universe conserves something more fundamental - the field values. This resolves one conceptual paradox in relativity: if I move towards some object, I can view myself as having some kinetic energy, or I can view the rest of the world as having some kinetic energy - the latter is certainly untenable because the energy would be immense but relativity cannot tell any difference between the two (and it doesn't have enough of a memory to remember that I accelerated). The field model states there is no "energy", only an energy difference - and this is exactly the same whether I am stationary in a moving world or vice versa. There is no "0 at infinity" boundary, there is just no energy - it so happens that the things we call "high energy" are such that they are smaller and move faster because of how field equations work, and what we call "low energy" is the opposite way. Nature does not "seek low energy states", but rather the "high energy" states also happen to be ones that rapidly radiate and will not be typically observed as stable. A classical display of prowess in energy balance is finding the blackbody radiation spectrum - usually inside a large metal container so that vacuum e+m modes can be evaluated and then quantized. I see two conceptual trapdoors here:

1. It isn't the vacuum that radiates (vacuum transmits waves but doesn't create then out of nothing), it is the atoms of the blackbody. This is seen when a solid spherical blackbody (sun?) is used instead of the hollow box and seems to most easily reconcile with all our e+m field experience and explanations. The atoms individually should emit the blackbody spectrum, and QM makes no comment on this mechanism,

leading instead to very abstract 'vacuum fluctuations' and 'zero point energy' which really isn't even an energy. In any case I say that atoms are the sources of the e+m radiation of the blackbody in my theory.

2. The use of Temperature, a statistical parameter that only applies to huge collections of particles in thermodynamic equilibrium. This will almost never be the case in situations we wish to describe - radiated light from a blackbody (into a colder space - by definition), two interacting particles, or motion of an individual particle. For this we might get away with a full distribution, but real conclusions can only be drawn from all individual velocities and properties - an immense data set which cannot be compacted to 1 parameter if we wish to examine the heart of these difficult mechanisms.

For example, microwaves can be used to warm food even though the microwave-emitting blackbody is very cold (cosmic microwave background at 3K). This is because what the microwave oven emits is not blackbody radiation - it is a specific distribution that is much higher than what the food emits at that wavelength, so the blackbody temperature of the food is pushed towards higher frequencies by low frequency radiation (microwaves can be used to heat an object to glowing hot - a shift of a few orders of magnitude between input and output radiation frequency). So, the blackbody spectrum must originate from the electron dynamics of a body of atoms in thermal equilibrium (not driven by a microwave inverter, not an ionized gas atom, not an atom in a fusion reactor). I've already shown that the Maxwell-Boltzmann distribution is established when particles are allowed to elastically collide for long enough in 3D; an entropy view will say that the distribution has the highest probability of applying, while an information theory view will say it arises from incomplete information exchange among dimensions (won't work in 1D - there exchange is complete). It should be possible to similarly show that electrons, interacting by their elastic-collision rules, will also reach some most-probable distribution - the Maxwell-Planck distribution. Or, at least, that is what will be radiated - the actual vibrations may well be higher at low frequencies as mentioned earlier.

However in both derivations we have unwittingly introduced quantization - by speaking of individual particles or electrons. Will this still work without the notion of particle? I'm not sure yet [7], but I will fully explore more what it might mean if electrons are taken to be a field. Two convincing demonstrations of the "particle nature of light" are individual pulses on a PMT as it is mover far from a light source, and individual activated

[7] particles are required for a consistent model - this is covered later

specks on photographic paper exposed to low light. In both cases photon-electron interactions occurred, and (temporally and spatially) quantized outcomes resulted. I have already hypothesized that photons are not quantized (field) and now am trying to claim that electrons are as well - but how can the experiments be explained then? In the PMT, the quantization does not happen in the output measurement circuitry (it can measure DC current, not only pulses), nor does it happen between stages (the stages would somehow have to convert a continuous impinging current to output pulses), which leaves only the electron-photon interaction as the quantizing source. If electrons are a field, this field will have local high and low points (like ocean waves) due to thermal interactions, and it may be set up such that the external impetus from the photon field is enough to excite a short current burst locally - both shortness and localization coming from random thermal inputs (and the existence of atomic sites - these are confirmed by x-ray and electron diffraction and need to be explained later). This leaves the possibility that amount of charge transferred may be continuous - but a PMT does not measure this. The Milliken experiment has been subject to some criticism, so I suppose the surest way to claim that electrons are 'discrete' is by looking at the well-ordered entries in the periodic table, each one incrementing its # of electrons by an integer amount, not continuously. And I think there is enough evidence to support the idea that electrons are independent particles even though we only ever observe them when they are sourced from or received by atom-containing matter.

Perhaps this is the origin of quantization - when coupled to the central potential of a nucleus, it is not simply "low-energy" oscillations but resonant (standing-wave) oscillations that will be stable against radioactive decay, leading to "electron energy levels" which find success in spectral lines and in solid state physics bandgap plots [8]. I think it is no coincidence that the observed electron energies can be expressed as a circular wave around a nucleus that has some finite number of crests/troughs. The field laws are then set up in such a way that the standing wave will not radiate but any "transients" that aren't the right (resonant) frequency will radiate, so we find the atom at discrete "energy states" or "excited states", each one more short-lived than earlier ones. This gives a different view of light - it does not transmit energy (as we should have guessed from the no energy argument) but an energy difference, meaning when it interacts with an atom-electron system it not only "creates" a higher-energy electron, it also "destroys" the lower-energy oscillation so "overall energy" is conserved. Yet light is so simply represented as sin and cos that this requirement makes

[8] here note again the seeming flexibility with which electrons take on various and continuous energy levels in the 'free' state - as in accelerators and free-electron laser, as opposed to typical quantization in the atom. So it is the binding to the atom that causes quantization, not nature of electrons intrinsically.

me question whether there is really any transition of the electron with incident light, or is it simply an add-on field oscillation that goes in concert with the pre-existing ones, being radiated on if it turns out to not form a standing wave and being "absorbed" if it does turn out to be a standing wave. Of course changing the atom potential will change what is a standing wave in that system, so light should be radiated or absorbed - this ought to happen in chemical reactions that produce light from energetic products (such as chemical lasers and glowsticks). The lowest energy states (electron oscillations) of the atom are stable, and this should be reflected in the model disallowing radiation for those modes (intrinsically making the efficiency of radiation go to 0).

There isn't much trouble in having electron quantization arise from being atom-bonded (other than why atoms are quantized in the first place), since even by classical laws we can set up systems which support a preferred frequency or frequencies of oscillation. Putting "a seashell up to your ear" shifts external white noise into a different distribution with some preferred frequency based on opening between shell and ear. A stringed musical instrument will audibly oscillate at the harmonics, despite being impulse-excited [9]. In all cases an oscillating system with a given boundary condition is found to lead to quantized [10] stored and radiated energy at the preferred 'resonant' frequencies. Could electrons be similar in this regard, setting up standing wave oscillations in the vicinity of an atom? Thus getting quantization out of "broad spectrum" excitation, like an organ pipe playing a note as a result of the white noise of incident wind. In reality quantized energies are not infinitely sharp either - emission lines are seen to be broad. If they were infinitely sharp, the slightest change in parameters (red- or blue-shift) would make it impossible for anyone to absorb the emitted radiation. Not all systems that oscillate lead to resonance or quantization - pendulum or orbits in gravity can exist at different frequencies and amplitudes, and no one is preferred or 'easier' than another. The response of systems like this to continuous/noise excitation then should not lead to quantization, but the real answer will require a mathematical analysis. Of course fields themselves are assumed to "self-excite" in a continuous manner to allow

[9] note that the string's radiation efficiency at the harmonic frequency is actually *low* which causes it to continue oscillating at a *high amplitude* for a long time whereas the other non-harmonic frequencies are rapidly radiated out and thus decay to *low amplitude* in the string; the sound of a singular note from the instrument comes from the slow transfer of the string's oscillation at the harmonic frequency to the body of the instrument which then effectively radiates it into the air; a bare string just cuts through the air and does not make much sound

[10] more or less quantized: a spring-mass system will still respond to near-resonant excitation, and in QM we see that atoms do as well - but this is explained in a backwards way as some probability integral for absorbing a photon of a different than resonant frequency, leading to energy non-conservation.

propagation of any wave (if field laws are viewed as applying to tiny point oscillators throughout space).

I move on to the case of quantization of light with photographic paper 'specs' representing "single photons". I already assumed that some mechanism makes atoms discrete, which naturally leads to discrete bound-electron energy levels, so it won't be too surprising to find distinct 'activated' and 'unactivated' chemical states (which are really electron states). The spatial localization of specs is taken to be due to thermal random influences on atom states affecting their ability to absorb or react to an external light field (film has to be kept cool and away from x-rays - no coincidence).

Previously I considered the idea of "local fields" and the relation to Huygen's principle. Here I would like to explore some real-world implications on interaction of light with matter. First one might ask just how "local" a local field has to be? As it would be inelegant to pick an arbitrary constraint I must concede that there really isn't a "local field" - the field, if it is real, must be continuous and extend over all space while behaving according to finite-propagation-time laws for a yet unknown reason. The local aspect relates to Huygen's principle - a wavefront can be represented at any instant by uniformly located point sources - which in turn is a way of saying that the field behavior is source-independent and therefore history-independent. By this long chain of thought we find that the field at any moment is only a function of its own configuration at an earlier moment (along with modifications due to interacting matter[11]) and nothing else. Once a source has emitted a wave, its disappearance will not impact the field. From this we see that the field is single-valued: despite contributions from many sources the "physical reality" is the sum of sources, while the individual sources are a "human construct" from our macroscopic view and interpretation. The laws are linear so we can apply them to individual sources for easier understanding, but "nature cares" only about the single summed field.

Now let's consider an application to metal and glass substrates that interact with light. If we ignore the single-valued field, we might interpret the metal as containing sources that always emit in anti-phase with the incident field: this results in perfect cancellation in the forward propagation direction and effective reflection of the wave - although really the original wave keeps traveling through in this model. Reflection and diffraction are emergent phenomena, all waves propagate forever. In the glass object, a volumetric set of point sources radiates slightly out of phase with the applied field, causing a wavelength-shortening effect that leads to the observation of a lower c and higher n in glass than in vacuum. We might even divide materials into di-electric and para-electric along similar lines

[11] which is also a field-made entity

to magnetic response of B to H. But I just argued that a single-valued (source-independent) field is a more elegant and coherent approach. In this view, the metal surface is one that maintains the e-field at "zero"[12], so that incoming waves really are reflected and the field beyond the metal is not disturbed at all. The glass object is not that different in this view, but still the wavelength shortening is immediate and not a summation effect. One concern here is, with the field being immediately modified, how can the matter interact with an external source? For instance in the mirror case, with a single-valued field the field is always zero at the surface, so the metal does not "see" the field variation - how can this be? Likely there is some slight oscillation away from zero that ensures the metal reacts to the external field: real mirrors do heat up and lose light in the reflection, and also have measurable surface (n,k) values in support of this view.

The field model implies that emission of light/radiation is not a random process but caused by external influence that is the inverse of the dissipative reaction that takes away energy in the form of heat - in absorption we have photon→multi-body vibration (phonon), in emission we have multi-body vibration (phonon)→photon. This might be used to predict the form of blackbody radiation - the atoms must have enough individual energy (high-freq limit) and must be properly influenced by neighboring atoms to emit the energy as a photon (low-freq limit). For the case of radioactive emission, consider a Bose-Einstein condensate of radioactive nuclei - will all emit at once? Stimulated emission - lasers - show that light emission is not wholly random - this is just taking the inference to its logical conclusion. Though here it is important to distinguish between a 'true' photon source which is an atomic interaction like a downconversion that emits a quantized oscillation, and a 'broad' photon source like an antenna or blackbody or bremsstrahlung which emits non-quantized oscillation: the former will register as single photons in a coincidence experiment, while the latter will not (even at low intensity). Perhaps then radioactive decay is caused by external factors, some high frequency low amplitude oscillations (how could such oscillations be detected otherwise? like we can't detect photons without appropriately sensitive electron orbitals) then radioactive atoms are highly sensitive detectors of external fields and represent something about outside space, just like background microwave radiation. Maybe we can get some experimental evidence by seeing the power output of an RTG on one of the space probes like Voyager, and variations from expected power output on earth.

By similar logic I would argue Bell's inequality can be explained by internal variables and also local interaction between measured property

[12] zero referenced to what? we do see in photoelectric effect that applying a voltage reduces the necessary light frequency

and experiment where the experiment angle affects local particle response. Consider similarity to 'crappy voltmeter/ammeter' idea. If we claim there is no "preferred" length scale, the nature of measurements should be the same throughout. Then measuring macroscopic phenomena with a detector like one in "quantum systems" (one that changes the system state due to its presence/operation) ie a "poor" detector, should also yield "quantum" effects in macro experiments. Otherwise a preferred (absolute) scale can be defined beyond which quantum phenomena do not occur. [13]

The wave model proposed above is roughly as follows: all "particles" are in reality complex multi-dimensional waves that are self-resonant and self-sustaining in certain discrete amounts and at discrete spatial scales. The waves warp space around themselves such as to wrap around on themselves and appear stationary and particle-like. Where QM suggests faster-than-light concurrent events, we may reason that more elementary "strings" on which "particle waves" exist can move infinitely fast - then we conclude that particles, and all that we see, are "beats" and "group velocity" packets on the underlying "strings". Since group velocity can be anything, we have the ability to control particles' velocity. But ignoring that point for now and assuming that particles are actual "wave-packets" on a string, we have an easy explanation for some weird relativity effects. Consider a string: `A-----B` and a particle on the string `A--~--B`. What's the fastest way to get information from A to B? If we have a pulse `A/\---B` it will travel all the way along the string, taking finite time. But a very smooth pulse will have a very fast influence: `A///\\\B` immediately becoming infinitely fast in the limit that both A and B move at the same time. [14] This compares favorably to QM uncertainty: faster particles have a wider 'width' or uncertainty region. This also works with relativity: to faster particles the rest of the world appears compressed (relative to their line of travel) and to the rest of the world the clock of the fast particle seems frozen (since simultaneous motion of A and B with little "pulsing" of the string - just moving it uniformly up and down - does not provide for observable local evolution).

A field will tend to become equal across validly connected spatial structures - field gradients are self-limiting or stable (not necessarily true? black hole formation). Actions are driven by field gradients (electric, gravitational). The action of a field on an object cannot be "felt" as a force unless

[13] An annoyance from multiple quantum physics lectures I've seen is the discussion of baseball-sized quantum particles as an explanation for why quantum effects don't matter on a macro scale. The problem is that there is no such thing as a baseball-sized quantum particle, instead we have real baseballs made of very many microscopic atoms each of which follows quantum effects, so the effects do not magically disappear.

[14] Another alternative is "spontaneous excitation" but that would require exciting a mode all along from A to B: A∼∼∼∼∼B.

allowed - objects in freefall seem to be *weightless* from inside, not accelerated downwards. Yet these objects are spatially accelerating (as could be "felt" by measuring distance to other objects) and moving down a gravitational gradient - then what exactly is the notion of "force"? Mechanical force is a coupling of the inertial field to the electric field between atoms. All atoms have this intrinsic coupling - an inertial load (increase in potential) causes an increased electric potential (inter-atom compression or separation in a solid) which is "felt" as acceleration by humans. A force is only felt when there are unequal potentials - for instance a braking car, the brake pad+rim are at unequal inertial potentials which are caused to become equal by contact (and the in turn allowed information exchange mechanism). The resulting change in inertial potential, transferred to interatomic compression, is transferred as a "force" to the rest of the vehicle, since potentials will tend to equilibrate in conductors. Thus we see that atoms (solid matter) are conductors of force and of inertial potential, just as wires are conductors of electric voltage/potential. The "force loop" in the car slowing down is completed by the inertial field.

```
y-axis=Inertial potential; x-axis=location in car:
               1=passenger, 2=brake/pad, 3=road

P ----____  while moving, the passenger and car are
   1  2  3     decoupled from the road

P ---\\___  brakes are applied, and the two potentials
   1  2  3     are now coupled; they begin to equalize
               by conducting through the body of the car

P -\\~~\\_  as the potential gradient spreads to cover
   1  2  3     the entirety of the conductor (car body)
               eventually the gradient reaches the
               passenger and road, both feel an
               acceleration now
```

y-axis=gravitational potential.. near a large gravitational pull the potential is nearly flat on the scale of the spacecraft between 1 and 2, so it feels like freefall, minimal conduction of potential through spacecraft (note we can experience the same in buoyant conditions like diving! because inertial potential is spatially uniform there is no 'path' for inertial flow so a diver can 'float' and be effectively weightless)

```
P --------
   1  2
```

near a black hole, the gravitational potential has a big gradient, on the

scale where different parts of the spaceship see a different potential so it is conducted, resulting in "spaghetti" effect

```
P ||\\----
   1  2
```

In other words, gravitational potential acts on all particles in a body in freefall and cannot be "felt" (because there is no gradient) while a body on the ground has a non-uniform effect from the grounded surface countering all forces (this propagates from the surface to the whole body to balance interatomic vs gravitational potential, seen as compression of the body downwards) which is how acceleration is felt. Any uniform potential (spatially or temporally) cannot be detected. A potential's "absolute" value cannot be detected (if it can even be defined) [15]. This generally applies to measurements: measurements must include 2 quantities which are XORed: the invariant (not affected by measurement) and the variant (affected by measurement). Because of the XOR, the "rest of the universe" can be effectively excluded, enabling real local measurement.

Measuring a length with a ruler:

- Invariant = ruler length + marks
- Variant = read position of ruler

In this measurement, there is an implicit assumption that ruler length does not change what is known (to compare to other measurements).

Matter in different configurations can serve as conductors or insulators of potential. For electricity, metals (semi-crystalline solids with metallic bonding) serve as conductors while non-metallic bonds serve as insulators. Conducting properties are frequency-dependent! Metals may not conduct RF (and reflect light) for instance while vacuum will not conduct DC. Compare:

	Static	Dynamic
Electricity	1	2
Gravity	3	4
Inertial	5	6

1. Electric field (DC). Metals conduct, vacuum insulates ($1/r^2$)
2. Light/RF (AC). Metals insulate, vacuum conducts (far-field)
3. Gravitational field. Matter conducts (and contributes/increases), vacuum insulates ($1/r^2$)

[15] see Aharonov–Bohm effect

4. Gravitational wave. Matter insulates (?) - vibrating motion damping and high energy required, vacuum conducts (far-field)

5. Mechanical forces. Matter conducts, vacuum insulates

6. Momentum/impact/free-float. Matter insulates (collision), vacuum conducts

Matter at constant velocity keeps moving in same direction. It is moving along its established "inertial field", the creation of which has required the input of the accelerating energy. This is similar to the function of the magnetic field in an inductor.

Consider which objects seem 'attracted' and which 'repelled' by the inertial field - this shows the field as made of two spheres at front and rear of object.

The nature of space is that far away things are difficult for us to affect - influence of fields dies out with spatial distance [16]. We can have action at a distance (such as communication/internet lines) by "tunneling/channeling" the information in space along a given path (wire or directed light). Free-falling objects do not feel acceleration, but objects on the ground do (from gravity). Objects maintaining their momentum also do not feel acceleration, but those changing their momentum do. This last point conflicts with the gravitational freefall observation, as we normally claim that momentum is increasing during freefall - perhaps momentum should be defined in another way. Traveling on a train, I see objects in front of me getting closer and those behind me getting farther away. Perhaps momentum, like inductance, is a type of field that "builds up" around a particle when it travels at speed. This field then causes other objects to either approach or retract from the observer/particle depending on the "direction of travel" or field orientation [17]. The fields can be visualized in 3D as a sphere in front and a sphere behind the observer, being the attraction and repulsion spheres. Attraction and repulsion towards the observer along a given direction is proportional to cos(theta) where theta is the angle away from the direction of travel. There is also an associated curl field, which moves objects around the observer without moving them closer/farther towards the observer; this is of the form of a donut around the observer, proportional to sin(theta). The sum of the attractive/repulsive field and curl field for a particle results in the normal Euclidean direction of object motion.

What is the point of such a field approach? In the search for a unified theory we have a lot of faith in the concepts of momentum and particles. Is

[16] in fact this is how we define distance - a smaller action on a larger number of objects

[17] even wackier, one could argue that this actually accelerates other objects towards/away from observer, and this is why we see a $1/r^2$ dependence of the gravitational/electric potentials

there a more fundamental way to describe momentum, or even space itself? Like Maxwell's equations which can generate photons, might there be some "matter fields" which have equations that can generate particles? Can we represent momentum as a field, such that gravity and force all arise from the field arrangement? Given particles described as interacting "matter fields", can we propose equations for the interaction between the electromagnetic and matter fields, and thus describe most phenomena on a unified theoretical basis - with only fields and equations, with no distinction of particles or photons? The possibility and power of such a model should make such representations worth pursuing. Plenty of straightforward evidence (gravity field strength law, $F = E + v \times B$, momentum/acceleration $F = ma$ [18]) can be used to narrow down requirements for the "matter fields" and to verify them with existing "certain" knowledge. Especially valuable will be the study of electrons, which are assumed to be coupled oscillators of the electromagnetic-matter fields in some way.

It was seen above that the 'matter field' defined in terms of sin and cos, while instructive, still summed to the Euclidean field, meaning the notions of gravity and inertia and rotational acceleration were not explained or defined by the model. Here I propose that all 3 notions can be explained by matter's self-field interaction, implying that the field itself (gravitational field or matter field) exists independent of the matter. Whereas commonly the field is taken as the instantaneous function of particle location and mass (and so on), I claim that the field is constantly updated by the particle [19], at finite rate, and can exist in states independent on the momentary particle properties. The notion of a mass comes from changing the particle's gravitational field so that it follows the desired trajectory (a form of "stored radiation" as opposed to far-field propagating radiation). This is not to say that the field is "difficult" to change as that would just re-incarnate mass as a field property, but rather that changing the field takes finite time and is done by the particles themselves acting on their pre-existing self-field. A higher force displaces the particles in their self-field more, leading to a

[18] also Bremsstrahlung radiation/FEL, diffraction/refraction/reflection, escape velocity, atom trap (lasers), SEM electron "size", gravitational waves

[19] rather, the field constantly updates across all space, but there is a local requirement at particle edges to keep a potential maintained

faster rate of change (acceleration) of field.

```
\_._/ Particle in self-field at rest
\-._/ An external gravitational field tilts the bottom
        of the particle's self-field {the electric field
        should be "squeezed" by gravitational acceleration
        then? Is this something we observe, or an
        asymmetry (which would be inelegant)?}
\_\./_/ Right, an electric field (push force) moves the
        particle up in its (left) gravitational self-field,
        thus accelerating it and leading to observed inertia
\_.-._/ Gravitational attraction of two objects by means of
        mutually interacting self-fields
```

This matter field also mediates gravity, explaining why free-falling objects feel no "acceleration" even though they are clearly accelerating towards the ground. Centrifugal acceleration can be similarly explained - the fields can only propagate linearly, so forcing the particle into a circular path means exerting a force against its self-field which "expects" a linear path. Note that in the gravitational alternative of orbits, there is no centrifugal force acceleration, because the fields interact directly with each other. The field also needs to propagate gravitational waves, and can help explain why matter cannot reach the speed of light (since that *is* the speed of the field change).

```
O->O  linear path of field
.
   .  circular path of particle leads to the
        self-field 'pulling' the particle back
        towards the linear path
```

Our original goal was to have a model of only fields though. Here with self-fields we are on the right track, but what does an accelerating object look like? In it, the electric fields of atoms are "compressed" and "push" the atoms against their self-fields (force from e-field = -force from self-field even during acceleration, explaining origin of inertia). We still have atoms as non-field agents. Perhaps, instead, atoms (electrons...) can be seen as high-field-curvature phenomena that constitute a high-order contribution to the basic field behavior [20]. For instane we have Maxwell's laws relating E and B, and perhaps we can write a similar law for S, the self-field: $S = \nabla(Q)$ or something. The particles (as experimentally evidenced - Heisenberg relation, interference+wavelength calcs, decay of particles such as $\gamma \rightarrow e^+ + e^-$,

[20] in this distinction, a close look at how we currently differentiate between 'near-field' and 'far-field' effects should be instructive

$p \rightarrow n + e^+ + m...$) are a high-curvature and highly localized variation of the field, for instance $\nabla^2(S)$. Then we might alter the "first-order" law into something like $S = \nabla(q) + \nabla^2(S)$, allowing high-curvature regions to self-perpetuate. But to address the observed field interactions enabled by electrons and protons (for example) - between the e+m and self fields - we need another interaction term such as $S = \nabla(Q)+\nabla^2(S)*\nabla(E)*B$ or something of the sort which ought to lead to the self-field-based $F = E + v \times B$. This will be the path to a field-only theory of matter interaction. This ought to resolve the wave-particle duality, especially considering equipment which is implicitly "quantized" can observe even a field as pulses or particles/quanta.

```
     \_._/ First-order, particle surrounded by field potential
                Zooming in very close on the particle, we
\____~~~~~____/ see a high curvature region that is
                wave-like but spatially stable
```

Based on the self-field idea I propose the following test of the field concept, using an "electron accelerometer" to measure gravitational acceleration:

Consider a water container that is accelerated by pushing (forward). Pushing is an em-field effect, acting on the water inertia which is a g-field effect. Inside the container, the water will want to flow towards the rear, due to inertial resistance. Water pressure at the rear of the container will rise, and at the front will fall, because of this. However a pressure sensor mounted on the container will not be able to measure this pressure change because any water pipes leading to the sensor will experience the same variations in pressure but in the opposite direction and overall no effect will be measurable. Yet by using a stationary pressure sensor or comparing to atmospheric pressure, this pressure difference can be seen.

```
\_\./_/ Right, an electric field (push force towards right)
        moves the particle up in its (left) gravitational
        self-field, thus accelerating it and leading to
        observed inertia
\_./ \_./ \_./ From an outside view, the self-fields along
               the container all pull their particles back
               towards the left, the leftmost particle has
               highest pressure (P propto L?)
\_._/ \_._/ \_._/ From an inside view, all the particles
                  are centered in the em+g self-fields so
                  there is no measurable dP in this
                  conservative field
```

Now consider a container of electrons that is accelerated by gravity (downward=right here). Gravity is a g-field effect, acting on the electron

motion which is an em-field effect. Inside the contained, the electrons will want to flow towards the rear, due to em-field resistance. Voltage at the rear of the container will rise, and at the front will fall. By the same logic, a voltmeter mounted on the container will not measure any dV; yet by comparing to a stationary voltmeter or to some external reference, a change in voltage should be observed.

```
\_\./_/ Right, a gravitational field (force towards right)
        moves the particle up in its (left) electric
        self-field, thus accelerating it
\_./ \_./ \_./ From an outside view, the self-fields along the
               container all pull their particles back towards
               the left, the leftmost particle has highest
               voltage (V propto L?)
\_._/ \_._/ \_._/ From an inside view, all the particles are
                  centered in the em+g self-fields so there is
                  no measurable dV in this conservative field
```

In field theory, particles are interpreted as manifestations of the field,and particles that have mass interact with the inertial field while those that are charged interact with the electric field. But this introduces an unnecessary distinction between the particle and its influence on the field whereas the two cannot be separated - a particle is defined [21] by its influence.

```
------- no particle ->  \_._/ with particle
```

The "atom" thus is not something that modifies an initially pristine gravitational field - the existence of the atom implies an existence of a nearby $1/r^2$ field and vice versa. The two cannot be separated. (How can a massive particle be created, as in electron-positron pair production?) Same with photons - which then couple sender+received into one coordinated "particle". Further with this picture we note an inherent localization of energy:

```
\_._/ vs -\./-  shallow vs deep field lines around
                particle, shallow will be more
                spread out
```

While case 1 is 'lower energy' it is very spread out, and case 2 is higher energy but this forces it to be more localized spatially. Maybe this doesn't make much sense because electricity is much stronger than gravity in any case and both are infinite-range.

[21] this isn't necessarily the case. the 'near-field' localized particle contains more information than its 'far-field' effects convey.

This brings us to the point of units. Speed of light c is too fast - so we are too slow or too tiny. The latter is unlikely since we are huge in atomic dimensions so therefore we are slow/low-energy creatures. Atomic dimensions are tiny - so we are too big (if we use atoms as elementary measure for some reason). Thus we are both big and slow, but relatively more slow than big. This ought to scale to other physical systems - bigger ones will behave more slowly in a non-linear trend (but also, potentially, in a more complex/computational manner). It is as good a starting point as any to assume that the field laws, already stated to be local, should be both fast and tiny for the most basic phenomena.

Taking a rough shot at what particles might look like in field terms:

```
g-field --//\\----\\//--
e-field --\\//----//\\--
            1       2   1=anti-particle, 2=particle
```

A particle and anti-particle have completely opposite fields. The g-field is spatially stable since $a = F/m$ and $F \propto m$, so regardless of whether the g-field is positive or negative the direction of gravitational acceleration is to accumulate matter, thus both particle and anti-particle above experience gravitational attraction: there is no gravitational repulsion. E-field is spatially unstable because like charges repel and unlike charges combine+evaporate creating light - e-field oscillations transferred from a localized to a spreading form. Particles like atoms are spatially stable combinations of g-field and e-field warps, the g-field providing stability and e-field providing charge interactions. Moving around a charge 'lump' like `--\/--` recreates predictions of Maxwell's equations.

```
g-field ----//~~~~\\----
e-field ----\\~~~~//----
                3       3=anti-particle and particle combine
                        and annihilate, resulting in pure
                        delocalized field oscillations that
                        will soon spread throughout space
```

The world is progressing towards most stable field configurations. Fusion of light nuclei is possible, but complete annihilation is not - the ideal is Pb. Photons (and any delocalized field oscillations) are also very stable. So eventually we end up with spatially spread low-energy field oscillations and lead-like atoms, not all photons nor all atoms [22].

Does the particle's "substance" oscillate between the g and e fields, just like light oscillates between e and m fields? Or do both exist simultaneously

[22] at least because we haven't seen any appreciable antimatter in the universe

and continuously coupled? A certain lag from oscillation would be a natural source of inertia [23].

```
Oscillation 1: particle oscillates between mostly
               g-like and mostly e-like
g-field --/\-- -/-\- /---\ ------
e-field ------ \---/ -\-/- --\/--

Oscillation 2: particle's g and e properties 'spin'
               about a common origin which they
               cannot attain
g-field /\--- -/\-- --/\- ---/\
e-field ---\/ --\/- -\/-- \/---
```

Oscillator 2 can be seen as a "spring" oscillator in 1D, with both fields attracted to their central point (consider also how this affects quantum waveform delocalization/spreading?). In 3D, two fields could stably spin around each other leading to the notion of spin.

Gravity - the gravitational field [24] - is the result of spatially bound/localized mass-energy. Then the same way the electric/magnetic field is the result of spatially localized electric energy. The field itself (gravity or em) is an unbound state that is infinitely spread out, so any energy which can enter this unbound state readily spreads and becomes unrecoverable (similar to heat). The field can be seen as a single giant particle that extends over all of space, like a Bose-Einstein condensate on a huge level. No matter how much is added to the field, it will retain an overall "zero at infinity" value, ie only relative differences in the field are measurable and given enough time without perturbation these differences tend towards zero. The field is continuous, in space and in field magnitude, while bound states are discrete - in space and in energy storage, the more highly localized/bound spatially, the more highly discretized (which will also apply to a bound field, ie inside a Faraday cage/microwave/harmonic oscillator, forming the intersection between particles and fields). This is how I propose to explain the wave/particle duality: light is a continuous field, but we only measure it with discrete atoms/electrons/molecules so we see dots/points instead of smooth contours. Energy is conserved statistically, but we don't have the ability to really see this process because all our experiments are particle-based and thus cause discrete outcomes which invoke the idea of a perfect (rather than statistical) one-to-one correspondence between energy transition in one atom and reception in another. As we look at smaller and smaller

[23] and is being considered in some unified models for tangentially related reasons [The Road to Physics]

[24] here I mean specifically the $1/r^2$ potential aspect

timescales, we see this possibility of energy non-conservation [25] but statistically it is always averaged out - we could call it an intrinsic uncertainty of physics, but I think it is easier to say that physics operates deterministically and it is our lack of knowledge about the full field arrangement that gives the appearance of 'random' and uncertain events. Particles can be unbound and permanently "dissipated", as in electron-positron annihilation which creates two gamma rays (e-field oscillation) and a momentum transfer (g-field oscillation). Such oscillations of the field must correspond to the bound state (indeed we can have the opposite process of field→particle if carefully set up), but somehow capable of escaping its spatial bounds. This unbound state is the entropic ultimate end-goal for all energy, as it represents infinite spatial spreading - the most possible available state. We are then quite lucky that we have so much bound energy all around us - perhaps we are at an early stage of the universe's life cycle. The quadratic potential fields in gravity and em are stable over time and spatially centered on a particle - unlike field oscillations (photons) the quadratic potential does not require energy to maintain. Transmission of information (energy level change) from one place to another could be done along a spatially bound (discretized) system or by using the field oscillations to transfer energy - communication cannot be done with a static quadratic potential field, so it represents the stored energy of the central particle but does not transfer this energy away from the particle. How can this static field be maintained? Perhaps it is not so static ultimately, emitting impulses at regular intervals as outlined earlier for gravity, with the impulses spreading to infinity and adding up over time to a quadratic potential.

The field then interacts with all bound states (including the originating particle - perhaps keeping it bound/localized by the very interaction - for instance the attraction of gravity when considered as the point of emission (at a nucleus or a subatomic particle) perhaps is so strong that it holds the particle together - then the rest of the external field is a consequence of this central localization boundary being so strong), causing discrete changes in bound states and transfer of energy in discrete amounts. Consider stimulated emission: the e-field interacts with excited bound states in a way that causes them to transfer their energy into the field coherently. Can we have stimulated absorption, ie a coherent transfer back to the bound state? I think so, indeed because most populations are not inverted, inversion being required for stimulated emission, I imagine that stimulated absorption occurs often on these "absorption-inverted" (ie normal) populations. Bound states that do not have an appropriate discrete energy level are unstable - they will interact with the field around them in a non-energy-conserving

[25] it is only an apparent non-conservation, because the excess energy comes from some local influence, if we had full knowledge of the system we would find energy is exactly conserved at each step, not merely statistically

way until either extra energy is dissipated or missing energy is obtained - this is why we observe discretization in actual bound systems but energy can still be conserved statistically. In fact I don't know if it makes sense to have non-stimulated emission or absorption: there is a reason for each energy transfer, including emission from an excited state (which could be a combination of surrounding e and g field oscillations - thermal energy (blackbody), incident light (photoelectric effect)) and of course absorption by an unexcited state (due to oscillations in surrounding fields from both internal and external factors - no coincidence that photopaper and photodetectors are all temperature-sensitive devices as thermal oscillations change how much (if any) light is needed to make a discrete transition possible).

There is a distinction to be made here between the field and energy. If the field itself is created by continuously-emitted pulses that spread out, then the pulses must have no energy/require no energy to generate; at the same time the field must be able to transmit energy differences as oscillations - so it sounds like we can extract energy from an energy-free emitter? Since we never observe this (and our universe is stable - ie this runaway process hasn't yet occurred anywhere in the universe) I will claim that it is impossible to thus extract free energy - because any lowering in magnitude (ie getting closer to zero/flat) of the field corresponds to a delocalization of the associated bound particle, all the way to the limit of the fully unbound particle and zero field. Particle localization and field magnitude are always strictly related, so cyclical processes conserve energy. The reason for this relation in the first place is to communicate information about localization to a particle's surroundings: without a field surrounding the particle, how could any nearby particles know of its presence? And if they don't know of its presence, can it even be said to exist? Consider the charging of a van de graaf "globe" - in the process I extract electrons and localize them by forcing them onto the globe - this takes energy but as a result of the localization the e-field around the globe grows appreciably. Then I can bring a grounded object nearby - it will be attracted, in the process I can recover the energy I put in towards localization but doing so means I am gradually de-localizing the electrons and reducing the external e-field of the globe. All de-localization is entropically favored, all localization is entropically hindered, thus to achieve localization I must delocalize other particles in the process - the second law of entropy. This happens in gravity - unlike the e-field case above, gravitational fields can "create themselves", starting from diffuse atoms that combine more and more, becoming more localized, increasing their g-field, and thus attracting even more atoms to localize. This seems like a negative-entropy process but in the underlying localization information becomes dissipated in the field, so entropy still rises - in this situation the information that is delocalized is in the form of heat (photons) released during inelastic collisions, with this delocalization the

gravitational "clumping" becomes irreversible, the initial KE of the particles being de-localized (from the localized momentum form) to the photon (e-field) oscillations, which happens independent of the creation of the g-field or its associated potential energy (which also escapes as photons but is not sufficient to cause "clumping" localization - being just an energy exchange between g-field and particle localization). The g-field happens to attract other massive objects, allowing clump formation - so increasing entropy is not to be interpreted solely as dissipation (even though it remains true that dissipation/delocalization is the ultimate high-entropy state, ie even atoms on a planet would readily delocalize as photons if given a chance), and indeed can lead to self-assembled structures which promote a fractal-like optimization favoring dissipation (which should not surprise us - ourselves being complex self-assembled organisms who feed off the dissipation stream of the sun).

Fields (electric, gravitational) like $1/r^2$ potential are dynamic entities that require a spatially bound particle to exist. Fields do not dissipate energy, though field oscillations (photons, gravity waves) do. If the particle creating the field disappears, the field will oscillate as it returns to its zero state, thus dissipating energy - from this I argue creating the field in the first place also takes finite energy and is part of the energy cost of creating the particle. This energy is expressed as a force on the particle, which remains constant as long as the field is there, likely playing a key role in binding the particle itself (high fields can cause particle decay: such as 1.2 MeV electron→gammas). Normally this field force is constant and takes no energy, but if the particle is moved relative to the field, the force can take energy, leading to concepts of mass/inertia/electromotive force/inductance. If my approach is correct, such a quantity will be present with *any* field. The self-interaction force also sets the maximum amount of acceleration the particle can withstand - exceeding it will result in the breakdown of the particle and radiation of its energy via the field. Such breakdown is designed for in particle physics experiments like LHC, and is also seen in nuclear reactors where U-235 is weakly bound in terms of the neutron (strong force) field, so even though it can handle large accelerations of $F = ma$ sort, it still breaks apart from thermal neutrons that exceed the local nucleus stability thresholds. Bound particles are entities existing inside fields, entities that are possible due to complex interactions between multiple fields that can stabilize a "standing wave" and keep it spatially localized instead of spreading to infinity - this requires quantization of the standing wave stable states to strict energy levels, even though the particles remain capable of interacting with the field in a continuous manner - the non-discrete aspects are simply radiated away and we interpret them as unstable. Such interactions between fields leading to bound particles are the only "scale bar" we can have - it is pointless to evaluate a field in an absolute sense as

it acts the same at each scale. When coupled to other fields, though, and given the speed of light, it becomes possible to generate spatially stable configurations and such configurations will have a certain spatial scale. On the flip side, it should be impossible to have any particle consisting of solely one field - such one-field entities can only be spreading-out waves not spatially constrained (because there is no scale bar to constrain them!). Fields are a sole way of transmitting and storing information, as particles or as waves. Waves travel unconstrained in the field - at the speed of light. As particles are an emergent entity of fields (that have the capacity to stay in place), they can be accelerated up to but never reach or exceed the speed of light (if they could reach it, they would be turned into waves - impossible to constrain spreading). This also means invisible/disappearing particles are impossible: they are created with a field interaction, and through to their destruction always interact with the world through the field.

To be clear, I claim that particles (like electrons) and waves (like photons) are *essentially* different entities. The most obvious difference is particles are massive and can be accelerated/decelerated to any speed between 0 and c, while waves are massless and must move at the speed of light. Particles are individual objects that exist on a specific length and energy level, while waves are global objects that can exist at any length scale and amplitude - an antenna emits unified field oscillations/waves but an electron filament emits separate/individual electrons. The applicability of equations like Heisenberg's uncertainty and DeBroglie wavelength to particles is not taken as indicative of some "wave-particle duality", rather the effects described by these equations are seen to be indistinguishable from the effects of not having good control over atom-scale phenomena [26]. For instance, an atom released from a trap holding it is seen to "spread out" spatially following a Gaussian distribution: QM says that is due to the wavefunction spreading, I say it is due to us not knowing what momentum the atom had when it was released from the trap (we have no way to check without perturbing it!). The math looks the same but I think the latter is easier to understand and has a physical reality that is less fantastical than "wavefunction collapse".

There have been a number of brilliant experiments that show why photons should be treated as particles, for instance [`http://people.whitman.edu/~beckmk/QM/grangier/Thorn_ajp.pdf`]. My view on these results is that it is certainly possible to make very precisely quantized and discrete field oscillations but this does not mean the field itself is quantized [27]. A 'rough' oscillation source like a light bulb filament will create all sorts of

[26] and that, on a fundamental level, both particles and waves must follow the same field laws as they are created by/within fields

[27] just because I can make precise frequency sounds with a loudspeaker, I do not claim that air is quantized!

electron oscillations that will add up to waves that go in all directions and at varying frequencies; a laser will create coherent oscillation at a single frequency and that has a specific spatial direction of propagation, and this propagation is within the framework of Maxwell's laws. Further breaking up the directional laser beam into temporal chunks one can indeed get to 'minimal' oscillations, beyond the level of which any lower spatial or temporal breaking-up will not transmit useful information that is expected - such as photon frequency which would require perhaps a wavelength's worth of spatial and temporal extent. These small discrete oscillations will then require extremely sensitive detectors to measure, and fast electronics to be able to judge temporal characteristics. But after going through all this trouble to create quantized and discrete field oscillations (and exclude the rest of the surrounding light), should one be surprised when the experiment shows that they are quantized and discrete [28]? Are these particles? They are spatially and temporally discrete, so in that sense yes. But they must always travel at the speed of light and cannot interact with each other or evolve, so in that sense no. Ultimately at this point I don't have enough of a theoretical foundation to convincingly resolve this issue, but the field model proposed above is philosophically and metaphysically much more tenable. Certainly the QM mathematics, combined with tricks and shortcuts learned in the course of a physicist's career that determine how the mathematics is to be applied to a real experiment (based on what is seen to describe experimental results very well), describe the experimental results very well. Still I believe local explanations exist for photon and other quantum experiments, that will result in similar math outcomes but a more understandable world picture [for example `https://doi.org/10.1126/science.1202218`].

What's the difference between fields and moving particles? Are photons particles? I think photons are purely field oscillations, not particles, because: they all travel and must only travel at the speed of light; hitting the earth from any of the stars by a stream of particles requires a tremendous number of particles whereas a field automatically decreases in amplitude as it spreads; photons as particles means tremendous information transfer - each particle has 3D space+velocity associated with it as well as spin/polarization, and where would all this information originate from? A field hugely reduces the information transfer between (say) sun and earth, so instead of perfect 1-to-1 momentum vector conservation, which would

[28] it should be noted also that by using such 'photons' one is probing the very short time-scale and length-scale behavior of materials, such as beamsplitters and polarizers; this behavior should not be expected to be the same as that with time-averaged large-scale oscillations - perhaps at these scales beamsplitters do not 'split' but instead 'oscillate' between one direction and another. Note that the single-photon nature disappears if merely a low-intensity 'rough' light source is used vs a special 'photon' source, in line with the field view proposed here

be absurd (as then what happened to the momentum vector of an electron just before getting hit by a perfectly conserving particle-like photon?) and gratuitous/excessive [29], only the statistically observed conservations apply and only key information is transferred from the sun: at the earth we only care about what the e-field oscillations look like rather than getting bombarded by unimaginable numbers of perfectly conserving particles - "photons" [30]. Waves, as they always spread in fields, are not capable of interaction with other waves or computation/state evolution. They pass through each other in an additive manner, any interactions being mediated by particles [31]. Particles on the other hand can interact with each other and evolve/do computation, but cannot communicate the results except by field waves (or emitting particles, but such emissions must also be accompanied by waves of the emitted $1/r^2$ potential at least, to communicate the presence of the particle to the rest of the world).

Particles only "see" their local field, so it is reasonable that they create a $1/r^2$ potential by fixing the curvature/slope of the surrounding field, just like we do when solving for the field mathematically. Whatever the particles do maintains an appropriate field around them even when the external background field changes

```
consider a particle in a field,           --\_._/--

now the outside field levels drop:        _-\_._/-_

this drop propagates towards the particle __     __
the particle maintains field curvature:     \_._/
```

even though the particles are "blind" to that change initially - so the

[29] indeed this is not scientific, but there is no way to prove the reality of any interpretation so I only follow this because it makes more intuitive sense to me

[30] in other words, an electron on the sun oscillates and contributes to the field oscillation; this field oscillation eventually reaches earth which causes an electron on the earth to oscillate. The electron on earth may be measured to have a specific momentum, but most of that momentum information came from thermal interactions with nearby electrons, not from the sun; only the oscillation has been transferred from the sun. This is as opposed to the particle view, in which the earth electron's momentum is perfectly related by the sun electron's momentum, transferred directly by a "photon" particle. In both cases energy and momentum are conserved, but the latter requires tremendously more information transfer, and where should a photon particle emitter keep getting all this information from?

[31] we can decompose waves into constituent sine functions which can be said to add up to the observed oscillation. However the "universe computer" does not add up individual sine waves, rather the field is always single-valued at each point in space, and behaves as a differential equation like the wave equation (analogous to how a computer solves a finite difference problem). The mathematical requirements for how a field behaves locally can be found by requiring the property that sine waves add up

mechanism must use field properties, and fixing a curvature/slope is an option that works - though I'm still not clear intuitively as to why this would be reasonable. Further support for the field view of photons: emission/ absorption by large structures like antennas and wires; emission/ absorption by tiny structures like molecules; easy handling of spreading by field: for the sun to emit a particle it must supply direction, whereas field automatically handles spreading to all space; explanation of Doppler frequency shift being able to attain any (no quantization) frequency; explanation of Bremsstrahlung radiation emission by moving particles.

What properties must the field have to work in the observed way? It must allow the interaction between spread out particles by affecting each particle's immediate surroundings. In the absence of particles, the field strives to equalize its value over all space, in the process all energy is dissipated to infinity - this is what drives spreading/dissipation. Yet we see, in addition to the "ultimately stable" zero state, the $1/r^2$ field is also temporally stable. Thus at each point field-intrinsic forces must balance out:

```
---\\\  1/r^2 potential edge
 <- ->  These pulls must sum to zero effect
          for the 1/r^2 field to be stable
          as we observe it to be
```

Because the edge curves, there must be fewer (in 3D) high-slope areas and more low-slope areas to balance out, and this causes field weakening as one moves away from the source. Then the $1/r^2$ field is stable everywhere except at the origin [32]: here the pulls are *unequal*

```
---\\\   ///---
    <- ? ->
```

and in the absence of a particle there to equalize all the pulls the $1/r^2$ field will immediately radiate away - this enforces that (say) the gravitational field of the earth is kept accurate even if we carry out mass-reducing nuclear reactions here at the surface - the effect on the moon, however small, is still present and gets communicated from the source of the nuclear reaction all the way to the rest of the universe by the field's initial instability at the $1/r^2$ origin of that reaction or particle. With a stable particle, the "problem section" at the origin is kept in force balance by whatever the

[32] even in the classical/accepted model there is a problem at the origin as the $1/r^2$ equation goes to infinity; I think the resolution proposed here is more reasonable

particle does to "warp" the field:

```
---\\\   ///---
      ~.~      Particle at bottom of field maintains
               required curvature to keep the rest of
               the surrounding field from
               "springing to zero"
```

and thus the rest of infinite space where the field exists is kept inherently in a steady state. This is elegant information-wise as it means the particle only cares about its immediate surroundings, and the field takes care of all the interactions with the rest of the universe - keeping everyone "up to date" on what everything else is doing. How could this be possibly done with particles? When a chemical/nuclear reaction causes loss of mass, it sends incomprehensible numbers of "gravitons" to every other bit of the universe? It boggles the mind that this would be a good way for the universe to work (for one, how would each particle know exactly where to send each "graviton"? and where would that universe's worth of information come from to be present at one particle?) Fields thus mediate interactions - it is no accident that $1/r^2$ perfectly preserves probability per surface area, thus the spreading information and its effects are statistically conserved.

It is important here to not treat the fields in a too classical sense, because their interactions with particles are to be interpreted differently. In Newtonian gravity, the $1/r^2$ potential of a planet is taken to be the base foundation, and point particles evaluate the field value they see and accelerate based on that. In my formulation, the particles are themselves constructed intrinsically of fields, thus there is no "acceleration" or "force", just motions of the field - recalling that in freefall none of the objects involved experience any felt acceleration - they just move according to their local field laws. So instead of a gravitational force balancing a centripetal force, I say "this is just how fields evolve". Additionally, fields can only be evaluated locally by particles, and in order to understand their surrounding field the particles must sample different points around them to pick an acceleration direction - there are no point particles and no absolute "zero at infinity" values. The fact that we can define forces and accelerations is a consequence of the symmetries of the underlying field laws - as I argued with "symmetry theory".

Indeed fields play an important information role: they only allow the transfer of very specific, and minimal/combined, information. Millions of millions of photon-emitting reactions in a lightbulb are automatically combined by the field into a single notion of wavefront, and this is all that the receiver can make use of - there is thus an effective information decou-

pling: fields act as one-way (infinite) couplings [33] , but in doing so must necessarily dissipate energy/entropy as information that enters a field must continue to spread. This field coupling is different from the original infinite-coupling example of a mechanical valve, which uses spatial binding along perpendicular directions to achieve its "infinity". The field uses spatial distance+time. This also suggests another infinite coupling: distinct fields, for instance using an electron (which is massive and charged) to move/affect a particle which is charged but massless (and thus being unable to resist the mass effect of the electrons directly). This is seen in "allowed/prohibited transitions/reactions", I believe.

```
How does a particle in a field behave?
Assume one side of the earth's g-field:   ---\\\
The particle makes a tiny curvature in
the field immediately surrounding it:    ---\./\\\
As the field stabilizes, the particle's
own 1/r^2 potential is created:         ---\_._/\\\
Eventually the 1/r^2 effect reaches
the earth, so the earth is pulled
towards it (barely)
As the field stabilizes, the
particle finds its immediate
field edges are unequal:               ---\-._/\\\
This difference is due to the
earth's externally imposed 1/r^2
g-field of course
The unequal field edges cause
the field to adjust itself
to be closer to earth:                 ----\-._/\\
Closer in, the field difference keeps increasing,
 and we observe "acceleration" of the particle
```

In all this, the particle still never sees anything beyond its tiny edges, but the particle must be finite sized in order to compare field levels and know which way it should accelerate.

Its finiteness also keeps its own $1/r^2$ potential from becoming infinite at the point origin. A rule that could lead to the observed "acceleration" into a $1/r^2$ potential is one causing different clock rates at different field

[33] because a field receiver may well not be capable of sending a response, ie listen-only. With valve, control side to valve is 100%, controlled to valve also 100%, but controlled to control 0%. With field, sender to field is 100%, receiver to field also 100%, but sender to receiver 0%. Maybe this is the reason our brains use chemical (particle to particle) signaling in conscious processing, as it seems a field based coupling is a definite consciousness border/boundary.

"stretch" amounts, so the field-piece of the particle closer to earth evolves at a different rate than the piece farther from the earth, the resulting phase shift leading to field motion towards the earth. This would be commensurate with general relativity timing effects. Or we can assume "space warping"/curvature as relativity does, but I still don't intuitively see the value of this. One issue with claiming such warping is what to make of particles that interact with multiple fields, like electrons which have both e and g fields around them? Do they warp both, is there an electric-field-space that can be warped/curved independently of real (gravitational) space? This seems unlikely as the resulting degrees of freedom are far from clear. At least time can be said to apply to all field evolution in a similar way.

Fields will extend to cover all of space. We find, though, that it is possible to construct particle-based (spatially stable) structures that can block out fields from a given volume. While I don't think we have any materials that can block the g-field, we regularly use metal enclosures to block the e-field. This type of structure decouples the large "infinite field" from the tiny field inside the enclosed volume [34]. In the absence of the boundary conditions typically supplied by the rest of the universe (which are now blocked by the structure), what can the inside, decoupled field do? How will it behave? I believe that the states this field takes on correspond to maximal integrated-information, and thus qualia [35]. Qualia are simply the field rearranging itself to satisfy all available constraints. Just like the e-field at large answers how a "big" antenna can radiate - which electron is responsible for the photon emission - they *all* are as they all contribute to the field which remains a unified entity nonetheless [36]. So inside an e-field decoupled from the rest of the world, all electrons/transistors/particles contribute to create a unified entity, and this represents the spatial localization and origin and unity of qualia, as well as its extents (in space). The extent and complexity of the system in which this field can exist (in terms of spatial shape) represents the full qualia space - all the experiences/qualia that this system's field can experience in theory. [37] The field will reconfigure

[34] this separation may be only at specific frequencies of field oscillation

[35] this decoupled field could also be said to contain some number of degrees of freedom (in terms of external effects on internal states), depending on the way the bounding structure is set up

[36] I am claiming that our consciousness comes not from neurons but from the complex 3D electric field they set up inside the brain. In fact our consciousness *is* this 3D electric field, and the qualia we can potentially experience is determined by the various possible shapes/arrangements this field can take on as determined by the neuron network connectivity.

[37] this implies that brain activity can be monitored and even altered using external em detectors - electro- and magneto-encephalography certainly work as sensors, and extermal electric/magnetic stimulation has been used in a very rough manner for general treatment (transcranial magnetic stimulation), but I'm not aware of any em (microwave/mm wave) spectrum emitters or detectors used to sense or modify brain activity. If my field view is

itself so as to go away from unpleasant and towards pleasant states, using the particles it interacts with as memory of which way it should go. Qualia thus has a sense of temporal continuity - it exists continuously in time just as the field does (previously I argued that qualia are pulsed and this makes our existence moment-to-moment, though I've written earlier why I don't really feel this way from introspection). But does this really make sense, as all conscious-like systems I can think of require energy spreading/dissipation - otherwise the field remains truly static, with no notion of time - why should it experience qualia if it always stays the same objectively? Perhaps qualia like we experience seem to persist in time because our biological mechanisms constantly re-charge [38] the chemical/electrical reserves available to the field, and the field constantly keeps finding ways to optimally dissipate this energy - it being received and given back to the decoupled rest-of-the-world through some sort of infinite couplings (ie using particles, which are an infinite coupling for the *field* just as the field is an infinite coupling to the *particles*). This is in line with consciousness as a key component of entropy - seeing the conscious system as a "black box", we see high-quality energy in and low-quality (dissipated) energy out - this means evolution has taken place and evolution means conscious/qualia-like entities directed it.

The acceleration of gravity is different [39] from that of a (say) car. In a car, acceleration = force felt, while in gravity acceleration = no force felt and resisting acceleration = force felt. Thus gravity shifts the "zero point" of acceleration. Orbital motion, instead of being treated as a balance of forces, is then seen as satisfying the zero-point acceleration requirement, continuously free-falling but going so fast that by the time the object falls toward the earth it is already far enough moved perpendicular to gravitational line that it can just keep falling and oscillate in 2 dimensions simultaneously:

```
 /-\             |
|   | = ---- +   |
 \-/             |
```

Circular motion without gravity requires an imposed centripetal force to match the acceleration of gravity, and this force is *felt* by the object.

---

accurate, this should be possible with present technology by a 3D antenna arrangement around the brain. This also has interesting implications for brain-brain interactions at very close range (ie head to head - further out the energetically possible radiation is just too low).

[38] maybe sleep is also required for such re-charging, ie a state in which the system is no longer decoupled so it can be refreshed before isolating again when awake; because it has to be isolated for conscious processing and if it is isolated it can't be recharged. It can't be a coincidence that all animals sleep - it ought to be an evolutionary advantage not to.

[39] really shouldn't even be the same word!

Gravitational "force" is thus quite a conceptual blunder. Then again, maybe there is a gravitational force but it is not felt because it pulls on all particles more or less equally while in a car the force is concentrated+transferred by contact with the seat... Does either view help in "resolving" the relative difference between seeing the world accelerating towards oneself and being able to tell whether it is me or the world that "is accelerating"?

Numerous experiments show interference of particles like electrons, neutrons, or even whole atoms. How can this fit in with the field model I have proposed? Consider the observations: faster particles (vs reference frame of experiment) have a shorter wavelength/smaller size, particles can show wave-like behavior when made monochromatic (same energy/momentum vs lab reference frame, small aperture), particles cannot be accelerated to the speed of light and light cannot be slowed down at all. Particles in my view are spatially localized information, evolving at the speed of light but with no net motion, like a photon bouncing back and forth between two parallel mirrors: `|~>|`. Now, the stationary particle is bound spatially so it cannot transfer any information to nearby space. However, the particle can be accelerated and then it does transfer information to nearby space (in the direction it is traveling) - in this sense it behaves more like a pure oscillation like a photon. The more it is accelerated, the more it takes on all the characteristics of a pure oscillation, like a photon moving between mirrors:

```
----
/\/\
----
```

and this oscillation character is *directional* - in the direction of relative motion between the particle and lab frames. Earlier I argued how the $1/r^2$ potential can be established by a dynamic system of spreading pulses in the field which get continually emitted by particles that are stationary:

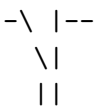
```
--||--      -\  /-      \____/      -    -
  ||    +     \/    +           =    \  /
  ||                                  --
```

Now consider the particle accelerating: in its own frame, during acceleration it feels its own push against its self-field, leading to the whole notion of mass (and *gravity as perfectly proportional* to mass), and once acceleration is over a steady symmetric self-field returns. But in the lab frame, the self-field of the moving particle is *not* uniform! Since the field oscillates at the speed of light, a fast-moving particle has a skewed self-field like a wave shock front:

```
--||--      -\  /-      \_   /      --   /
  ||    +     \_|   +     \_/   =     \ |
  ||                                  -
```

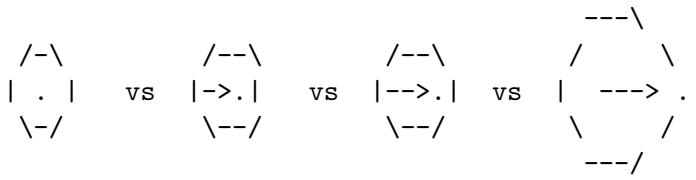
As the particle is accelerated towards the speed of light, the bottom of the self-field tends to $-\infty$, so such acceleration is energetically impossible since

it is this self-field that the accelerating device must overcome, by its own field:



This warped field is *stable* for moving particles, just like a $1/r^2$ field is *stable* for stationary particles! Both do not dissipate or require energy to maintain.

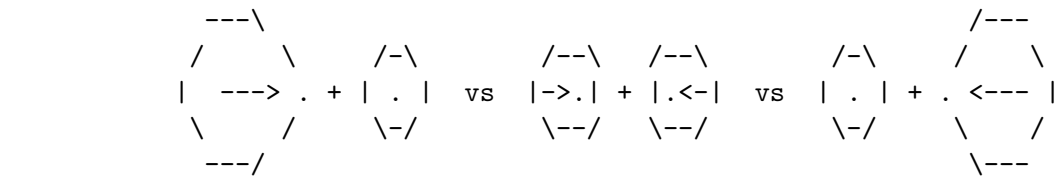
From the top view, also the field looks quite different:



Tending towards a 90-degree 'light cone' in front of the particle as it reaches relative speed of light. Note this means that a 'snapshot' of a moving particle is inherently different from that of a stationary particle. The stationary particle will have a uniform/symmetric surrounding field and the moving particle will have an altered/asymmetric surrounding field; both field arrangements are stable in time but the asymmetric one requires that the particle moves spatially. As the particle is accelerated, it should reach an ultimate size limit of its "core" which will be fully exposed at the front of its self-field at the speed of light [40]. If particles really do emit pulses with a characteristic frequency, then this apparent frequency will be increased from the point of view of an approaching particle by the Doppler mechanism in the 90-degree 'light cone'. And, with the particle more "exposed" and point-like at high relative speeds, the probe abilities become finer, or "size" becomes smaller, this effect is employed in electron (and even helium ion) microscopes which achieve higher spatial resolution with faster particles. Observed diffraction patterns of particles come from the lagging field being pushed forward past the particle and then back again during a reflection, acting similar to pilot-wave models of QM [Bohmian Mechanics/De Broglie–Bohm theory] except the pilot wave is local to the particle and interacts bidirectionally with the particle [this can even be recreated with a macroscopic droplet on a water wave field `https://www.youtube.com/watch?v=W9yWv5dqSKk` which also

[40] this means the particle cores can directly interact with other particle cores to produce nuclear reactions and create new particles. This is what happens in accelerators like LHC. At low speeds the particles' surrounding fields keep other particles away so nuclear reactions don't happen.

matches the above asymmetric-field claim]. Note that relativity demands that the interactions lead to the same effect no matter which frame is taken as observer:

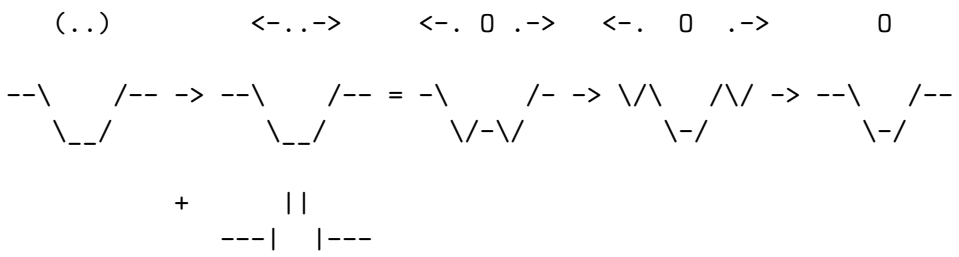


It is common in physics and chemistry reaction diagrams to show the concept of "energy", for instance showing fission as releasing atoms + neutrons + energy. But what is this energy and how is it released? I had wondered this for a long time, in fact it would probably be accurate to say this very question is the reason I wanted to study nuclear engineering. What is this "energy", really? From what I understand now about crystal lattices, heat phonons, and radiation slowing-down interactions, I would say this: in a nuclear reaction, some type of info exchange happens that makes the self-contained information of the nucleus into information that is able to propagate outwards quickly: the kinetic energy of the split nucleus fragments is what is meant by "energy" - whereas initially the atom was still, its fragments end up moving apart very quickly (same momentum but high KE) and by interacting with surrounding atoms eventually bring about an increase in crystal lattice temperature/vibrations - heat. There is a 'temperature' of nuclear reactions - the highest crystal temperature that a reaction could bring about, which must be very high indeed for a nuclear reaction - fusion is indicative of such temperatures; using nuclear power at a low temperature like 300C then is quite a waste entropy-wise [41]. In the course of the nuclear reaction itself, the info exchange is strictly local - only felt by what has been the nucleus, and affecting rest of the material much later by individual interactions now from fission fragments.

Why do these fragments fly apart explosively? Well, gravity is acceleration of objects toward each other. Anti-gravity then is acceleration of objects away from each other. Nuclear fission (or any energy-releasing reaction) causes a loss of mass in the final product - this loss of mass must cause an outward propagating ripple in spacetime which ensures a balance in the gravitational field around the past nucleus is maintained - since the mass is now lower, the gravitational attraction also needs to be lower. To conserve total gravitational field, and communicate information to the rest of the universe, the gravitational change must be communicated as a spreading

[41] that is to say, there is a lot of wasted "computational power" that ends up going into the not-useful-to-us evolution of the crystal lattice

Gaussian with constant spatial integral.



In fission, the initial nucleus (..) splits into two fragments <-. and .-> and a remaining fragment O. The gravitational field during the fission event behaves as if an anti-gravity impulse has been added, and the . fragments "ride the wave" of the antigravity impulse spreading which accelerates them while leaving the remaining O fragment with a lower gravitational field. When the reaction happens the anti-gravity impulse due to loss of mass is most concentrated at the nucleus, so it has a very strong impact on the fission fragments which it pushes apart at tremendous speed. By the time the impulse extends beyond the nucleus, it is so weak as to have a barely measurable influence - however little it takes to indicate the loss of mass of binding energy at a distance.

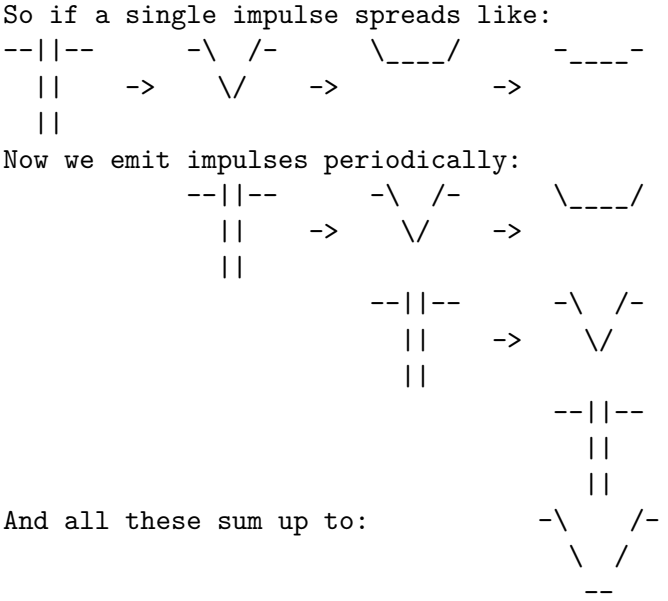
Consider rocket propulsion: chemical burning creates reactions that are anti-gravity in nature, and this pushes the rocket up against earth's gravity. In all this, the gravitational field around the earth and the rocket are kept accurate, by the spreading wavefronts of antigravity impulses. Now, since reactions can both lower and raise the mass of the products (by releasing/absorbing energy respectively) it follows that we can also emit gravitational impulses that signal an increase in mass and pull objects together. So consider a propulsion system:

```
<-[ Mass-lower reaction ]-> * [ <- energy <- ] :
                            -> [ mass-increase reaction ] <-
<-[     antigravity     ]-> * [ ->  flow  -> ] :
                            -> [        gravity         ] <-

-> [ Net force ] ->
<- Net momentum emitted <-
```

As with the idea of antigravity impulses spreading out from a center into infinity (and this spreading being the entropically most absolutely favored state), I would now like to view gravity as also formed by such impulses. A gravitational potential is then not a static entity, but a *dynamic summation* of a time-integrated set of emitted gravity impulses ("gravitons")

which all tend to spread to an infinitely diffuse state [42]. These impulses are always emitted by any energy which is made to be localized - ie mass-like or evolving in time rather than in space. As soon as the energy is allowed to become non-localized and to the extent that it is space-like (not localized, spreading at speed of light) the gravity impulse is not emitted, and perhaps an anti-gravity impulse is emitted (this may amount to the same thing: _/ + ^ = \-/), thus any spreading type of energy is anti-gravity-like (repulsive) as we see with photon momentum repulsion. Any attractive interaction (gravity, strong force) are emitted by and lead to localized time-evolving particles (planets, nuclei - all stable in space and evolving in time). Repulsive interactions are the opposite, a result of less mass, and causing other surroundings to also become spread out in space (evolving in space - traveling at c, not evolving in time).



The result is a quadratic potential surrounding the impulse source. If the period of emission is related to how often energy takes on the same states (2π rotation for example) then spatially smaller things are heavier (nucleus vs electron).

The conclusion is that locally bound energy seems to attract other locally bound energy, while unbound energy seems to repel other unbound energy (completely diffuse spreading). Why should bound energy be attracted to each other? Perhaps because this attraction ensures that eventually all bound forms will be able to interact and release their energy

[42] such a dynamic entity implies information non-conservation; I later revise this viewpoint to claim there is an inherent stability to a $1/r^2$ potential

into the unbound form - the ultimate entropic goal - for escaping the local bounds may require a transition only enabled by another massive object (this could also be the meaning of life - to help release energy/increase entropy in ways that "dumb" atoms cannot). Why should bound states seek this release? Because that ensures that the universe, eventually, reaches a "zero", infinitely spread out/diffuse equilibrium state, that no particle or entity can survive forever without any mechanism to destroy it - this is illogical on philosophical grounds as then such a particle/local state must really exist forever and even outlive the universe - whatever that means, like an indestructible object. I say that the universe strives for such an infinitely diffuse state and is constantly evolving towards it - but why? With the big bang hypothesis, the universe started out as a point - the dual of the infinitely diffuse final state, both 0-dimensional. Indeed every entity we talk about has a dual in this sense - whatever we describe, we also describe the rest of the universe that is left out. There is always an 'inside' and 'outside', in a control volume or surface or object. Why should the universe go from one 'zero' state towards another? Maybe both are equivalent and the progression of time is illusory - though I've argued that our sense of "now" strongly indicates time is not just made up but a consequence of evolution (temporal iterative change in systems). But if it is illusory, why do we feel it going forward, in the diffuse/entropy-raising direction?

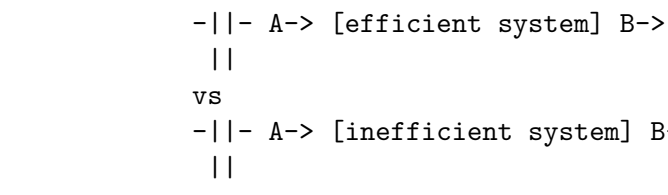
If I imagine going backwards in time, then I really will have memories of the future - my past in forward time is my future in reverse time, so I will know exactly what "will happen", but be unable to take any actions to change or alter it. In forward time, I don't know what will happen, but I can take actions to alter it [43]. Quite an amazing duality. Why do I feel time going forward? Because I am after all a localized system, and as such I can only evolve/learn/memorize by increasing entropy - releasing some of my energy so that the remaining localized system is prepared for future encounters with memories of the past, memories made only by dissipating energy [44] and thus placing it beyond our localized reach. For localized systems like us time runs forward, for spreading systems like light time doesn't run at all (indifferent to concentration vs spreading - all like a single time instant to the impulse, though not to us external localized observers), and for diffuse systems like the universe maybe time even runs backward (ie entropy-*reducing*). Reverse time would be a weird thing indeed. If forward time is the realm of "my control" and individuality, local actions and influences, reverse time is "divine control" and complete lack of

[43] this goes beyond just 'feeling in control' because my premise is the world is deterministic after all so we can't "really" alter the future, but we can control energy dissipation going into the future and cannot do this going into the past

[44] because memories have the capacity to be arbitrary, their creation requires dissipating energy; memories cannot be made in a reverse-time world

autonomy - at any moment energy from far reaches of the universe concentrates precisely in a given way to cause you to do something, "remember" some future action, or spontaneously bind energy into localized structures. The universe then can play and do all sorts of things to modify the localized systems, keeping a record of it in the "diffuse memory".

As I mention energy spreading often, I would again point out that energy doesn't "want" to spread, but the # of possible spread states vastly outnumbers localized states, so once the barriers to spreading are removed the energy can be expected to rapidly+irreversibly spread; that is the most stable (probabilistic) state. All energy flows must be in the diffuse gradient direction. Because energy always seeks the most probable (most diffuse) state, we see that systems cannot achieve more than 50% (?) energy efficiency in an absolute sense. Maybe this is misguided as a well-designed system makes use of the spreading to the greatest extent such that the finally released energy is already in a very diffuse state, thus approaching very high efficiency, depending on how well localized the energy was initially maybe 100% is achievable.



During step C, no useful work is done while energy spreading is still occurring. The efficient system extracts lots of work from spreading and the remainder in C is not very much, while the inefficient system only slightly extracts work so lots of potential energy is wasted as dissipation in C. Then it is easy to claim all heaters are 100% efficient! And that all systems are ultimately fancy heaters.

Gravity in this model is also always spreading. Then it is no coincidence gravity is constant *acceleration* - if we had a way to accelerate an object in a gravitational field its energy could increase tremendously and indefinitely, yet the field itself takes no energy to maintain - the gravitational impulses are just emitted by matter, always, as a fact of matter's existence. I have a feeling this will not be possible, but if it were possible to capture these gravitational impulses and localize them/keep from spreading, we would have a truly inexhaustible source of energy → the impulses are always emitted as localized, we extract useful work by letting them spread/diffuse in a controlled manner, we can be kings of the universe [45]. Probably the

[45] perhaps it is this spreading of impulses that is responsible for the 'universe computer' functioning and computation, doing this would be equivalent to turning the laws of physics to our advantage

limit here is any uncertainty principle - by binding/localizing one parameter we must have a diffuse dual parameter, so we can bind the energy but lose the particle (ie one-shot extraction) or bind the particle but lose the energy (continuous but zero extraction), never infinite extraction.

5

Information Theory

main message: a notion of conserved information leads to a requirement for information exchange and no unidirectional transfers. This can be elegantly applied towards understanding entropy as the equal spreading of information to as many states as possible, emphasizing it is a 'numbers game' rather than the information 'wanting to' spread out.

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(note: there is an established field of study called Information Theory that owes much to Claude Shannon's works. What I refer to in this book as information theory is only tangentially related to this field. Perhaps I have chosen an unfortunate name but it is already stuck in my mind.)

– M

The widely used and taught physics theories describe the world as a collection of interacting physical objects - a space-based representation. To understand Newton's three laws of motion, we must imagine the existence of a physical space in which objects move. To understand Maxwell's equations, we must imagine a space in which electromagnetic waves can exist and propagate. To understand Einstein's general relativity, we must imagine a space in which planets and rockets warp their surrounding space, leading to gravitational effects on other objects in that space. So the existence of both space and objects within that space seems natural and straightforward, a logical starting point for theories - even 'modern' ones like string theory or quantum electrodynamics. None of these theories have within them a power for explaining what space (or time) is, nor why objects should exist in that space. Nor would I claim to have an answer to this - such an answer may really be the theory of everything (in contrast to such grandiosely named attempts in present day physics, which cannot explain why space

or time is observed). In this chapter's exploration, I attempt to form a physics theory with minimal reliance on space or objects, instead with a focus on information, something I believe is a more fundamental truth. If I had the task of writing a computer code to simulate the universe, what would this code look like? How would I store the state of the universe in computer memory? The universe as we see it looks 3-dimensional and evolving in time, but we are ourselves inside the universe (subject to its illusions) and thus cannot naively assume that this space and time is what the 'universe code' looks like. What seems to us as a 3D space may be any sort of arbitrary underlying representation that makes universe evolution in time an inevitability. But as far as I can tell, it is not possible to describe something without using information, and no matter how that something is stored in 'universe code' it must keep its own share of information. Perhaps the information will look different from different representations (for instance, our human representation vs a 'universe creator' representation), but its underlying purpose will remain constant. So instead of describing how objects move in space - a 'high-level' physics theory - I seek to describe how information evolves over time. The notion of information is broad: it might well be objects moving around (position/velocity/temperature), electric field strength and patterns, the presence or absence of an object, and even 'human' concepts like what someone believes. I believe there are laws that information follows, and the power of understanding these laws is that they become broadly applicable to any system where information is present (which is to say, any physical system) - whether it is a system of particles in space, or a system of people in society, or a system of electrical elements in a circuit.

Let's start with a few practical examples showing just how broadly the concept of information can be applied:

- Difficulty of blocking the transfer of information (communication). This manifests itself on a physical level as the existence of light/ radio/ sound waves propagating outwards in space and being very difficult to completely block or perfectly reflect to the source (entire textbooks are dedicated to blocking electro-magnetic and acoustic interference). This also manifests itself on a human level as the emergence of increasingly wider-reaching communication channels (why aren't we content with horse-delivered letters? why do we want TV and fast internet?) and difficulties faced by entities who try to block/censor information. Information seems to spread, almost by definition.

- Necessity for transfer, rather than 'creation' or 'destruction' of information. In the real world, a computer can only do as much as its programs in memory allow it to do. A computer could not generate truly random numbers. A person's character is only as 'rich'

> as their life experiences and memories. A person would not be creative/imaginative without exposure to diverse stimuli, being locked in solitary confinement would eventually lead to limited and obsessive behaviors. It seems that information does not just get created out of the blue, but rather must be transferred into a system from another system or vice versa.

From the above two examples, I postulate two properties of information. First, information naturally spreads. Spreads? As much as I've tried to avoid the notion of space, it seems I cannot proceed without it. What I want to say is that information spreads outward in *space*, but perhaps information theory can provide some hints as to what space is in the first place. Objects that are close/nearby in space are those between which information exchange (via photon reflection for instance) happens most quickly. Military rangefinders send out a pulse of microwave photons and time how long it takes to receive a reflection from some object of interest, and based on this time display a distance to the object. Time and distance are directly proportional by the speed of light. Additionally, objects that are nearby take up more of each other's solid angle, making information exchange more likely and stronger. Putting my hand near a lightbulb, I can feel the warmth from the bulb, but putting my hand far away this warmth is diminished because of a smaller solid angle (how much of a surrounding sphere's surface area is taken up by my hand. All of the visible sky is approximately 50% solid angle, the moon is a small fraction of the sky, holding up a penny in front of my eye to cover the moon is an exercise in matching solid angles). Such change in solid angle is also symmetric - if I move towards an object, the object also finds itself closer to me by the same amount. Requiring information exchange to be symmetric in this way places a constraint on space: relativity, or that information exchange as seen from one object is seen in an equivalent way from another object.

By further postulating that information transfer must always occur with a constant rate/probability we find another constraint on space: namely that it is not possible to move away from all objects, if I move away from one place I must move closer to another. If I were to move away from all objects, that would reduce my information transfer in an absolute sense, which is not allowed (by the postulate). This makes our three dimensions 'rigid', though it does not justify why there should be exactly three dimensions.

> "if there were no limit to the dimensionality of space, then we would expect a set of n particles to have $n(n-1)/2$ independent pairwise spatial relations, so to explicitly specify all the distances between particles would require $n-1$ numbers for each particle, representing the distances to each of the other

> particles. For a large number of particles (to say nothing of a potentially infinite number) this would be impractical. Fortunately the spatial relations between the objects of our experience are not mutually independent. The nth particle essentially adds only three (rather than $n-1$) degrees of freedom to the relational configuration. In physical terms this restriction can be clearly seen from the fact that the maximum number of mutually equidistant particles in D-dimensional space is $D+1$. Experience teaches us that in our physical space we can arrange four, but not five or more, particles such that they are all mutually equidistant, so we conclude that our space has three dimensions." [Ch 1.1-1.2 of Reflections on Relativity]

At this point note that from all our experience we find that information contained in a certain volume of space can be learned by an observer that controls all the boundaries of that space: the surface area of an imaginary 'bubble' around the space. Containers like water bottles function by providing an impermeable boundary completely surrounding the desired space that is meant to contain water, if the boundary does not completely surround the space we will observe leaks (of water/information). This is a statement also on the nature of space, that it is even possible to surround an object and fully control information transfer. Apply this to human life as well: we are defined by our environment and people we interact with, the things that 'surround' us.

The second example already suggests a notion of a conservation of information. I also cannot at this point avoid introducing the notion of objects, or systems. So even though I cannot justify the existence of either space or objects, I find it necessary to use these concepts to make information theory applicable to reality. By conservation of information I mean that specific *objects* conserve their share of information. It is possible to simplify this further: all objects always store a specific amount of information, no more no less, and this amount is in a sense the definition of the object. So an atom might have a position, velocity, quantum numbers/spins, and a few other characteristics but it is a finite and unchanging amount of information, though the content of the information may of course change readily. We see this clearly in mathematical models (same ones as used to simulate real experiments and calculate physically relevant quantities - that is to say, models which accurately describe the physical world and thus must provide some insight on the 'universe code'). We learn in high school of the importance of 'square matrices' in finding an exact solution to a set of equations; the square matrix is special because it has as many equations (rows) as it does parameters (columns). And to solve for the N unknowns, we must have N equations in N variables (or 'boundary conditions').

Throughout my student career I believed that such mathematical models give some new information, allowing us to know the previously 'unknown'. But information theory applies here too: we see that to find out the N unknown values, we need to supply N known values, the y in $Ax = y$. The amount of information stored by this mathematical construct is constant, by supplying the y we already fully define the x. In a sense this is like looking at a cube from one side or another, the cube is the same but our perception of it changes. The underlying information is the same in either y or x, and the system of equations has transformed the information from one interpretation to another. In essence, physically useful mathematical models require an input of as much information as they can be expected to output. If we make a thermodynamic model of the earth as a huge sphere with a single temperature parameter, we cannot predict the occurrence of life. If we wanted to predict the occurrence of life, we would need to have enormously complex parameters, and for all of those parameters we would need to have correct values of initial conditions for our model to have any validity. But in the process of determining and measuring all the parameters and their values, we would already have all the information needed to know the answer. So it seems even our most cherished physics theories don't do much more than regurgitate information we have supplied but in a different format.

And how could it be otherwise? The degenerate matrices and insoluble (over-constrained or under-constrained) systems of equations, dreaded by the students that have to try and solve them, are inelegant and not physically useful precisely because they do not conserve the amount of information. An over-constrained system gives out less information than was put in, meaning it does not make effective use of all available information, wasting computational effort and giving a subpar answer, perhaps arbitrarily discarding some excess information. An under-constrained system gives out more information than was put in, meaning some of the output information must have been made up/arbitrary, rather than physically relevant. Today's physics theories strike the balance between these two polarities, of making the most of a minimal useful set of information: "Everything should be made as simple as possible, but not simpler". But all I've suggested is that good theories conserve information, do we have reason to suppose that real world objects also conserve information? There is an argument to be made that good theories are ones that effectively describe the real world, so the above statement carries significant physical meaning. Out of curiosity, we may look at scientific experiments, where we find a notion of effective vs ineffective experiments. By no coincidence, the effective experiments maintain 'control' conditions as constant as possible, while varying 'independent' parameters and measuring a corresponding number of 'dependent' ones - carrying out measurements systematically in a matrix form if mul-

tiple independent parameters exist. The ineffective experiments suffering from under-constraint attempt to manipulate multiple independent variables at once, allow 'control' parameters to fluctuate, and carry out limited measurements with overconfident extrapolations. The outcomes of such experiments suffer from arbitrary fluctuations, limited repeatability, and poor understanding of what's going on even if the results are deceptively 'clear'. There are also the over-constrained ineffective experiments which use 'overkill' methods to attain limited results: making nanometer scale images of macroscopic areas, taking up hundreds of gigabytes of storage, and ending up with a single number as an experimental result. While the result may be useful, it should not be overlooked that a complex process of reducing lots of information into a less informative answer may well lead to an inaccurate or error-prone answer, making the extra human and computational effort of questionable benefit. Effective experiments - real world phenomena - strongly suggest that information amount is conserved in real objects.

If we accept that information amount is conserved in our surrounding universe, we are led to a general conservation of information law, one that I think is fundamental to the 'universe code'. Because if information amount is conserved, then if I seek to get 'information out' from an object, I must put the equivalent amount of 'information in' to maintain the constant overall amount. Namely, unidirectional information flow is prohibited. Any interactions involving information must be bidirectional exchanges. This notion will be important enough to the rest of this book that it will be termed a law: *the law of information exchange*.

> The law of information exchange: only as much information can be gathered from an object as is supplied to it during an interaction. There is never unidirectional transfer of information.

This is very counterintuitive, because in daily life we seem to routinely see 'transfer' of information from one object to another: I read a thermometer to find out the temperature outside, where is the bidirectional exchange? I get information about the temperature, and the thermometer (as well as the temperature outside) stay just as they were. This illusion of information transfer arises because we rarely interact with the elementary physical objects that actually exchange information; as humans we work on a 'high level' of abstraction, making powerful inferences that seem to give us more information than allowed by bidirectional exchange. This will be explored later with the concept of 'infinite couplings'.

To make better sense of information, it will be instructive to see examples in the real world. Underlying fundamental physical-level information (to which the law of information exchange applies) manifests itself at all

scales, including our everyday interactions with the world, in fact enabling macroscopic 'information technology' and notion of information as human-human communication. How can we make use of information in language and science? We might define this 'human information' as statements that are:

1. Descriptive in nature rather than purely relational
2. Specified with an exact and particular scope
3. Readily verifiable by experiment at any time, establishing its validity

For instance, "earth is flat" is not information unless better specified in scope - "the ground I see around me is flat" is better and indeed more informative/readily verifiable. Now we know that the planet earth is not flat from experiments, so "planet earth is flat" is not information either. In the early years when no experimental proof was available, this was *not* information, nor "planet earth is round", since that was not known. Rather both were 'suppositions'. Here we see an important point - that limiting the scope of information from a general to a specific case requires knowledge of *all* cases, which is generally infeasible and contaminates information with suppositions. This is why I have to claim that all information be (at least in principle) experimentally verifiable at any time, and thus except for special cases of definitional consistency, "all" has to be replaced by "all observed". For instance, "objects are made of atoms" or even "some objects are made of atoms" is *not* information, but "all observed objects are made of atoms" is information. More subtly, this reminds us that anything that we describe must be capable of being observed by us (interacting/exchanging information with us conscious beings - the machines/tools we use to help observations don't have to interact the same way with other beings), but this does not mean that the universe or laws of physics are constrained in the same way.

The point of relational statements is a challenging one. Let's take for example the "ground around me is flat" statement. If I say "ground around me looks the same as the ground around you" that is a relational statement, since the actual nature of how the ground looks is not established. This is the realm of mathematics, where relations take precedence over actual meanings of particular values. But in a bigger sense we may argue that all information is relational, because there can be no information that is not in reference to an observer. Here the concept of looking at the earlier 'thought experiment' universe with two objects is *not* valid, because by looking into this universe we have brought our own (and our universe's) biases. To get a true view of physics in such a simulated universe, we must imagine ourselves *as* one of the objects in the universe (ie big in relation

to my size, fast in relation to my sense of time), but none of our theories are nearly complex enough to allow this. Similarly, from a pure information theory view, to have a true model of our scientific experiments the model should be complex enough to simulate us (the human experimenters) actually performing the experiments in the scope of the rest of the universe. Yet we get by with extremely simple, even rudimentary, models - the reason for this is underlying symmetries, as will be further explored under symmetry theory.

But all of the above only means that good theories conserve information, not that it is conserved in the world. For instance, is historical data information? It may be descriptive and specific, but cannot be verified except by *supposing* that the past and only the past affects the present. But this leads to a rather bleak world in which everything that ever will exist already exists, being just a matter of how it is mathematically manipulated what fragment is called the "present". For instance, "the speed of light is c" is information, but "the speed of light is *always* c" is not, and cannot be (and is actually considered false in some cosmological theories). Similarly "the earth was round 20 years ago" is not information, for it is *not* directly verifiable at present without using suppositions. In fact the concept of time seems to break down, which suggests a reason why classical theorems in physics (which have an absolute time parameter) tend to be very limited in their applicability to real world problems, requiring the expertise of a physicist to specify where and for how long the theory can be applied (for instance a cannonball follows ballistic paths in air, but later can be moved around by people, melted, left in the ground; all not described by Newtonian laws).

To use the theory in a practical sense requires that we deal with the notion of time dependence of information, since any real experiment will not be instantaneous. Strictly, the theory can make no claim as to validity of historical data, as it is impossible to make an experiment to test the past. We rely on remnants of past events and experiments to not change over time so that conclusions drawn from them remain valid at present. There is no way to distinguish any change in time that affects every parameter of an experiment (such as every atom+space expanding, speed of light increasing). We must make a few axiomatic claims:

- Hypothesis of existence: There are real-world objects which are considered to "exist", that is they will retain all experimentally accessible parameters (information) indefinitely in time unless acted upon by other objects in existence. That is to say:
  - Objects that exist store information over time
  - Objects that exist can exchange information with other objects

that exist

  - Objects that do not interact with other existing objects maintain their stored information in time (and space). This does not prevent a "creator" from looking at the world, but means that such a creator cannot be said to exist by us.

- Hypothesis of causality: This is already encompassed in the hypothesis of existence - that objects can exchange information (by definition information is measurable in principle), the rest follows from unidirectionality of time and uniformity of time: unidirectionality of time places limits (quantum/entropy based) on how information can be exchanged, while

- Hypothesis of time uniformity: Information from a present experiment will apply *without any modification* to an identical experiment if it were done in the past or in the future. While this may seem like causality, it is actually not required for causality. For instance if something changes with time in a known way, the known laws of physics can still hold (such as speed of light changing slowly over time, or carbon dating). This hypothesis makes real experimental analysis more tractable by assuming that no changes in laws of physics take place, since none have been observed.

- Hypothesis of unobservability: The universe is a close and complete system that is not observed (in the experimental way, ie by objects that exist) by other objects that are not themselves part of the universe. Equivalently, it is impossible for any objects in the universe to observe (in the classical/physical way) anything "outside" of the universe. In this case the universe contains a constant and unchanging amount of information.

This is effectively saying that there exists a basis of information completely true through time (the laws of physics) and that any experimentally measured changes in information are due to interactions between objects that exist and *not* due to changes in laws of physics. So, there exist certain guidelines for exchange of information (laws of physics) that are constant in time. This is a "grounding" of our presence in time and allows new types of interactions to be discovered - for instance if the elemental composition of a sample changes over time, we might look into radioactive interactions, instead of claiming that locally (or globally) the laws of physics have changed, although either one is possible. In this sense, using the laws of physics as something "constant in time" is rather arbitrary since they have no material existence, but it seems to have served science and humanity well.

From the above hypotheses that

1. objects in existence store information in time
2. objects in existence can change own information only be interaction with other objects in existence
3. information retains its validity over time

we come to the *Law of Conservation of Information*

> An existing object or group of objects that do not interact with other existing objects neither gain nor lose the information (result of experiment performed on the objects) contained therein
>
> (or)
>
> The experimental measurement of any isolated system can be carried out at any time and an equivalent result will be obtained

Applying the law of conservation of information to groups of objects yields the more familiar statement:

> Since any interacting objects constitute a group of objects, if we assume the unobservability hypothesis we can say that in exchanges or in static state, information is neither gained nor lost.

Thus, the amount of information in an unobserved system is constant. We note that there is no strong support for this - while it is arguably applicable even in an infinite universe, we have no reason to believe that information might not be transferred ie through black holes or at the edge of the universe. In any case I would claim that locally (our planet, or even solar system) experiments suggest the hypothesis is correct. It is impossible to test since the best we can do is approximate a truly unobserved system. What we do see in experiments is that parameters of a system that are unobserved remain constant, with the unobservability hypothesis I claim

1. All unobserved parameters remain constant
2. The world (universe) is unobserved (in the classical sense)

The creator could have a way of observation that does not affect the underlying information, but this violates information transfer laws for existing objects as outlined earlier.

I already claimed the bidirectionality of information transfer, but this conclusion was far from intuitive, and one I came to only after a few more axiomatic claims.

- Storage size hypothesis: Any object in existence can store only a specific amount of information, and it must state exactly as much information to continue its existence as the same object

This implies the *equivalence of similar objects*, that is any atom is equivalent in its characteristics (amount/type of information stored) and differs only in the specific values of information stored (ie location, velocity). Then by the conservation of information, any group of objects can store only as much information as the sum of its underlying entities with no "group effects" (ie a linear summation), and also therefore that any group is in essence separable. Thus, groups can only be a convenient construct and cannot be said to have real existence. Furthermore, by the conservation+storage size/equivalence hypotheses: *Law of Information Exchange*

> Any existing objects that interact must have (individually, by storage size hyp.) the same amount/type of information before and after interaction. Therefore, only as much information can be learned about a system as is supplied to it in the course of an experiment.

This means *all* experiments that determine the information in a system also perturb the system, and furthermore that the more information it is desired to collect, the more the system must be perturbed. Or, *any* experiment in which the system is observed also gives the system information about the observer. It is impossible to have *unidirectional transfer of information*. Here we come to an important practical effect: emission of light. Since light carries information, it must also return information about the receiver to the sender. Thus light must always be incident on a physical object. This logically justifies quantum experiments in which (ie) the presence of a detector in a light beam path may be determined without activating the detector. Specifically, if it were possible to measure extent of reflection of the photon then a second detector could be in the same location as a laser source, or even a carefully designed laser that measured the amount of optical energy it contains. We might consider making a map of matter density of the universe by performing an experiment in which a light source is scanned across the sky. Then when photon production is seen to fall/rise, it will indicate that there is no matter present to receive the photon. [1] That is, the photon can be used to tell whether there is an

[1] I no longer agree with this and see it as a refutation of the photon model. Instead light is emitted locally and exists as field oscillations; the information provided to an emitter is not about the receiver but about its local field surroundings.

observer on the other side or if that path is unobserved; it cannot differentiate between observers which imposes the classical speed of light limit on traditional (photon exchange) communication. Similarly, all interactions between objects (gravity, electric, magnetic) must only exist between objects in existence and cannot extend outside the observable system. This also includes things like quantized electron wells for emission/reception of light (ie probing electron potential in a sample by light transmission frequencies). From here we have a hint of what must be done:

- Determine rules that govern information exchange, ie objects do not know they are experimented on, thus both probe and response objects *have to* exchange information for experiments to be possible - how is this done? Why do we get the illusion of an independent observer?
- Determine what objects can share information: spatial or temporal constraints? Quantum entanglement? How does an atom "decide" to send a photon to a particular spot?
- Find effects of this interaction, such as on stars at the "edge of the universe", or stars next to black holes, or gravitational attraction of planets

Any interacting system is experimented upon - the challenge is finding out what the experiment is. For instance a spinning fan is seen to slow down+stop in air, an irreversible loss of "energy". But for an information theory view, this was an experiment in which

1. The air in the room was used to get information about the fan (speed/ direction/ shape)
2. The fan got information about air in the room (speed/ density/ viscosity)

In the course of the experiment, the information must have been conserved but has been transferred, and the experiment would not repeat by itself. By setting up the experiment in an appropriate way, we can cause information of interest to travel to us, while normally we do not care what information is exchanged back to the sample. In this theory we must consider the latter as well. We can deduce that the information exchange for all common properties is space-dependent, and seems to be decently characterized by exchange between two bodies. The law of conservation of information requires that any information exchange must be *symmetric* with respect to the exchanged quantities. For instance in a general system of N particles, each of which may have a state of 1 or 0, we can say that

the total number of 1s and 0s is constant (conserved). We have not defined any mechanism or mode of interaction, so this system is completely static (this represents all classical physics approaches where an "external observer" describes all states and applies all laws by iteration in an external time-based universe). But if we were to define a dynamic system that conserves the information (experimental measurement of 1s and 0s) any interactions between the particles would have to be re-distributions in nature. If we defined a system such that interactions are a physical inevitability, we would have a real world physical object/experiment. So, *Quantization law*

> Any quantized information can only be re-distributed and cannot be altered

Then we see that n-body exchanges are possible, ie 001100 $\rightarrow$ 101000. But experimentally, we see that the particles participating in any exchange (that is characterized classically) must be spatially dependent only. For instance a sheet of paper can be used to block out the sun, because the paper atoms will preferentially interact with the eye, excluding the sun and the rest of the universe. Experimentally, it has been convenient to assume that most interactions occur as a sequence of 2-body exchanges rather than the general n-body redistribution.

Information theory: Things can be explained in terms of information (result of all possible experiments [2] on a system = system)

Symmetry theory: Systems are defined by their symmetric and asymmetric components (these determine properties of classes of systems without the specific details that make systems unique) - this leads to the possibility of creating simple frameworks and classical physics theories (system = symmetry + asymmetry)

Thus the number of symmetry/asymmetry relations = information about a system. Some thoughts:

1. Physics theories (frameworks) can only be based on thought + real experiments and because they are symmetric they can only re-cast information given as input $\rightarrow$ thus theories have *no* predictive power

2. Frameworks (system definitions) follow the uncertainty principle - more precise/ accurate ones are also less broadly applicable

3. Causality is a crucial element that must emerge from a combination of symmetry+asymmetry (time+symmetry $\rightarrow$ causality, and asymmetry in process $\rightarrow$ time)

[2] all mutually exclusive/orthogonal experiments, ie each measuring an independent quantity

4. Frameworks are ubiquitous → they are a consequence of how nature works and a reflection of underlying symmetry *and* asymmetry (that is context-free)

As described previously, systems are composed of symmetric and symmetry breaking components. The symmetric components are degenerate in a sense, due to the symmetry itself, thus applying equally throughout the system. In conventional frameworks, the symmetric component corresponds to the "rules" or "laws" governing the system. Typically these are framed as equations, where the equal sign is a representation of the equivalence symmetry (which makes equations so useful, as described earlier). For instance, conservation of mass or $F = ma$ are symmetries of the system. The symmetry-breaking components collapse the symmetric system (of equations or a physical one) to a certain possibility of initial conditions/final outcomes. In $F = ma$, the distinction between F, m, a is a symmetry-breaking component. These components determine what results an experiment will obtain (referred to as "information" earlier) whereas the symmetric components determine what experiments are meaningful to carry out, or the architecture of the system (of the "storage medium" of the universe if there were one). We note also that the symmetric aspects of the system are the underlying reason that models and computer simulations of reality can be used with certainty to make predictions about the world - even "macro-scale" or human-sized models which have no notion of (ie) atoms or the universe are completely valid. This in turn is enabled by a complex cancellation of underlying elementary symmetries such that only main ones are presented (mostly). Thus the symmetries of Newtonian mechanics are not those of quantum dynamics, which in turn are likely not those of nature.

Why symmetry? For a “universe computer” to make a universe without constraint requires an initial ‘blank canvas’ or ‘nothingness’. Then the only way to define this nothingness is not by any definite properties but by relations, by what it allows – it allows everything but at a symmetric cost, so as to always conserve its own nothingness. The presence of these symmetry relations is the elementary structure of physics. This is an interesting explanation based on [`https://www.youtube.com/watch?v=Dw44V15xgPo`], though I disagree that the information is ‘infinitely malleable’ as that provides no explanation for the reality of the world we experience - asymmetry is necessary.

The common statement in logic is $A \to B$, $B \to C$, therefore $A \to C$. From an information theory point of view, however, such a statement is inaccurate since it does not conserve information. Namely, the B is lost! The correct way to write the conclusion would be:

$$A \to B,\ B \to C,\ \text{therefore } A \to B \to C$$

This way we do not lose track of (ie) the experiment that led to a particular result ("measurement") as is done in scientific papers by referencing sources. However we must go beyond this construct and recognize that the nature of the experiment itself may affect the outcome, even when what is nominally measured is the same. This easily demystifies some results of quantum mechanics such as the uncertainty principle - all that is claimed is that the experimental outcome will depend on how the measurement is carried out and on the particle/system history. It is surprising only because, by luck, physics on the human scale mostly cancels this out by various symmetries, or a scale mismatch (observing big objects using tiny photons). However this still occurs on the human scale, such as poll results affected by how questions are worded, machines failing in some cases but not in others, and measurement of distance/speed dependent on what device is used for the measurement. All these examples constitute the B aspect and must not be ignored in a complete information theory.

Next, we face the tough question of how to define "measurement". In a very real sense, there is no true absolute measurement - all values we use must be in relation to something else. Thus for an information theory we may say not that "the speed of light is c" but that "the speed of light is n oscillations of atom x measured by experiment y".[3] Then information theory must be a relative theory.

If information is observed but does not affect anything, there is no proof it was observed in the first place. If it does affect something, that means it will be passed on to other experiments and that a physical law can be formulated to explain how it affected what it did. Thus for any meaningful definition of information it *must* be exchanged and never unidirectionally transferred, even outside the universe by a creator unless the creator just watches and doesn't interfere (if it interferes, we can formulate a physical law/learn its intentions and thus an *exchange* will have taken place).

It is claimed that, for a useful definition of information, there is no possibility of a unidirectional transfer or observation, thus by its very essence information must be exchanged. We start with the concept of an external creator and then generalize this to real experiments. Assume the case that a creator has made a model system, then there is nothing to stop it from observing the system's properties without the system being aware of the observation. This constitutes a "copying" of information. Now, if the cre-

[3] the SI system achieves this, here it is important to see that the resulting units are a matter of convenience for communication and not absolute physical truths. The units themselves are an emergent feature of underlying universal symmetries which we have deemed particularly useful.

ator/observer makes no use of this observed information whatsoever, there is no way to prove objectively that the observation was carried out - ie there are no effects! It is thus quite meaningless to have this kind of observation and physically impossible to justify a mechanism that would allow it. The other situation is that the observation is used by the creator to somehow intervene in the model universe. Then, the inhabitants of that universe will observe these interventions as physical laws, unaware of the creator's role and unable to find it in any way. Thus, inadvertently, information about the creator (and its universe) is transmitted through these interventions as physical laws or perhaps their violations. A final case is if the creator's observations have no effect on the model universe but have an effect outside the model, in the creator's universe. In this case we must look at the entire life of the model universe and consider the information used - we will find that the information given by the creator to construct/evolve the universe is exactly that which is transparently observed by the creator, and thus again information has been exchanged through the initial conditions and "eternal" laws of the model universe. Now, instead of a model universe, consider a real experiment carried out in a lab. The classical view is that of an experimenter as creator, choosing, controlling, and observing the experiment. By the same logic as above, though, we see that such a view is incomplete. For in the very act of picking a system/control variables/adjusting parameters between trials/carrying out multiple trials, the experimenter provides an information input to the experiment. Questionable quality/dubious experiments attempt to get more information out than was put in (ie certain aspects not controlled, chemicals not pure enough) leading to unrepeatable results or false trends. Over-designed experiments use "overkill" tools to get out less information than they could have.

We might also consider another view on this. The first claim is easy to believe: that the experimenter does not observe a sample but rather interacts with it. So in a microscopy measurement I carry out, I "tell the sample" which spot is being tested, what parameters are applied, what the probe method is. And the sample tells me what properties it has. The aspect more difficult to believe is the idea of who is controlling the experiment, or "in the driver's seat". The obvious view is that the experimenter is in charge, starting the experiments, collecting and publishing the data. But in a very real sense, it is the experiment (sample) that is in charge, for the data it provides is what the experimenter will publish, and will determine what the experimenter or other experimenters will do next. This shows how the notion of "in charge" or "controlling" is one that we have defined for our convenience (which has real explanative power due to symmetries allowing exclusion of the middle segments of large cause→effect chains, a lossy compression algorithm that allows us to interpret/understand the complex world around us) but does not correspond to the reality of countless inter-

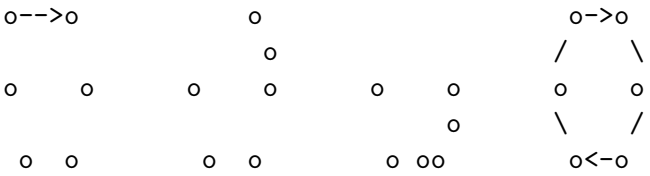
related influences.

Consider the transformation

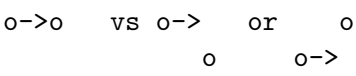
$$[a, b] \rightarrow [(a + b)/2, (a + b)/2]$$

where the output is the average of the two inputs. This transformation results in an information degeneracy since the input cannot be determined from the output. I question whether such processes can occur in nature, since they would satisfy the information exchange criterion while providing an analog for the observed 2nd law of thermodynamics - ie the spontaneous increase in entropy (decrease in possibilities for energy extraction).

A fast gas molecule is introduced into a ring. We expect that collisions with other gas molecules will spread out the momentum such that eventually the molecules travel in uniform velocity:



Normally, elastic collisions would not exhibit this behavior. To observe this, there must be some "information dilution" or degeneracy mechanism that is not a 1 to 1 mapping. For instance, a collision of 1 molecule with 2, or transferring the collision energy into both linear motion and vibration (heat) of the target molecule. A simpler case might be the physical nature of the collision, head-on vs grazing incidence, which splits collision energy among multiple directions of motion/dimensions.



We see that head-on collisions (which do not "dilute" information) are less common than grazing ones, and that grazing ones tend to exchange only some fraction of information rather than 100%. That means a particle's initial state (information) gets exponentially diluted, until it carries an equivalent amount of initial information as the other particles whereupon the exchanges do not effectively transfer net information. Doing a mathematical analysis with a geometric treatment to find probability (cross-section) of various grazing angles and resulting information exchange in 3D leads to the attainment of the Boltzmann distribution (in 1D information is fully conserved (superconductor), and in 2D a non-Boltzmann but similar-looking distribution is observed (thin film phonons/surface plasmons)).

A steady-state analogy of the above thought experiment is the transmission of force in a solid material. For instance applying a point load on a surface results in a spread-out surface load on the other side:

```
   \/  Point force down
--------
--------
^^^^^^^^ Surface force up
```

The load, having been spread out in space, can only be concentrated again by having (ie) a sharp object that will re-apply a point load.

I argue that partial information exchange leads to the concept of entropy and the observed macroscopic behavior of systems. Consider a molecule entering a tube filled with similar molecules (a):

```
        (a)              (b)                  (c)
     [  o  o  ]      [   o  oo]           [o       ] o->
o--->[o   o  o]      [o oo    ] o--->     [ o  o   ]  o->
     [ o o    ]      [     o  ]           [   oo   ] o->
```

Complete information exchange will result in a single molecule exiting the tube (b). Partial information exchange will result in diffuse force as in (c). This is the case due to the nature of information *exchange* - when the faster molecule interacts with a slower molecule, the outcome is two molecules that are closer to each other in (the initial molecule's) speed. In theory there might be some type of exchange in which the faster molecule gains more speed at the expense of a slower one, but this is countered by the effect of relativity - the particles interact in their own relative frame, in which both particles are on an equal footing - that is, there is no notion of a faster/slower molecule thus no "preferred" information flow direction. We see that after a collision that is grazing, the x-velocities of molecules is partially exchanged, while the y-velocities (which started equal) remain equal.

```
o--->   o              o/ v=(0.6, 0.1)      o       o--->
v=(1,0) v=(0,0)        o\ v=(0.6, -0.1)     v=(0,0) v=(1,0)
```

From this, I argue that the "original" information content of the molecule is exponentially degraded with each interaction, and when occurring similarly for all other molecules it means that "individuality" of particles exponentially decays to a "group" common state. We call such systems equilibrium systems.

We may get a sense of the true information content of a system by preventing partial-exchange interactions, or minimizing their extent. This

might be done by taking a "snapshot" of a system, or by making use of "information input" that is faster than the "information degradation rate" (which is based on the frequency of interactions). A case of the latter is turbulent flow - the molecules experience irregularities in a wall surface and transmit them but because of the flow speed they are unable to reach an equilibrium state and behave with the complexity expected of a multitude of individual molecules, requiring particle-tracking simulations to understand. Conversely, when system disturbances are slow enough such that information quickly degrades, we see no effect of individual particles. In fact, we see the behavior of one "macroscopic molecule" that behaves in essence like its microscopic counterpart and carries the same information content. Thus we can describe laminar flow with only a few quantities like velocity and location, whereas turbulent flow requires such a collection of quantities for each individual unit in the flow, since they no longer can be said to degrade to an equivalent singular information content. What we observe in a wire is the behavior of a "huge" electron with voltage V, what we see in a water pipe is the behavior of a "huge" water molecule under pressure and other constraints.

Earlier I posed a question whether "larger" systems have more or less information content than "smaller" systems. By larger systems I mean those with an overarching order, such as a radio vs a chunk of material resulting from melting the radio. The answer is not obvious - the radio is in one sense the more complex system, being able to interact with radio waves in a desirable way, but the molten chunk is also complex - having more irregularities in atomic arrangement and such microscopic information. To resolve this consider an analogy with information systems - where a Morse code transmission may be a "large" system while a broadband cable transmission may be a "small" system. Which one "carries more data" is a purely human interpretation - without advanced electronics the Morse code is more info-dense while the cable system is ‘white noise’, but with advanced electronics clearly more data is being sent through the cable. Consider a binary signal comparison of the two:

```
Morse   000000....  11111...    000000...
Cable   010011....  10111...    101110...
```

To the universe, either combination is *equally unlikely*. This is like the fallacy in a roulette game that red or black is ‘due’. We are forced to conclude that the information content of both data streams is the same in a universal sense. Yet we have an intuitive problem with this - obviously the long strings of 0s and 1s in the Morse case can be written more simply by compacting them? Thus for 100 0s in a row we could just write, well "100 0s", and ‘compact’ the transmission. Then, for completeness, we must find

a way to convert the number 100 to binary, and also find a way to transmit the idea of the pattern itself to the recipient so that the recipient can recover the original data. This is in essence how zip files work - requiring a special program to open them. To be self-consistent, we *must* reason that the information content of 100 0s and the number '100' along with the pattern to generate 0s in such quantity have an *equivalent* information content. This is a way to find the information content of a pattern, which is identically a mapping, or a *function*. I would claim that to the universe neither the Morse code nor the cable code is preferred - and for this I refer to the *experimental* successes of the concepts of entropy and the ensemble. In effect experiments on gas atoms (for instance) show that they are equally likely to be found in any arrangement - and such a theory leads to testable+accurate predictions. Our intuitive dissonance with the idea that both binary streams above have the same information content stems from how evolution has programmed us to search for "simple" patterns (like repeating 0s) for the universe has no concept of "simple". It is our luck that many laws have a simple formulation in terms of our mathematical language, but we have to be cautious to claim whether a "pattern" exists - it may be "evident" that the repeating 0s can be compacted but if we were looking for other patterns (like Fibonacci numbers mod x in base 2) we might have seen that the cable code is also described precisely by a pattern. In that case we would concede that *that* pattern (along with initial parameters/length) has the same information content as the original cable code. In other words the information content of the underlying message cannot change with any given algorithm and therefore there must be *no absolutely compacting* algorithm (one that will only compact input data). This can also be reasoned by trying to repeatedly feed such an algorithm with its own output - eventually collapsing any data to a number (of repetitions to a null result) - conversely if this is possible, then the data has the information content of a number + algorithm. Any algorithm that compacts some data must make bigger other data. But in all cases algorithm+output has the same information content as its input. Finally returning to our physical system of the radio, we realize that what we consider 'orderly' or 'useful' or 'large' is a purely human construct - the molten chunk may indeed respond in useful and complex ways to inputs that are unknown to us like cable-receiving electronics were unknown to previous generations. We must conclude that both systems have the same information content - though widely different in their human applicability - which gives further reason to believe the earlier assumption of information conservation (this extends to a per-particle information model by repeatedly splitting the system and finding the result unchanged - thus the info of a particle is also conserved).

So far I might say:

- The information content of a number $(-\infty, \infty)$ is reduced by 1/2 by a binary digit
- The information content of data reducible to a number by an algorithm (function) is the information content of a number + information content of the algorithm
- In a sense a function defines a system (with symmetry/ asymmetry/ info) and thus has the information content of that system
- If two algorithms can reduce the same data to a number their info content is equivalent

Everyday we are exposed to the effects of causality. Typically cause and effect occur in the same distance/time scales and are easy to tell, but sometimes a mysterious 'random' occurrence takes place, a glimpse of chaos underlying our imagined orderly world - turbulence, lightning, fracture - I call these 'upconversion processes' since they allow microscopic effects to have macroscopic consequences. Similarly there are 'downconversion' processes in which the microscopic particles are carried along by the overwhelming momentum of the larger system - global climate change, pressure drop causing turbulence (via external pump), loading of material causing brittle fracture. As considered above, 'large' and 'small' are human constructs that make things easier to explain, but in a universal sense these processes should not be viewed as mysterious, but simply a manifestation of the ever-present information exchange occurring across all 'scales'. Nonetheless these processes have clear power (from human-operated machinery (controlling hand-operated levers applies huge forces) to computers (tiny transistors having a macroscopic impact) to weather (a big system has impact on our tiny brain cells)) which comes from not just simple exchange of information, but the ability to *control* exchange of information. Consider a simple upconversion process - a hydraulic valve. When shut, it disables/interrupts information exchange between two reservoirs. When open (which can take little/no work) the information exchange is allowed, leading to fluid motion and exerted forces. Consider a simple downconversion process - climate change, which as it changes limits and constrains the actions of smaller beings like ourselves affecting what we can and cannot do without doing any nominal work. Such conversion processes are perhaps more appropriately termed 'control' processes (later I consider the point that all processes are control processes to some extent) since they control what the underlying system can and cannot exchange information with. Although it seems strange to refer to brittle fracture as a 'control' process, this is what happens in a sense - the system has been set up externally (load) such that a particular defect or crack has control over whether the

rest of the structure shatters or stays together - similar to the control of electrons by a semiconductor or the aforementioned hydraulic valve. The control processes do not necessarily require an expenditure of power, and could in fact be used to generate power (regenerative braking). However we may still find that these processes result in an overall increase in entropy (total information uniformity). [4] At this point we come to the more genuinely mysterious, entropy-reducing processes. I cannot offer convincing proof that these exist, however I would argue an obvious example is the gravitational accumulation of matter (starting as diffuse gas/dust) into orderly planet systems, stars, and galaxies, a clear opposite of the classic thermodynamics problem where a gas starts localized on one side of a partition and spreads to cover all space available to it. I would claim that the action of gravity is an entropy-reducing process. Might there be others? The most unlikely emergence and evolution of life, and its persistence, suggests that other such processes act in (perhaps) chemical bond/structure formation, or even in nuclear reactions. This remains an interesting issue for future consideration.

Entropy could be seen as "energy purity", and at this point I seek to elaborate on the concept using the quantum mechanical bath-coupled oscillator. Briefly, entropy arises naturally from the QM tendency of energy to seek all possible states, and occurs when the path of "desired" (human-useful) energy propagation is not very well defined by appropriate conductors and isolators. Interpreted in this way, a number of ambiguities are removed in terms of "usefulness" of energy, or "disorder", and the process is more general. Energy can shift between forms (oscillators) given an appropriate QM coupling between these forms/states, and will stay in one state in the absence of such coupling. So, a gasoline tank does not spontaneously heat up, nor does a moving piston. By introducing elements to the path which are a potential energy coupling (anything interacting between stationary and moving parts) such as bearings or rollers, or insulators or length along a real (resistive) wire, we enable some of the energy (and, in time, all of the energy) to couple into all available states, of which a thermal bath is a great sink because of so many degrees of freedom. [5] Yet other elements, like the combustion chamber in an engine and electric motors, specifically are designed to convert between types of energy. Since we can convert energy types ideally with 100% efficiency (KE-PE device - pendulum/orbiting planets) we see that the fact that all states are sought does not mean there will be an even energy split among them (on average/ensemble, though,

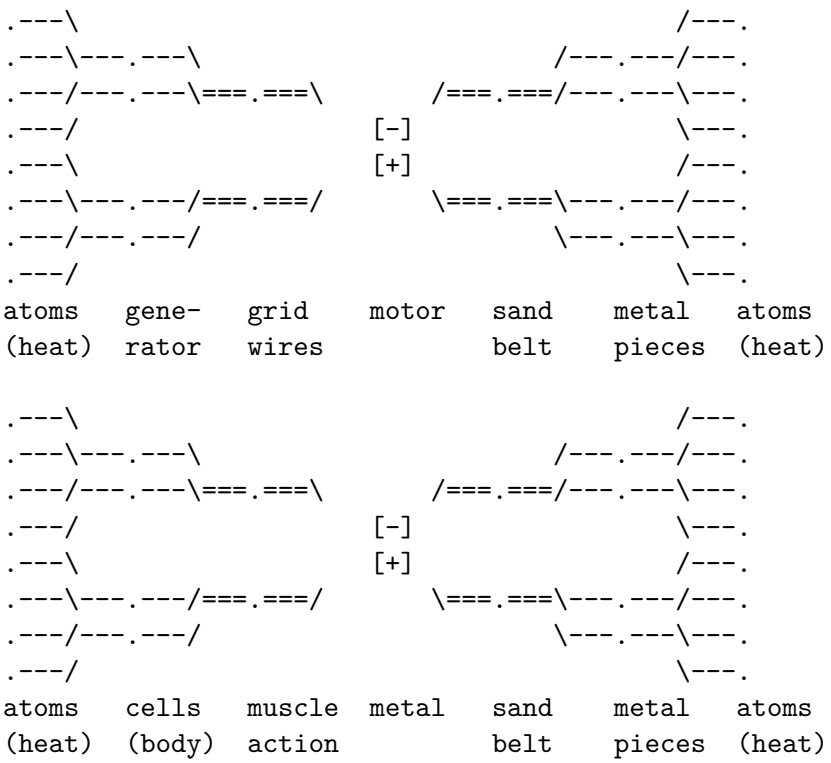
[4] precluding a controller like Maxwell's demon

[5] an "efficient" process will make it very easy for energy to couple into human-useful reactions and hard to couple into the thermal bath (mostly useless). The lack of degrees of freedom eliminating thermal bath coupling is why superconductors have to be kept cold.

this is true: see equipartition theorem). Then, machines and transmission elements can exist that function with 100% efficiency.

A question occurred to me when using a belt sander to shape an aluminum part: I am holding the metal piece against the belt and it takes minimal effort, yet the relativity principle says this is no different than if I moved the piece on a stationary belt, yet that would take a lot of effort. How does "the universe" know that when I use the belt sander I don't have to put in effort - and where does the effort come from? Earlier I mentioned that absolute energy is questionable while energy difference is definite. And there is one energy difference: between the metal and the sanding belt, which move at different speeds. Putting the two in rubbing contact against each other will tend to reduce rather than increase the energy difference. But in practice this energy difference persists over time - why? It must be counterbalanced (like a loop, see below) by another energy difference on the belt or metal. If I move my arm relative to my body, I create an energy difference at the point of unequal motion - in the muscles and joints. If I stay stationary, I close the force loop but not the energy difference loop. With the belt sander powered on, the motor closes the energy loop - it contains the fastest component in the sander - the rotating electric field - which the rotor tries to attain, by the same mechanism as placing the metal against the sandpaper will tend to equalize their speeds. From this view it is easy to see that bearings and belts, which exhibit relative motion, all will affect the energy difference balance one way (or another). My body does not exhibit internal relative motion so I feel no effort. The fast motion of the e-field in the motor is in turn balanced by even faster motion of some generator in the power grid, and so on to some complicated questions (where does it all come from?). So in using the belt sander, I am saying "I think the grid's e-speed should be zero", which propagates as a slight phase shift onto the grid, and eventually onto the generator which then slows down accordingly (and so on to the "ultimate power source"), which is quite impressive in that I am tapping into a huge energy-difference loop and readily affecting it. The process looks fractal in nature, and we

will continue to see such fractal shapes in further exploration:



While traveling abroad, walking to a metro station to get to the airport, I thought about how the transportation network is set up like a fractal. One of the measures for "optimal" fractal systems is equal time spent along each path segment: such as for a binary list search this implies a fully balanced/symmetric tree so for each member the search time is constant and 1 unit is spent on each successive level. Perhaps something similar can apply to transportation. So I would spend the same time (say) walking/on bus/subway/airplane - which is not really true in reality but all within an order of magnitude. I spend most time on the airplane, which actually makes this faster - the fastest limit is a plane door-to-door. Thus we see such a fractal arrangement is not fastest time for me but rather fastest time given all other users, perhaps shortest distance traveled or shortest distance of infrastructure - but practically, equal *loading* of infrastructure - an impedance match of inflow and outflow capabilities throughout. In such a system, how could I distinguish where on the fractal I am, for purposes of measuring and optimization? Ideally there would be no absolute fractal level, but still we can distinguish between straight segments (vertices) and junctions (edges/points), and this (along with time) gives a metric for a length of each fractalline segment on the journey. This distinction is made

by notion of convergences: on a segment, all nearby pieces evolve together in a coherent fashion, whereas at a junction, many pieces that were not previously nearby (in their evolution) are joined and become nearby or vice versa the nearby pieces are split up into not-nearby pieces that no longer interact. As above, drawn out this makes tree-like (with soil roots and air roots) diagrams for most engineering/power processes, considering both the microscopic sources of power and microscopic reservoirs of heat but a single path of evolution through a dissipation pathway like a motor. At the same time this distinction is not really satisfactory - since in reality the particle trajectories do not ever 'converge' onto a single line - that would be symmetry-breaking, so we can only claim a fuzzy "nearby" area - but what constitutes nearby is not very clear. This is to say, when can we conclude that given particles are on a straight segment? Perhaps only by saying they do not interact with outside systems by joining or separating - namely thermodynamically isolated. All the particles in an isolated/inertial system will evolve coherently, and at fractal vertices/points will evolve by interacting with other systems. For example, a bullet fired at an object: inertial when flying, then creating a cascade of inertial/collision interactions (and originating from an "inverse cascade" from the brain neural net to the striking pin of the gun).

The compilation of this text in itself was only possible due to fractal structures. I had filled up a number of notebooks with ideas, meaning to eventually write them down in a coherent way, but somehow not being able to start until I realized that to arrange everything I should go through all the notes and make a list of topics, then group them by theme, then go "in the weeds" and start working on the text. Without this fractal approach, I literally could not have written this book - it is too much information to handle without ordering by groups and subgroups. Doing such ordering is a physical requirement. [6] There is some deep principle here about how information works and can be handled. It seems that fractal-like structures thus abound in the surrounding world (trees, centralized networks, concentration of control, energy flows). The example of turbulence comes to mind: similar patterns over many length scales, recursive structures. And what is the point of turbulence? To increase entropy, to distribute the atoms in an optimal energy-dissipating way given the external boundary conditions. The fractal recursive structure is a hallmark of such entropy optimization. I argue, life on earth is also a complex solid-state (vs gas in clouds) form of entropy optimization, which is why we see fractal structures spontaneously

[6] our brain is intrinsically good with hierarchical structures/trees, and interpreting info in this (fractal) way helps us pick a course of action (this is why computer file systems, of all possible ways to implement and display them, employ the notion of folders and subfolders). Also seen in science to understand complex phenomena (ie split up into parts, most impactful on top level, then more and more specific on lower levels).

form - as they are most effective at this optimization and are a stable limiting case for evolution. Consider consciousness itself as it functions within the brain: information is collected from multiple points, centralized, and sent back to multiple points, making a fractal-like structure of the instantaneous qualia. Consider the communication networks we've established (internet, TV, business inventory/sales, postal services, transportation and tourism), which all serve to enable life's needs and thus increase entropy in an optimal way in their own sense, which end up as fractals because such a shape is most effective/useful for us to choose to construct. I tried thinking of a way to create an internet service that is fully distributed and decentralized - where each user communicates with others nearby. It works well enough for small localized groups, but scaling this up to any modern usable scale becomes quickly impractical but a solution awaits: make some nodes 'central', those can carry/tunnel more information between distant points, but then information about who should contact which central nodes needs to be distributed, and we quickly form a fractal, centralized network - just like what the existing ISPs and cell phone companies have already established. It is physically impossible to satisfy the needs of large-scale entropy optimization/communication/information exchange (which are all one and the same) without a fractal structure to control the flows. At small scales, a distributed and fair/decentralized solution works, just like laminar flow in pipes, but at a certain turning point centralization and emergence of complex, interrelated, recursive structures takes place - turbulence, life, intelligence, multi-variable optimization, evolution and memory and prediction, stable and unstable systems. Business (mines → processing → manufacturing → warehouses → stores → individuals), government (society at large → representatives → governing bodies → president → lower ranks → administrators → affected individuals → all individuals), armed forces (diffuse intelligence → field operations → advisors → general → lower ranks → lowest ranks → affected individuals), transport (walk → bus → metro → airplane → car → walk), internet (PC → router → big router → router → PC), research itself (knowledge sources → relevant knowledge → applications) are some fractals in man-made living systems. In nature: lightning, trees/plants, clouds/storms, brooks/streams/rivers, ocean flows, animals (resources → animal → wastes), solar energy flow, can all be described in fractal terms. Are there structures which are not fractal? Invariably they are either inanimate (not participating in information dissipation) or at small scales or inefficient and susceptible to takeover by better fractals: family is a loose network though there is a tendency to have an 'oligarch' in charge (centralized), school classrooms/coworkers/peer groups tend to be loose though still a social 'pecking order' emerges, the road networks in old cities tend to be more egalitarian/distributed but also slow to the point that some are converted into bigger/faster roads to enable more effective

travel resulting in a centralized structure, neighborhoods and individual houses tend to be more on an equal/non-fractal footing though still things like homeowners' association emerge and the government extends its fractal arm to provide some oversight/control. Fractal structures are unstable in the absence of entropy flows and automatically emerge in the presence of entropy flows, fractals are life, maybe even consciousness itself.

Consider me pushing on a wall.

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 o  ||
-|->||
/ \ ||
TTTTTT
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There is a force loop established, such that my forward push is balanced by the backward push my feet exert on the ground. Half of the loop is in my body - between hand and feet - and half is in the wall and floor. The rest of the earth doesn't need to know about this loop - it is not radiated. The loop ensures conservation of force and momentum; I believe a virtual loop can be drawn for any conserved quantity, which may be elegant because loops can be seen as particles (string theory vs loop theory?). But how does this loop get created? It's not instant, so what is it that causes that specific loop shape to take place? What is the situation in the moments before the loop is closed - can I do things beyond my typical $F = ma$ abilities? Consider a tall ledge similar to the wall above:

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The force loop now will take a long time to propagate all the way around the structure. Am I free to move the wall as I please until the loop gets closed? This has close parallels to transmission line theory and could be calculated in those terms. When touching the wall to establish the loop, some energy will be lost as 'radiated' vibrations - how do the mechanics of this work? Other examples of loops: electric power cord/lines, magnetic flux lines, e-field lines, using a power tool, static shock, buildings and structures (using gravity as one half of loop), pressurized devices (more of

a surface than loop, but still works), metal presses, and hammers (using inertia as half of loop). Based on the fields used in loops, I would claim that loop closure can be achieved through electric+magnetic or gravitational+inertial fields, in short e- and g-fields. An ice skater pushing off a wall pushes against his inertia - causing loop closure to wall/earth inertia through the g-field. This 'loop line' will go through the air, like field lines on a magnet. [7] Stronger arm-wall forces can be achieved with a higher skater mass (greater radiating efficiency of force loop lines into the air) or by rigidly standing on the floor (directly coupling force loop through solid floor). Energy difference can also form loops, where like magnets objects will tend to 'align' to dissipate energy in the same way. Thus the energy created by the skater's arm muscle is balanced by g-field closure on skater's body (and wall).

Everything in the universe must be interconnected. All events must affect all other events, to make a coherent intertwined whole, like threads fitting together to make a piece of fabric - any loose threads fall out and don't make a contribution. If some event did not affect other events, it would be possible to draw an 'isolation boundary' and thus split the universe into different-evolving parts, something which I assume is unallowed under the concept of a single universe. Even testing for the presence of such a boundary already breaks the boundary as then I know that some part of the universe hasn't interacted with another, but now it has interacted with my measurement and my measurement has interacted with the rest of the boundary, so as long as I am in the universe and observe the measurement the boundary gets coupled to my actions and is now leaked/breached. Every action will affect every other action, future and past (though as regards the past, we like to think of causation so we say only the future actions will be affected by present actions, but also recognizing that present actions have been determined by past actions. Without assuming a time arrow, we could say equivalently that every action spreads out to future and past influences, and across all of space).

[7] though it's not detectable in air (I don't think?) so this point may be dubious. Maybe air flow around objects is an indication of force? This doesn't work for the wall-pushing example

6

Information Couplings

main message: the basic physical gearing and lever mechanisms all work because of the angular nature of space (independent dimensions). Extending the principle to an infinite gearing creates the concept of a valve/transistor, which controls information flows while paradoxically never interacting with them directly, leading into the idea of information flows as computation (with power plant turbine example)

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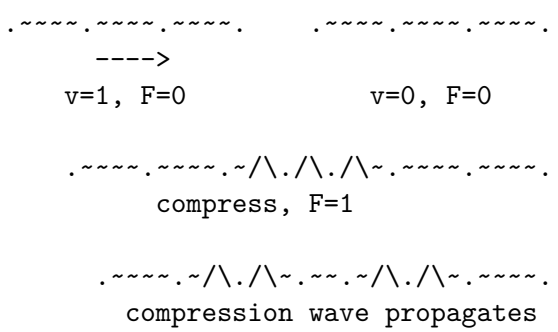
Applying the concepts of information theory to real world experiments shows a seeming contradiction between the law of information exchange and the intuitive feeling that one-way information transfers are all around us. I will focus on the case of a macroscopic measurement (like reading the temperature of a furnace) as such measurements seem to be undeniably one-way. Practically when a measurement is carried out we have an idea of a system (with a spherical boundary) 'on which' the measurement is performed. The goal of a measurement is to tell us about the system, thus the measurement has an explicit dependence on the notion of a spatially bounded system. Measurement, then, is a coupling of information between the system and something outside its boundary, permitting information exchange across the boundary. Surprisingly, it is preferable for measurements to be minimally coupling so as to not perturb the system, as any information coupling leads to exchange with the measurement device/outside and thus disturbs the system. Such a disturbance amounts to an increase in entropy - since partial information exchange (as outlined earlier) will tend to equalize the system and its outside environment (including measuring device), across the system boundaries. So entropy is an essential part of measurement - for net classical information to be manifested at the measurement device, there must be some difference in entropy that the measurement's coupling allows to equalize (the entropy difference then must be maintained for continued

measurement). Entropy-free "measurements" form the realm of quantum computing and bring their own challenges. Places where entropy changes occur give the illusion of a one-way coupling (despite elementary exchange being two-way), in the same sense that information is radiated outwards coherently, which is easy to do, while causing coherent inward (space to point) radiation is probabilistically unlikely - partial information exchange still being the culprit here. Because of the irreversibility of entropy rise, any such processes must be regarded as very high information coupling (and high system perturbation), as well as high 'isolation' ie low impact of observer's actions on measurement device. Amplifiers, light bulbs, speakers, even light reflecting off a mechanical dial, are all examples of such an 'isolating'/high information coupling, with entropy change. All measurements that we deal with must eventually couple information into human-sensible forms like visual/auditory/tactile signals. In practical measurements, at least this last stage will be an 'isolating' coupling - since this transfers highly coupled information (big perturbation), to be in accord with the low-perturbation spirit of measurement, our initial/most basic information probe into the system must actually be designed to be low-coupling (ironically) to serve as a limit on the system perturbation, while subsequent stages of the measurement will couple this small information to increasing numbers of particles (entropy-raising) for ease of observation/low risk of perturbation. For example, a thermocouple is used to measure the temperature of a furnace. The furnace boundaries are designed to keep heat in, and disallow heat transfer. To know the temperature we must let that information be coupled to outside the furnace walls, which the thermocouple does by allowing exchange between temperature and electric current, the latter of which is allowed to easily cross the furnace boundary. At this point the measurement is designed to be minimally coupling - so that there is little heat loss from the furnace (through driving a current - same mechanism as Peltier/thermoelectric heating and cooling) and also so any perturbation of the current by external means (ie the measurement device itself) has little effect on the furnace (since at this point the current can just as well be converted to temperature instead - the coupling must be 2-way). Once the low-perturbation information has been transferred out of the furnace though, we can start to make high-perturbation couplings so as to maximally 'transmit' (appearing unidirectionally) the information. The limiting factor on furnace perturbation is effectively what happens between the thermocouple tip and its connection at an amplifier - which creates a tiny heat transfer if there is a thermal difference between the two. At the amplifier, the whole of this (small) perturbation is coupled to thousands times more electrons in a coherent way, such that any possible reverse coupling would require coherent feeding of electrons back - which is statistically implausible and is the nature of entropy rise (amplifiers must by their nature cause an

entropy rise). Amplifiers must be designed to do this without disturbing the primary thermocouple coupling, ie amplifier temperature/cold-junction compensation. The amplified signal, being 'isolated' at least by an order of output current:input current (in that a perturbation to the latter can only have that fraction of an effect on the former), can be handled much more loosely, such as to drive a high-current LED for visual output. The LED itself is a measurement that couples the current in a thermocouple meter's boundaries to light which can escape these boundaries easily. The LED is a big perturbation on the current, and thus entropy-rising and effectively isolating - there is not much an observer can do to convert the light emitted back into a similar magnitude current. An experimenter (human) can directly observe the light and then the measurement can be considered complete here. A high-coupling and high-perturbation measurement such as the LED can be considered as "system evolution", thus blurring the line between measurement and 'regular' system behavior. Inasmuch as such couplings require an entropy difference, this suggests at least two approaches to measurements - having the system act as either entropy sink or source (for instance, by having the thermocouple junction either hotter or colder than the system being measured).

Propagation of forces - when touching/pushing something, how does it "know" whether to push back or accelerate and how much? This happens by a force propagation throughout the object, which can be interpreted as waves 'feeling' the object boundaries and eventually (with dissipative processes) establishing the equilibrium we observe (such as $F = kx$ or $F = ma$). The force propagation is a finite-speed and local process (ie each atom knows and responds only to its surroundings, finite-difference type), paralleling that of transmission line theory but usually among multiple dimensions. Like I and V in transmission lines, force propagation conserves F and v (force and relative velocity). The integral $I * V$ and $F * v$ will both give energy, so both theories conserve energy. The two variables establish an equilibrium in a controlled way since they are coupled in an oscillator (there is a difference between an atom at rest in its potential vs an atom traveling at velocity v in its potential - this matters for propagation mechanism while for equilibrium state only E ($v * F$) is sufficient - not how this explanation justifies the variational energy/virtual work approach used in statics). So,

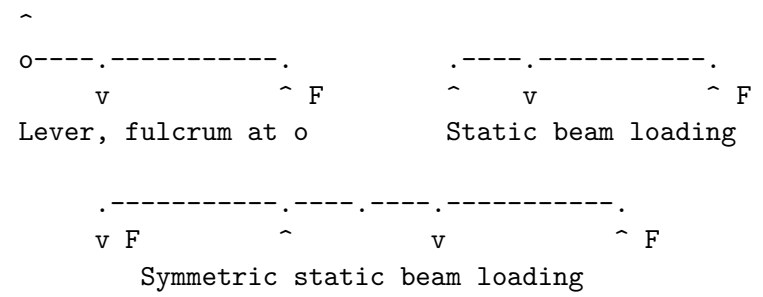
one object impacting another (1D mass/spring) looks like this:



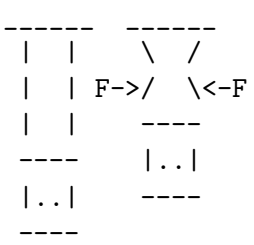
If the impacting object is faster than the force propagation speed, it can pierce otherwise solid materials with minimal force expenditure - only that required to break the immediately adjacent bonds. This is the basis of penetrator missile/arrows/railgun projectiles - they can easily pierce inch-thick steel rendering armor impractical. Doing this *requires* speed. The propagation properties of both objects matter: consider doing a karate maneuver to break a board held by a helper, either held rigidly or held loosely, with an identical punch used to break the board. If held loosely, the board accelerates and hits the helper in the face, and for further insult doesn't even break. If held rigidly, the energy from the punch instead goes into breaking the board and the helper remains safe. Same idea applies when holding a gun with recoil - a rigid hold gives much more control and less kick-back than a loose hold. Same applies with car seatbelts - they attach the passenger to the seat relatively rigidly which gives a gentler deceleration because the passenger stays coupled to the large mass/inertia of the car.

It would be useful here to describe the origin of moment - the possibility of gearing or leverage, on a more elementary level. Of course, conservation of energy means that with $2\pi r$ a longer r must mean a lower F because v scales with r. But this skips over some interesting mechanics - specifically, just how does a rod "know" to increase force transmitted as a function of r (without actually doing virtual work)? Consider a lever that we can

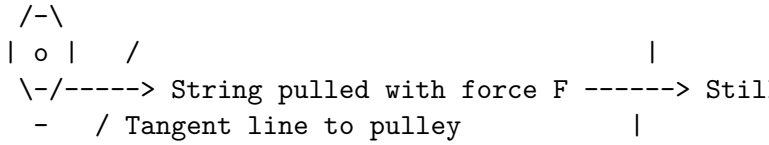
interpret in a static situation as a case of beam loading:



The goal is to understand what allows the beam to hold its shape, because this is crucial to using it as a lever/fulcrum. Strings can be used for leverage:



The force F used to squeeze the strings together is less than the weight W of the box, but nonetheless the box can be lifted. This is because the rest of W is handled by string internal stretching, and is similar to what happens inside a beam with a moment load. Consider a string on a pulley: the force is constant all along the string



F is constant along the string, but the angle of F vs tangent line of pulley at that point starts out at 0 degrees at the pulley and approaches 90 degrees at large r, meaning F cannot oppose circular motion at large r. If r is forced to be constant, pulling the string in a circular motion at r means winding the string around the pulley by a constant pulley circumference over a much longer circumference at r, so already some gearing must occur. The force per unit distance at r thus must be less, to conserve energy. This is achieved by the near-90deg angle between F and tangent at r (the remainder of F, directed towards the rotation origin, is a force component

that exists but does no work since r is forced constant - this contributes to rigid beam bending when a moment is applied).

How can we force r to be constant? Perhaps a set of grooves surrounding the pulley. But also by pushing the pulley: consider a 'rigid column', ie a string that pushes (but not quite a beam, ie no bending):

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 /-\------< Column pushed with force F <------ Still force F
| o |
 \-/
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Same as the string, the angle between F and tangent line at r causes a gearing effect. Once again we must keep r constant, and we can do this by combining the string and the column:

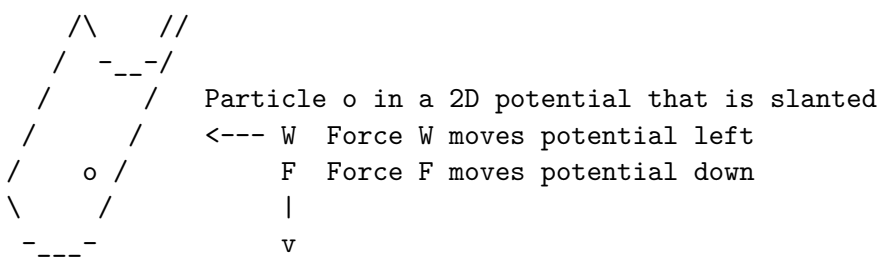
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 /-\---Push-<---\\\\\\\\\\\\\\\\              ^
| o |                            ==============^ Fnet
 \-/---Pull->---////////////////  < Fbend >   ^
```

This creates an effective 'rigid beam' or lever, such that the point at the end can be moved at constant r to achieve a mechanical gearing/force amplification. As $r \to \infty$, the whole of F must be handled by bending forces, so beam deflection increases with r even at constant F. So, the gearing of a lever is essentially an angle effect, such that the applied force is only working against a small angular component of the amplified force, the rest of it going into beam bending and doing no work because r is kept constant by the rigidity of the beam. A similar angle gearing is used with a wedge or screw threads, so the force applied is at an angle to the force that 'does work':

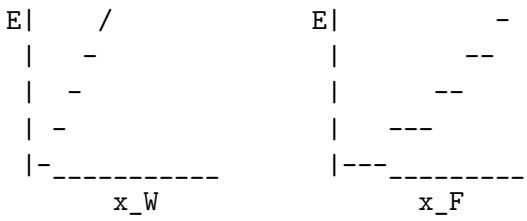
```
     |\ ^ Fup
F -> | \        F < Fup, remainder of Fup goes into Fdown
     |__\
        v Fdown
```

So, this angular gearing underlies pulleys, squeezed strings, and wedges. It seems that the underlying physics require that $F = F_1 \sin(\theta) + F_2 \cos(\theta)$ be instantaneously and reversibly true, ie this is a property of force itself (and perhaps space) that any such angular split is equivalent and specifying either F_1 or F_2 with known theta requires the other one to be a specific value. This can be interpreted in terms of potential-energy wells as

projections along different dimensions (a "microscopic wedge"):



Now project the particle's energy vs displacement along direction of W vs along direction of F:

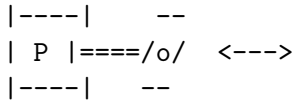


Since energy is conserved, $E(x_W) = E(x_F)$ thus $x_W < x_F$ and $dE/dx_W > dE/dx_F$ and thus $W > F$. The angular leverage is thus allowed by wedge-like shifting of energy potentials along 'soft' projections while the load sees 'stiff' projections. In other words, looking along x_W which is the way the object to which an amplified force is applied see the wedge/lever/mechanism, any small deviation from a desired location requires very large changes in energy. At the same time, looking along x_F which is the way the operator of the mechanism sees the situation, any small deviation from a desired location requires only small changes in energy - because, as shown above, the mechanism is designed such that it generates internal (structural) forces that are determined by the operator but that interact only with the load.

I mentioned a while earlier the notion of upconversion processes (amplifiers, valves, transistors) which seem to hold a special role in their essence for operation of any machines. Here I will take a closer look at just what these processes accomplish, and what gives the illusion of their one-way (isolated) nature even when underlying physics are always 2-way exchanges. We may more appropriately call such processes "directed" as opposed to one-way or controlled, as will be made clearer below. All measurements have at some point a coupling that permits the quantity of interest to exit the system boundary, and all such couplings are inherently 2-way and thus are designed to be physically small compared to system size (so outside influences can have at most a tiny impact on system energetics - and on *system evolution*, contributing to the one-way notion of measurement which is strictly not true). In order for us to make use of this information coupling without

affecting the initial system (as that would mess up the very measurement we are trying to make), an entropy-generating amplifier type (upconversion) device is used, which may be as easy as looking at a dial gauge illuminated by a light source (where the entropy is generated). This coupling seems to be quite different from the first type, as here there is an entropy change and it is decidedly not a conventional 2-way exchange: the amount of light falling on a gauge really has no effect on the measurement even in a theoretical sense (if light is assumed to be isotropic - usually it won't be in which case there *is* a coupling but it is very small indeed [1]). What is the difference and is it a foundational one?

Consider a pressure-actuated valve:



The pressure P in the tank moves a plate with a hole o in it left and right, and this hole cuts/allows flow through a pipe (like the early valve example). This is a general amplifier model that can be applied to other upconversion processes. At first glance this is one-way: the position of the valve affects the flow, and the flow doesn't affect the position of the valve; the valve could be said to control the flow. In reality there will be a finite coupling between flow and valve, at least from Venturi effect causing a lower pressure at the small-area aperture [2] thus a faster/slower flow will exert some small force on the valve position. But with more clever valve and flow design it seems we can take the ratio of output force to valve force to be effectively infinite, coupling information from one valve to many particles. In a real sense the valve doesn't care about the flow at all: the portions where it blocks flow exhibit 100% information exchange with the valve material (elastic collisions) and the portions where it opens the flow exhibit 0% information exchange with the valve (valve doesn't know whether there even is any flow, it simply doesn't participate in exchange). In both cases no energy is transferred by the valve, so it may be more logical to argue that entropy rise is a function of the flow, not of the valve. In this way, paradoxically, the flow "doesn't care" about the valve either! [3] The valve is not an effective measurement device because it doesn't actually interact with the

[1] or maybe if light were fully isotropic there would be no way to read the gauge so no information is coupled. This may be a deeper indication that the minimal extent of the 2-way exchange even in upconversion processes is based on the information transferred, giving a physical unit of information.

[2] Venturi effect can be interpreted as a directionality of pressure in a moving particle

[3] *we* care, because we can tell the difference between *potential alternatives*, what is and what could have otherwise been. But the flow just evolves according to the system it sees, valve or no valve.

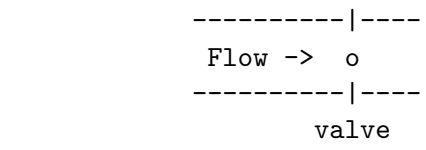
flow, going from 100% to 0% exchange both of which are energy-preserving (and entropy-preserving, and information-preserving ultimately) - this is eerily like a quantum "black box" measurement where carrying out a "measurement" but then immediately carrying out an operation which "destroys" the classical information of the measurement makes it impossible to get information out, restores the quantum particle to its initial state, negating simplistic "wave collapse" interpretations [4]. But then we must conclude the flow doesn't care about the valve - indeed if we equalize pressure on both sides of the valve there would be no flow and no influence of the valve. What the flow cares about is the presence of a pressure gradient in the system, which the valve can 'show or hide' depending on valve status; further evolution in the flow (turbulence, throttling) which are energy-dissipative depend on the pressure difference and flow media properties, not on the valve. So, what the valve does is "set a course" for time evolution of the connected system. Two systems starting in nearby states and made to evolve along slightly different courses will over time become arbitrarily far apart (like chaos theory), and this is what gives an amplifier its resolving power [5]. The one-way appearance comes from the irreversibility of energy dissipation of some part of the system, the amplifier/valve determining the path of dissipation can do so with only minimal energy expenditure, and we interpret the evolution of the system as "information" by comparing it to *potential alternatives* which don't actually exist but could exist according to our understanding of reality. The same way, a rudder on a boat that is locked in place at a certain angle sets the boat's travel yet the boat's travel doesn't affect the rudder. The rudder is not energy-dissipative as it is locked in place; what it does is set the boat on a given trajectory that is also affected by boat motion (engine)/wind/currents. Over time the effects of different rudder angle become evident, given that there is energy dissipation (ie boat not standing still). Forcing a boat along a specific course does not change the rudder position (such forcing is, rather, made easier or harder based on rudder position), while letting the boat travel with a given rudder position does change the course that the boat takes. What is achieved is not any energy nor entropy difference but a difference in what, of the countless ways for a system to evolve, actually takes place. It is like a rotating arrow road post, where travelers come along and follow the arrow direction they see. Rotating the arrow takes minimal effort, its impact is only meaningful if travelers heed it, and its influence in due time can be im-

[4] if the valve *did* care about the flow, it would no longer be an effective amplifier, sapping information/entropy from the output and making it affect the input - resulting in a partial information exchange.

[5] as before, there may well be a lower limit on resolution based on minimized couplings of information units, but this is small by all engineering measures - still cannot be neglected in this theory but I don't have good evidence to elaborate on this yet

mense as it determines how travelers use/apply/direct their energy on their journey. Thus even if two travelers expend the same energy and travel the same distance, they may find themselves very far apart unless they were initially given a similar *direction* by the arrow. [6] This is indeed the essence of evolution [7] - systems interacting and changing in time. It seems that for evolution to take place, there must be energy flow (ie entropy difference), thus in a sense entropy along with temperature *define* the notion of time for complex systems, and equilibrium systems are timeless/frozen.

I will try to formulate this concept but it's a complex one that I don't fully have a handle on. Consider the situation of being locked out: I take the car key when leaving a car, and upon returning I can use the key to open the door. But if I don't have the key to the car, I have no way to get inside, but I need to be inside to get the key. So the progression Inside→Outside→Inside is allowed, but Outside→Inside→Outside is *not*. It is a strict physical disallowance, an infinite barrier, there is no way around it, and this made me think it could be a type of infinite coupling. So far I've used the example of a valve, where I believe the orthogonal dimensions are key, and the above example shows also the relevance of time evolution. Can the types of physical couplings be enumerated? I will first try to better understand the valve in a general sense. Looking at it as force loops, we have two:



One loop handles the force exerted by the flow on the valve: this force enters the valve structure and the piping it connects to eventually closing back on the source of the flow (pump?). The other loop handles the forces required to adjust the valve or keep it in place: this force also enters the valve structure and the loop is closed through any external controller of the valve. The two loops intersect in the valve at orthogonal angles so they do not couple or exchange information. The intersection is allowed because the valve atom has a well-defined (x, y, z) location but the forces on the atom can be independently balanced among 3 orthogonal dimensions: as long as $F_{x+} = F_{x-}$ and $F_{y+} = F_{y-}$ and $F_{z+} = F_{z-}$ all at (x, y, z) there is no requirement for $F_x = F_y = F_z$, all these are independent. Despite all this there is an inherent asymmetry: $dz \Rightarrow dF_x$ but $dF_x \not\Rightarrow dz$, where F_x is the force on the flow and z is the valve position and $\Rightarrow$ means affects.

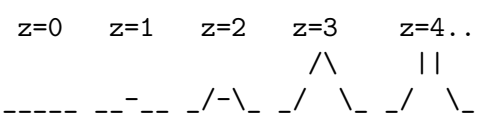
[6] Thus, "directed" processes is an appropriate term.

[7] computation, for one, is done by transistors connected to each other, every step a directed process.

In other words, changes in the control loop lead to a different path of evolution for the controlled loop, but changes in the controlled loop do *not* lead to a different path of evolution in the control loop (unless back-coupled). Why is that? What causes the asymmetry? The first requirement is that the controlled loop has a path of evolution that is affected by the valve. The second is that it cannot affect the valve's influence on its own evolution. This is the "infinite" of infinite coupling. How is it achieved? We are dealing with *potential* differences, at the particle level there is just information exchange and no notion of a larger system. The controlled loop can be altered between many potential paths of evolution by the valve. The controlling loop on the other hand has only one path of evolution which then cannot be altered by the valve. It may be important that the controlled side transfers energy through the valve while the controlling side does not, so a one-time change by controlling leads to a long-time influence on controlled, which could be considered a temporal coupling in its own right. Yet I can think of "one-shot" valves where the influence is also temporary, and still the asymmetry remains that one side affects another while not vice versa. What distinguishes controller from controlled, or to decrease confusion, primary from secondary sides of the valve? The primary side affects the secondary's evolution, but the secondary does not affect the primary's. Why? Consider the degrees of freedom: the ability to change a basic parameter. The parameters are defined by fields: we have 3D position and force, where the force drives the position; then we have 3D e-field and charge, and similar for magnetism, and similar for strong/weak fields as such. All of these are orthogonal and thus any pairing could be used as the "plunger" portion of the valve. A degree of freedom is the ability to change a parameter by the associated force: this is a direct coupling and inherently transfers energy between spatial extents. So the valve is set up such that the secondary flow does not have freedom in z - it cannot achieve necessary F_z to move z of the valve, so to it the valve is just another stationary/static feature just like the pipe walls which also constrain the y degree of freedom - F_y cannot affect y due to the strong pipe. The remaining degree of freedom is x, where indeed F_x can affect x if the valve is open. Note that no degree of freedom does not mean that (say) $F_y = 0$, the particle-particle interactions in the pipe lead to $F_x = F_y = F_z$ and a notion of pressure, but there is no freedom in y because it is bounded by a strong potential, preventing energy flow/dissipation in that direction. This is more general than just saying x and z are orthogonal - in a real valve the secondary flow will have a real F_z but the valve is designed so its effect is negligible in terms of actually moving z - consider pneumatic valves in power plants/pressure amplifier, these use very large diaphragms to generate high forces so the secondary F_z cannot compete - this still functions as a valve though not physically orthogonal. From the primary side, the same z parameter is easily varied

by a direct application of F_z, so there is a z degree of freedom. In the primary, changing z does not change any degrees of freedom (it could, with a "locking" valve), while in the secondary, changing z changes the x degree of freedom, and the secondary does not have z freedom to change z by itself. As before, projection of a potential along primary and secondary directions will show a steep slope for secondary and shallow slope for primary, and this is the cause of the asymmetry. In an ideal amplifier the slope becomes infinitely steep on the secondary and completely flat on the primary, and this gives rise to the term "infinite coupling".

Consider an electromagnetic relay: the m-field pulls the contacts together and when they are together the e-field can couple. Once again an asymmetry: the m-field influences the e-field coupling but the e-field coupling does not influence the m-field. The secondary (e-field) flow here does not have the ability to create a F_z to move the contacts together but it is affected by z whether it is coupled or not. If I write e-field = $f(z)$ this is an artificial equality: the equal sign is really a time-based influence and is *not* bidirectional here because it does not represent information exchange as the two sides are not information-compatible. If I think of a potential barrier as a function of z:

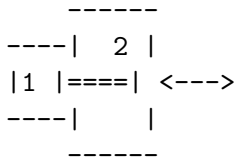


So eventually there is an "infinite" steepness potential from the e-field point of view (though at $z = 1$ the potential is not infinite thus there is a bidirectional coupling, however slight, between e and m fields at that moment. Maybe this fleeting coupling is behind conscious qualia?). E-field cannot exert an F_z because these are independent quantities - e-field controls charge transfer not location, to couple the two you could use an electron/charged particle - by charging the contacts indeed the e-field will lead to F_z but it will be much below what is necessary to move z so once again the z degree of freedom is limited. Whereas the m-field is set up to exert a large F_z so it has that degree of freedom, and thus constitutes a primary flow. The root of the asymmetry is that you can be affected by parameters that you don't have the ability to change, that are "constants" and "unalterable" from your view but variable and alterable from another view (that of the primary flow). Degrees of freedom will be indicative of the basic structure of information and are useful to fully enumerate it in that regard.

With the relay, I can connect the primary and secondary flows. With the primary, I know current $\leftrightarrow$ m-field $\rightarrow z$. With the secondary, $z \rightarrow$ e-field $\leftrightarrow$ current. So coupling the two I have current $\leftrightarrow$ m-field $\rightarrow z \rightarrow$

e-field ↔ current... Now it is a macro-scale evolving system, a loop coupled to itself which thus creates quantized states and the ability to use them as memory. How fast will this system evolve? Depends on size+light speed, this system is an elementary computer unit/oscillator.

Consider a valve that is operated by air pressure:



Here the valve's F_z degree of freedom is fully open to the system itself. When the pressure in chamber 1 is higher than chamber 2, the plunger will be pushed to the right so that chamber 2 is sealed. When the pressure in chamber 1 is lower than chamber 2, the plunger will be pushed to the left so that chamber 2 is emptied. In equilibrium the system is not capable of exerting G_z due to balancing forces, though a statistical fluke could in theory lead this to self-actuate. When $P1 \neq P2$, the system is able to exert F_z and thus exemplifies both primary and secondary characteristics: it is pushing the plunger on one hand, and on the other hand the motion of the plunger changes the pressure that is pushing it, by opening/closing flow paths. I don't know if this should even be considered a valve, but mechanisms like this (and say toilet flush/refill valves) should be handled by the theory. Needle valves are another example that dimensional orthogonality as such is not necessary but degree-of-freedom differences are necessary.

When walking by the road outside, I realized the importance of rules of the road - I was walking on the sidewalk, but people driving would stop at red lights and crosswalks, and not cross the line diving the road into lanes. It is the latter I will consider - some lines on the road physically don't mean anything. They cannot stop a powerful vehicle from crossing them. But now set up a system with a human in a high amplification/control position of the vehicle evolution, and the human rules of the road, and now the lines can effectively keep the vehicle contained. In a long drive there are many turns and corrections required to safely reach a destination, and with the lines on the road the vehicle will stay in the correct lanes, because of the human (or AI) driver. It is in fact tempting to claim that this act requires consciousness - an attachment of a system's evolution on an arbitrary set of symbols. The very notion of symbols and ideas/thoughts/instructions is a defining characteristic of consciousness. In the absence of humans, the letters in a book are just arbitrary arrangements of atoms, that don't mean or do anything beyond elementary near-neighbor physical interactions. But with a human that has been taught to read, these letters take

on the greater meaning of symbols - they are now coupled to potentially abstract and definitely arbitrary concepts, and can lead to changes in real physical actions. This coupling may well be the role of consciousness. For example I can read a recipe, and then take real physical steps, altering real system evolution, with an impetus being nothing but some atoms on a piece of paper arranged to make a specific visual pattern. So, through my conscious thoughts that pattern is physically coupled/entangled to real system evolution. Seeing a map of a new place, I make a decision to drive to some interesting location, a significant change incurred by only a few bits of 'information' on a computer screen, coupled with all my previous life experiences/memories in subconscious processing. Then what to make of physics, because such entanglement is a real physical phenomenon, since we are physical beings? The high school physics set up a space that has a single time variable, and where the focus is on objects acting and interacting (much in line with our inherent actor-action constructions - see chapters on self). But what do we observe? We can only observe stable systems - by definition after a long enough time only the stable states remain. The universe then is exploring all possible systems and eventually the most probable (entropic) will remain. But because there are so many possible universe states, the evolution is slow enough that we have a sense of time progression. Of course, I will claim again that time progression is relative to the system experiencing it (speed of consciousness). Everything is dynamic, constantly changing and exploring new possibilities, searching for the most locally stable state, which is what we observe as it exists for the longest fraction of time duration and all our senses and machines perform at some point a time-averaging measurement. This is readily seen in action with humidity and water: water that appears as steady-state drops eventually migrates to more preferable vapor or condenses on cold surfaces, migrating towards lower vapor pressure regions. Invisible to the eye, the water always forms a vapor that 'explores' the environment nearby and migrates to a more preferred entropically or energetically state - but ultimately both must be "two sides of the same coin" as they determine what state is reached later on. For whatever reason, the universe makes it more probable for particles to explore nearby regions than far-away regions, and perhaps this very requirement is what slows down universal evolution so we don't reach the global minimum too quickly/efficiently. So some things - changes of the system - can be allowed or not allowed to happen, by blocking the ability of a system to explore low-energy states readily, always done by isolating/surrounding the mechanism of low energy transfer (with a spherical 4*pi boundary in 3D space). This goes right down to the quantum level - isolating is done by making energy exchange quantum-prohibited at some level. So, when I have a motor connected to a battery, there is nothing to stop the energy transfer from battery chemical energy to motor rota-

tional energy, until the motor back-EMF matches that of the battery. As it were, energy wants to be shared equally between motor and battery (and the vast universal heat bath), just like the example of molecules on one half of a gas container eventually spreading to exist in the whole container entropically once a barrier to spreading is removed, and more fundamentally expressed as the equipartition theory. If I put a transistor between the battery and motor, I isolate the ability of energy exchange/stable state search, because a few atom layers in a transistor inhibit/make unallowed the necessary ways in which electrons would explore the big-scale system. The more energetic (high-voltage) the electrons, the more difficult it is to block such exploration. Turning on the transistor, such exchanges are now allowed and the system can perform a wider search for a low-energy state, which starts the motor turning, and eventually transfers all energy into the most stable version - heat - such 'inefficiencies' being best avoided by disallowing heat-generating processes such as friction and ohmic heating - using good bearings and low resistance wires for instance. These components in turn play the role of conductor/isolator, keeping the energy of the battery/motor from exploring the wider space which includes the possibility of heat. Applying a mechanical brake to the motor now explicitly allows such exploration, and energy will readily convert to the high-probability heat states at the brake pad interface, slowing down the motor, since there are tremendously more (entropic) heat/momentum distributions at the atomic level than there can be distributions in a macroscopic battery+motor (effectively 2-element vs infinite-element) system. But the brake pad can only get so hot - what if I externally heat it to very hot temp and then apply brakes? Perhaps what will happen is a transfer of energy into the motor - a laser-like phenomenon where a high number of high-energy states are exposed to the possibility of transfer into a lower-energy state do so in a coherent manner - the coherence in laser being in-phase light while in the brake pad coherence would be accelerating the motor in the same direction it is already spinning - a negative stiffness spring as it were. Because of the huge number of heat states, though, perhaps such a "coherent motor" could only be feasible on a micro-scale and with carefully controlled heat interactions. Still the laser and magnetron show that it is possible to transfer incoherent (DC) energy into coherent (in-phase) energy - and to do so efficiently, which sounds like an entropy decrease but is allowed because at some level the DC energy will be drained to the point where reverse conversion is impossible.

What of fusion? While energetically the states very much prefer the He arrangement over 2H, which lets fusion take place, entropically there is a joining instead of the fission splitting, so this is more difficult to achieve as only a few states are low-energy as opposed to many possibilities in fission. In fission, the single atom splits into energetic (fast moving/vibrations)

components which can go anywhere in 2*pi space and then through collisions with other atoms transfer their concentrated energy into well-spread heat energy; all along this trail the energy spreads out and out in space, reaching increasingly numerous and high-probability states, meaning the energy "prefers" to be turned into heat as there are many more ways for it to be heat than for it to be concentrated into bits of atomic fragments motion which is still more than for it to be concentrated inside an individual nucleus. In fusion, an energetic neutron is emitted which could be converted to energy, but nominally there is no clear way for the unified nucleus to give up its energy - and energy does not flow up a concentration gradient. Beyond the problem of extracting energy after reaction, there is a need to reach the reaction state in the first place. There are natural barriers that keep this reaction from happening - the electric repulsion of the outer shells of atoms keeps the nuclei from exploring that low-energy state. And even once a plasma is used to force the atoms to strike each other and react, two nuclei combining into one implies energy concentration. This is entropically forbidden so such a combined nucleus will readily split back into its individual nuclei, yielding no net energy unless a device is designed to extract energy out of the combined nucleus immediately, minimizing time that energy needs to be concentrated. What fusion creates is not just an energetic nucleus - but a nucleus energetic enough to split right back into its constituents. All steps along a chemical reaction take place by finding most probable states - one is no "better" than another, so a combined product could well revert to its original source - after all it has exactly the right energy and momentum to do so, unless that energy is quickly converted into a less-concentrated form which "locks in" the reaction products and sets the direction of the reaction. This is what gives the illusion of one-way information transfer, and why amplification to achieve this requires energy dissipation. A reaction could be run in either direction, theoretically, with proper control of energy flows and what state is made more probable. Conversion of energy into radiated forms happens in both fusion and fission - the lack of a pathway for an energetic nucleus to convert its energy into heat forces the nucleus to split its energy (as it now becomes energetic enough to break out of its own nuclear-force barriers) into radioactive bits and pieces, and only those are then allowed to turn into heat that we desire. By not capturing the energy at the point of nuclear splitting (very high T) we lose significant efficiency compared to what we could have gotten, and we also get radiation damage, but this difference guarantees that any reactions that do happen will be indistinguishably one-way. The atom doesn't know any better that we want heat and not messy radiation - we just dump energy into it until it breaks and then hope that eventually friction will play its role - it works but is not elegant. Like over-charging a battery until it catches fire, then using the fire as heat energy - it works

but we could just discharge the battery directly if we knew any better.

As I argued earlier, energy tends to readily take on states that are spread out - not due to some "want" but simply by probability since if state changes are allowed the most numerous ones will be most likely to be occupied (the premise of entropy). But how do we make use of this in practice - in real power plants? Consider the case of water steam passed through a turbine, accelerating it and losing pressure and temperature in the process. On a big level, the heat energy is allowed to spread - from a little bit of steam to a lot of cooling water and then eventually into the atmosphere and space as a photon field (ultimate sink). But somewhere along the line, we are able to limit/control the spread, and thus force the energy to also take on rotational+electronic forms, which themselves have a much longer path to their ultimate thermal spreading. Why can't all the energy be made into electricity? Why can any of it be made into electricity? In the absence of a turbine, the energy can spread by direct thermal contact, the spreading will thus be more effective - the turbine poses a barrier to spreading and thus the rate of energy transfer from hot to cold is reduced. A closed valve would also block the spreading completely - so we have the case of no turbine = unlimited spreading = no electricity generated; turbine = limited spreading = electricity generated; closed valve = no spreading = no electricity generated.

```
--- --- ---   as in variable-pitch turbine blades,
 _   \   |    from left to right -
--- --- ---   fully open, turbine active, turbine closed
```

Within the turbine itself there is an asymmetry - looking along a line from high to low pressure flow, the turbine blade collision points are constantly moving away from the gas molecule so a collision will tend to slow down the molecule towards zero in the lab frame. Looking from low to high pressure, the points are moving towards the gas molecule, so collision will tend to accelerate the molecule towards infinity going into the low-pressure area.

```
 ----^---^---^----      -----------------
H ...\...\...\... L = H    .-> .-> .->  L
 ----^---^---^----      -----------------
```

This is curious: the molecules prefer to go towards the area where they move slowly, so there is a time effect. Time stability is the only definite criterion: things that stay constant for a long time are more stable, and more numerous in time just like spatially spread states are numerous in space. Thus these slow-moving states are temporally more likely to be encountered, and we can say that particles will automatically 'slow down' to

a common speed but will not spontaneously speed up relative to each other. I argued that this mechanism is also at work in general relativity gravity: looking at an absolute clock, particles outside a gravitational potential have a faster clock rate, thus for 1 second of the particle there are x absolute clock ticks outside the potential and y inside the potential such that $y > x$, or the deep-potential state is more numerous in time, ie exists for a longer absolute time. This is in accord with the idea of "forward time travel" - an astronaut next to a black hole can watch the external universe be accelerated in evolution with regard to him (as dramatized in the film [Gravity]). This makes gravity attractive - objects oscillate closer and farther but the time warp biases this so the appearance is that more time is spent closer (and closer and closer, so independent of velocity). This makes ensemble states also attractive - molecules will tend to enter a distribution wherein they can be just as slow as the other ones (while conserving momentum). So then what about a fan - it speeds up air, creating a high-energy state that is not temporally stable? The fan can only do this because it is driven by energy - electrical energy in this case - which reaches a temporally stable (slow) state in the process of driving the fan (the electron oscillations in the AC motor are slowed down by the loaded fan). This process works out such that the slow-down of the electric field exceeds the speed-up of the air "field", so the net effect is with time forward evolution the air molecules speed up while a larger quantity of e-field slows down, so overall energy still spreads temporally and spatially. Making the motor weaker, such that it doesn't slow down the e-field as much, also makes the fan slower so it can't speed up the air as much. A perfectly conserving coupling, that has net spread of zero, is temporally indifferent - it does not have a preference to operate one way or another in time-forward evolution. To get a desired motion, a coupling must allow a net nonzero spread, and the nature of this spread will determine the direction in which the machine/device operates. An efficient machine manages to operate with minimal spread overhead, yet we see that larger spreading means more "motive force" to drive the reaction/machine - to the limit of getting the machine's highest possible output power when 50% of power is used in transmission/delivery of the energy states (consider the most power I can get out of an electrical plug: this will be achieved with a resistor R = measured resistance of the plug terminal-to-terminal, perfect impedance matching).

Information is an ultimate conserved quantity in space. Mass can change into energy, but information cannot change into anything, it is unalterable and defines the content of space. Space follows the law of information in - information out = information stored locally/bounded. Space and fields are continuous, and information in space must spread. Particles are self-binding information, continuously circling around itself and thus staying spatially localized. Given some information in a volume, over time

what leaks out is called unstable and what stays inside is called stable. Thus field oscillations are unstable and particles are stable, in space and time. The conditions for a stable bound information state are strict+quantized, so particle states are quantized. Any aspect of a particle that does not satisfy the quantization is by definition unstable and in time will spread out from the particle, leaving behind only the stable "quantized" states to observe experimentally. Particles are unstable when transitioning between quantized states, and in this time emit information (or absorb it) until a stable (quantized) state is reached, not because they seek or favor a stable state, but because the definition of stable is what's left behind after everything unstable has been radiated/spread out. Given enough time, the only remaining information has to be stable thus quantized (or zero and spread out). We are experiencing the slow conversion of mass to energy, or stable to unstable information, which happens because probabilistically all changes into an unstable state are irreversible as the information spreads into the cold cosmos - unbound/unstable information can explore more and more spatial configurations, so its return to the original bound configuration becomes highly unlikely to the point that we mostly ignore it. The spreading of information is the life force that drives all things. Consider the earlier example of a power plant turbine: it generates electricity by expanding steam in a controlled way. Why should it be possible to get the spreading of steam energy to allow a spreading of electric energy? Information is always conserved so I argue the total spreading is always the same. The turbine converts potential spreading of steam energy into spreading of electric energy. If I remove the turbine, the steam will expand freely, creating great turbulence and very complex sets of molecular interactions, the resulting swirls and structures being a sign of the life force. With a turbine, some of this life force is siphoned off from the steam turbulence world, the expansion becomes more orderly, the complex swirls and turbulent structures disappear, but in turn reappear in the electrical grid. My computer chip has nanoscale features which precisely control what sort of interactions are allowed and not allowed, so instead of the free-space turbulent swirls of steam molecules, I control the swirls of the electrons at a nanoscale level to do something useful for me. But the overall complexity and swirly nature, overall life, is conserved. Either I get steam swirls, or a CPU computation, but not both. The CPU computation being more "useful" is the result of me knowing at the nanoscale what paths are available for the swirls (and so, Maxwell's Demon has no problem with this), while the free-space steam swirls mean little to me. But who's to say they're not useful, or not "alive" - since they dissipate energy like all living beings? In fact, there is an unimaginable amount of information dissipated all around me in "not useful" forms like heat, so easily invisible and not considered as information at all. But it is there - when I switch on an electric heater,

the atoms in the heating element experience very complex interaction timelines, each phonon and electron interaction having its own specific impact just at that time and place, information that I don't know or use but is still there and still tremendous. If I designed the heater at an atomic scale to be special like a CPU, I could perform impressive calculations with all this information spreading, but I only care about temperature and not the precise way it is reached, so I ignore/never consider just how much processing that heater is doing - because the processing is on a problem I don't know and towards a solution I won't understand. And the processing taking place in the heater represents processing which was prevented from taking place in the steam as it passed through the moving turbine - which pre-emptively slowed down molecules and sped up electrons instead. Perhaps information spreading is what creates qualia, then this is a world of feelings and experiences, not abstract physics. Then my consciousness is created by very carefully controlled information spreading from chemical/molecular-scale stable information stores along molecular/cell-scale pathways controlling the nature of the "swirls" to solve for an optimal way for me to continue existing/surviving. The consciousness is spatially bounded by infinite couplings and temporally bounded by temporal infinite couplings (ie emergence and decay moment-to-moment controlled by an external infinite-coupled system, like a crystal oscillator for a CPU clock), which has allowed evolution to fine-tune the qualia of the system (qualia = paths of energy-spreading) such that the most entropically probable state that will be reached by the spreading of information leads to the survival of the organism. The spreading of energy along these paths leads to my real qualia and experiences moment to moment. We are surrounded by other systems, consciousness and qualia tremendously more complex but not necessarily self-aware or acting in concern for its survival: turbulent flows, storms, sunspots, heaters and boilers. As a kid I had the intuition that moving things are alive: trucks/cars, electronics, machines. The adults convinced me I was wrong, that only humans can feel pain, and only animal-like things are alive. Now I am led back to my more honest childhood appraisal and I feel it to be more and more correct, though with technical details now more defensible and specific (spreading of energy is required for life and qualia, stable objects do not experience qualia or time).

So can large systems be conscious? Is it legitimate to call organizations/governments "living things"? What do these living things experience as qualia, if they are living at all? Infinite couplings are key, as they allow

influence without direct *interaction*. Schematically:

```
World ~~(photons, sounds)~~> {Sensory Organs (eyes, ears)} -->
    |infinite coupling| --> [My conscious experience+qualia,
    computation of optimal solutions, conscious action/choice]

World <~~(outputs)~~ {Muscles, body regulation} <--
    |infinite coupling| <---------------|
       ^--[Thought experiments, talking to myself]--|
            ^--[Memories so I know I am me]
```

Now consider an organization with two people affecting each other:

```
[Person 1  ]--||--- [ Rest of world ] --||--[Person 2  ]
[Conscious ]->||->[   World that     ]->||->[Conscious ]
[Experience]<-||<-[affects each other]<-||<-[Experience]
```

These 2 people form an *interacting* system/loop that has infinite couplings to the rest of the world. So a consciousness could potentially be emergent in this bigger system: [8]

```
[ Rest of world ] ---- || ---- { [Person 1] <--> [Person 2] }
                  .........
                            emergent conscious experience?
```

I still don't feel any of these emergent qualia because what I am is defined by my memories which are infinite-coupling bound to my experience only, but it would not surprise me if the emergent consciousness has unique qualia of its own and acts as a living being. After all I have the same experience with my brain cells: they are pretty complicated entities that interact with each other and as a result I experience a vivid set of qualia, yet I have no idea what it's like to be a brain cell. Could it be that I take on the role of a brain cell in a large organization's qualia experiences? The organization would also have vivid experiences, but no idea what it's like to be me. Then what I see and how I interpret the world is only a mental representation, which happens to provide useful (to me) clues about my surroundings but does not actually represent the surroundings. I see myself as sitting on a chair in 3D space surrounded by various objects, but the reality is I am surrounded by gas molecules and the photons I see

[8] it is fitting here to consider how the leaders of a group (ie CEO, general) also have an infinite coupling with their workers/subordinates: they can send out mass messages and orders, but workers cannot readily affect them in any way: just like the conscious brain is shielded from the rest of the organs by infinite couplings. This in fact defines the distinction of leader vs worker, conscious vs not.

are inside my eyes not "out in 3D space". My experience of colors is more dependent on evolution than on underlying physics - the white wall next to me is actually a very complicated spectrum arrangement of atoms, with no inherent qualia attached to it - it simply exists and responds to given experiments in a given way, the qualia of "white" or "hard" are all due to my brain structure and are not properties of the external world. It is very tempting to just see the world as exactly what my qualia tell me, but I know that it is tremendously more complex and rich, all of which goes mostly unnoticed and even actively ignored if I rely solely on my qualia experience. The sky is not "blue", it is our brains which are capable of generating "blue" qualia, and which evolution has somehow made associated with sensing a given wavelength by the eye. The description of physical reality must be in terms of numbers and physical relations, whereas the richness of qualia and our observations of reality rely on the complexity and nature of our senses - our brain as well as our scientific instruments (different instruments will "see" different results even on the "same" experiment).

Particles inside a given volume can emit a field that other particles outside the volume will feel. The typical view is of the field as a stable entity, but I define it as unstable and tending to zero, so maintaining a non-zero field over time requires continuous emission by the bound particle. This seems like it should not conserve energy, but it does - as we can only extract energy from field differences in space or in time, a non-changing field value is fully conservative. One could argue that since the $1/r^2$ field is stable around a particle, it should also be considered a stable feature, indeed perhaps this field is a necessary requisite to even have the stable bound particle as it somehow helps with binding it. Still to reconcile this field with the energy spreading/dissipating field we usually experience, it is logical to interpret the $1/r^2$ potential as a dynamic entity, just like particles themselves are dynamic even though they are stable. Information conservation is trickier to apply here, as the $1/r^2$ potential is information - and if it is continuously spread and emitted, this would imply an "information source" at the particle, which I have claimed to be impossible by definition. Perhaps information is not conserved in this way, but that makes me wonder why we can't just make free energy, or perhaps I need to better define what exactly constitutes information so that whatever maintains the $1/r^2$ potential is not it.

7

Conscious Systems

main message: from information theory grounds, I suspect amplifier loops support conscious experiences. Establish the physical reality of feelings and argue that feelings are a real physical driving force, not something imposed "on top of" a feeling-less machine that just sits and experiences the feelings for no particular reason (this duality is an illusion)

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In grad school I took a physical metallurgy class, which had a fascinating notes chapter that implied motion of defects in metals can be considered as "life". Earth is bathed in low-entropy energetic photons from the sun, and "poops out" high-entropy low-energy photons into space. A piece of metal that is being bent/deformed gets low-entropy motion from the prime mover and dissipates high-entropy heat in the process of deforming. The defects in the metal piece (vacancies, dislocations, crowdions) move about - interacting with others and self - such as to bring about the high entropy state; their motion is what *defines* how the metal will change shape and they can't help but move so as to maximize entropy. Defects can grow, multiply, and annihilate, forming an "ecosystem". But experiencing "life as a vacancy" one would find that life proceeds so as to increase entropy and in the process move the metal into a new form/shape. To us, operating a machine which bends a metal piece into shape, any such life is not really important as long as it leads to the desired bending. So for a defect there may well be no purpose to life in its terms - it just moves around, dissipates energy, and moves other atoms in the process. But the ultimate "prime mover" energy source bending the metal, the point for bending the metal, and even the nature of the metal, is far beyond the comprehensive grasp of the defect 'lifeforms'. The end result needs them but doesn't really care about them, because all they can do is dissipate energy and increase entropy. This may not be so surprising to apply to our world. Life on earth evolved

because of ready availability of high quality energy from the sun (indeed, an excess of it) and has been stable as it is effective at increasing entropy. In all we do, we must increase entropy, and that is the state that the universe "seeks". There is no particular reason for our lives to be "meaningful". This question on the meaning of life always seemed a bit strange to me - even around 10 years old, I had a feeling to say "that's easy - there is no meaning!" but discussions with adults made me realize this is not socially acceptable/everyone treats it as a monumental and deep question, so if I can answer so blithely I must be really naive/missing something. Now having established my values and with scientific support I can be certain enough in this thought to write it down here, and perhaps to start accepting it. [1]

Our bodies are composed of the same building blocks as inanimate objects, and they follow the same laws of physics as systems we measure in the lab and codify in textbooks. This much - which seems easy to accept given the success of the scientific approach in medicine - says that, at a small enough level, the electrons/atoms in our body follow the deterministic, impersonal, exact laws of physics (indeed we can now computer-simulate drug interactions with the body on an atomic level - as much proof as we are likely to get for this view). Thus the whole of our bodies is also a 'cold' physical system - and this is not really so surprising - looking at other people/animals/bugs/plants, we can scientifically quantify any organism we want, and find that in given conditions it behaves in a given way, just like a complex computer program/robot. What *is* surprising is that I have experience - I can feel pleasure/pain, and be in a certain mood, resulting in a sensation that cannot be put in words/symbols, and based on other people's writing and talking it seems they also have experiences - even while all their actions could be described as if/then statements. Every indication tells us that humans follow the laws of physics, so the only conclusion is that this vivid experience/feeling is a *physical law*, just like $F = ma$ or $E = mc^2$. Our experience of life is not something to be left to the "soft" social sciences/humanities, but is as cold and hard as conservation of energy

[1] As pointed out in Society, our society has a screwed up idea of death - on the battlefield is honorable (even better if kill others too), of old age/immobile/breathing by machine and all spirit wasted away in a "cold" hospital room - this is the ideal to strive for. I think it is a pathetic sight to have an old-age death like this, it is an ultimate insult to the person that once was. If I am to accept the "meaning of life" has no concern for me, it is easier to come to terms with death - and the joy of being in control, choosing my last day. Dying weak and feeble in a hospital bed, upsetting all immediate family members who have to take time off work (after paying your caregivers for years) - *this* is the ideal, coveted, old-age death? It is absurd. We pretend death is not real, that somehow it is better if it's unplanned and random, even old-age death is basically saying - I'll let some random disease kill me, don't care when don't care how. Like covering the ears and pretending if you don't acknowledge the existence of death it somehow won't happen; it will happen - and you won't be in control, which is probably the least logical way to approach this situation/inevitability.

and entropy laws. This means we can apply scientific analysis to understand what determines consciousness - and I believe we will find our naive view that only humans have feelings/experiences to be as outdated as flat earth. There are two questions underlying consciousness: first, I feel things - raw senses - in a way I cannot describe which is yet intense and real - for example the color red, a touch on my body, sensation of cold/hot, pain from injury, tastes and smells - all what I will refer to here as "qualia". Why should qualia exist and what defines them physically (for instance photons have frequency and intensity, are qualia similar? What differentiates pain from pleasure? What "creates" or "destroys" qualia? What transmits or transfers them in time?)? Second, the things I feel, all seem to affect a common core - what I call "I" - so there are not just qualia but a "someone" who lives out the experience and actually has the feelings associated with qualia. Who or what does the experiencing (is it a special arrangement of atoms? A closed loop system? Individual electrons?)? How can this entity get input from multiple qualia simultaneously and experience them in a single coherent sense? How can this entity stay stable in time/be created/destroyed?

There are a few important observations I can make by introspection combined with existing science knowledge. First, the experiencing entity "I" seems to be a coherent, single entity that has well-defined boundaries on qualia it receives and what it can control. I can move my hand at will and sense objects that touch it, both carried by unspeakable "move there" qualia and "touch there" qualia. Things like my heart rate or perspiration or digestion I have no control over nor can I feel any associated qualia except indirectly (ie hear my heartbeat or feel pain in digestive tract, but I cannot feel my heartbeat as its own sensation nor feel the food moving about as its own sensation). So consciousness has physical boundaries - the upper limit is temptingly put as all the nerves within my body. Anything going on which doesn't affect the immediate vicinity of my body is of no effect in generating qualia or affecting my life experience. Second, I experience a sense of time and continuity. I can think back to this morning and recall a vague experience of what I felt back then (though this experience is rather dull and muted compared to real-time sense qualia, it nevertheless has that unspeakable semblance to it - it is not purely abstract/linguistic). I feel like the "I" that I recall existing a moment ago did not disappear and a new one created in its place, but rather that I experienced one moment after another after another, in succession and without a marked change in "I" nor in what the qualia feel like to this "I". Yet when I fall asleep I feel this consciousness to completely cease any feeling or qualia-response. I have learned over many years to know what to expect when waking up so I am not surprised by having slept, yet at first this must feel like a mysterious phenomenon to a baby - at some point the world and qualia experiences fade

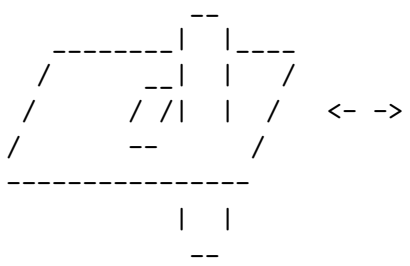
away just to reappear momentarily later at a different place/time. This is indicated by the confusion I and others experience when (ie) falling asleep from exhaustion or from drugs - a hazy memory and spending time figuring out "where/when am I now?" and "what happened when I fell asleep?". So at the same time we have evidence of non-continuity or at least suspended qualia response (and thus consciousness) which can be stopped/started on a regular basis. Third, when qualia happen we cannot choose whether or not to feel them/experience them except in a roundabout way (shutting eyelids or turning off the lights to stop visual qualia). This is phrased as a tautology - since qualia are defined as the things we feel, so unfelt qualia are impossible. Still it is an interesting point that our control, if any, is only indirect - we cannot choose to ignore or block qualia, they must happen and be felt regardless. They cannot be made optional. Even if it's impossible to do anything about a toothache, the conscious "I" feels it continuously (unless blocked chemically or physically - in which case we don't feel the qualia at all). We cannot be aware of the presence of qualia except by directly experiencing it - we can't feel its presence somewhere and then decide whether or not to experience it/act upon it. Fourth, we have no control over qualia - we cannot consciously create them (except if imagination/thought counts as qualia), directly transmit them (the torturer does not feel the pain of the tortured, there seems to be no "conservation of qualia"). We cannot even describe them by any language means, and emotional means like opera/theater are shaky and abstract. Yet while we can't consciously make qualia, the qualia we feel are generated by our own bodies - eyes generate "light feeling" qualia, skin pain receptors generate pain qualia (the 'generate' here should not be taken too literally, all I mean is that if the qualia were to be defined by anything, it would be defined by how our bodies are wired rather than by any objects outside the body). Fifth, qualia seem to be multi-faceted, not different representations of a similar thing like photon energy. This may be something learned by the brain in first years of life and thus an arbitrary mapping, but I feel I cannot arrange qualia in any logical 1-D order except by the intensity. For instance, I cannot compare a touch qualia to a sound qualia and tell that one goes "before" the other, as if qualia could be defined by a single "frequency" parameter. I can, though, match the intensity of diverse qualia, ie match the pain from cold water to the pain from a loud noise. The qualia feel unique/distinct based on the sense, and I can feel multiple senses ie listening while looking while walking/feeling ground. As the mp3 and jpeg compression show, qualia don't have a 1-to-1 mapping with physical input to the sensory organs, that is different physical inputs can create the same/similar feeling qualia. Sixth, "I" seem to be a single entity - despite the millions of atoms/electrons/cells/amplifiers in the brain that underlie thinking/emotion/information processing. One view is that "I" is thus some

elementary particle, but I find this unlikely because there are limits on what information a single particle can receive/output due to its size and localization, and the simultaneous qualia we feel must require at least a number of parallel connections. This means that whatever process is responsible for creating consciousness can unify very large systems into one coherent entity that I experience as myself. As seen with brain injuries and memory loss, the "I" can typically persist and carry on even if parts of the brain don't work - so it is not a super-fragile system where everything has to be just perfect, but rather is adaptive to whatever circumstances are at hand (part of brain not working, falling asleep, taking hallucinogenic drugs) and still feels like the same "I" to the person experiencing it. Mentally impaired people don't have "inferior experience", and are unaware of their deficiencies as feel-able qualia, being only able to understand such differences by indirect/abstract comparison with others. So the process that creates consciousness is not very picky - it doesn't require any exact neural network or atoms arranged just so, and yet what it finds (within the brain) that can support consciousness, it unifies into a single "being".

So we continue to the question of consciousness in systems - taking advantage of the fledgling information theory. The process which I mentioned as different and mysterious is the "upconversion" process - that which occurs in amplifiers/transistors, anything that controls something "big" by changing something "small". What exactly makes the amplifier possible when my theory claims that all interactions must be 2-way, that is information-preserving, so a first guess might be that such control is impossible, just like the momentum of a big thing can only be slightly affected by the momentum of a small thing (linear relation, equal exchange) rather than outright controlled. A train conductor can, in a real sense, stop the train with the push of a button whereas pushing the train would do effectively nothing - this change is enabled by a series of amplifiers very carefully arranged, so the finger pushing the button really feels no/negligible momentum change that the train undertakes - this certainly doesn't sound like 2-way exchange. Amplifiers must be 2-way devices which still create a directionality [2], a notion of 1-way transfer of information rather than exchange. How is this

[2] the infamous arrow of time

possible? Consider a model of an amplifier as a valve: [3]



The control piece can move horizontally left/right and is a flat sheet with a hole that blocks or enables flow through a perpendicular vertical length of pipe. If the asymmetry is problematic, there could be imagined a second hole and length of pipe arranged such that the flow area remains constant (one closes, the other opens); however this does not affect the findings or the effect here. In the ideal amplifier, the control sheet can move to cut the flow (horizontally) with no resistance: it is 100% coupled to whatever is desired to be amplified, and fully takes on its (horizontal) position. The exchange there is 2-way, nothing unusual (in a real system, there may be required a certain degree of non-ideal coupling such as a bare minimum to transfer classical information, but this will not be discussed for now as I am still developing the concept). The amplifier is designed such that vertical motion of the sheet is not allowed; the vertical motion is 100% coupled to the amplifier structure which stays fixed, also nothing unusual here. Any particles flowing in the pipe that hit the sheet and are pushed back vertically also become 100% coupled to the structure. The system holding the amplifier is assumed to be designed such that the particle flow cannot couple to sheet horizontal motion (this may not be really plausible - minimal coupling required (see above), but we assume possible for now) - or all particles can only move vertically. If the particles couple horizontally, the 'controller' will be affected and this cannot be called ideal amplification. As for the particles that do not hit the sheet - passing through the hole - they have 0% coupling with the sheet. So actually there is no real information coupling between controller and flow - the flow cannot affect the sheet's horizontal motion in any way, on the other hand, the controller moving the sheet cannot learn anything about the flow (or lack thereof). Whatever happens in the flow is of no consequence to the controller - eerily similar to quantum mechanical "black boxing", as the amplifier affects the flow in a mathematically consistent way but unless one already knows what the flow "should" be there is no way to actually solve for it. Just like trying to push

[3] is multi-dimensionality (ie a distinct notion of perpendicular/orthogonal) required for an amplifier or even for gearing in general? Refer also to earlier moment article

the gas pedal on a car that is powered off - the controller has no direct coupling to the controlled system, and such lack of coupling is required for any amplification notion. We are clever enough to figure out indirect indicators of the flow and then couple them to the controller - as will be outlined later, this is a first step towards consciousness.

It is easy enough to see the lack of coupling between flow→controller, but how is one to say there is no coupling between controller→flow? Isn't that the whole point of an amplifier, to make the flow directed by the controller? Yet paradoxically we must conclude no such coupling exists either - the vertical flow is either 100% coupled to the amplifier structure via sheet or 0% coupled through hole, both of which preserve information/energy (in a similar way as PWM avoids dissipative losses by alternating between 0% coupling (allow full conduction in transistor) and 100% coupling (allow no conduction in transistor), anything non-ideal leads to finite controller-flow coupling and energy dissipation). [4] None of the flow is coupled directly to horizontal sheet motion. And this may well require a specially designed flow for said amplifier - just like transistors can't handle an overvoltage and the pipe amplifier here can't handle pressurized flows which would push the sheet horizontally. A successful amplifier thus must be part of a bigger *system*. Still there is no doubt that the controller affects the flow and flow doesn't affect controller, so do we have 1-way information transfer? No, as what is transferred is a (arbitrary) relation - when the controller does this, the flow will see more or less of 100% vs 0% coupling, both of which are energetically equivalent so changing between them takes no energy. There is no elementary information transferred, but to us who can observe the flow and judge its different *potential* paths for evolution (ie compare the 0% coupling-full flow, and 100% coupling-no flow, cases would look like far in the future) we see a clear impact of the controller. The controller picks one among energetically equivalent and potentially infinite paths for time-evolution of the flow. The controller has no feedback from the flow [5], even though external beings like us can see the effects of the controller on the flow and adjust it accordingly - this is an indirect coupling, not "elementary". For time-evolution of the flow to occur at all, there must be an energy/entropy source active, but again the controller has no idea whether this is the case. This requirement is the reason computers use

[4] perhaps the controlled system can be said to be "entangled" with the controlling one, as the former's evolution depends on the latter.

[5] this can be interpreted in terms of the lever/gear article as an "infinite" gearing with the potential energy projection as 0 for any horizontal location of the sheet (equivalent energy) but rising to infinity for any vertical movement. Just like the finite gearing of a lever or pulled string, the infinite gearing of an amplifier conserves energy but provides no direct coupling between controller and flow - only a "virtual" coupling effective over time

finite power - combined with non-idealities in flow resulting in heat generation. As for the flow, it is effectively indifferent to the valve's presence: it evolves in time by whatever path is available while the controller picks the path, the flow just follows the rules of the game, and if the rules change the flow will change - *we* know this is because of the controller's action and motion of the sheet in the valve - but the flow doesn't know and doesn't care. *We* can tell the flow carries "information" about the valve position because we are observant and have memory, so we get the illusion of 1-way information transfer, even when none occurs. As a physical system, the flow evolves as it always would, no elementary information is coupled (at the *cost* of requiring some external knowledge about the flow before being able to use it as high-level "information" by us observers - ie the pressure and flow rate corresponding to 0% and 100% respectively - if these change such as by a pump failing our amplified readings will be invalid). [6] So the amplifier's controller doesn't know about the flow [7]. What happens if we couple the amplifier's flow to the controller? We will get a distinctively non-linear evolution: depending on what the flow is initially, it may cause oscillations, reach a stable value, or undergo a more complex process. As now it seems the closest thing we have to a "brain" is a CPU [8] - designed of countless transistors connected to each other forming a network - I will claim that such interconnected amplifiers are the basic substance of our own brains. And seeing as our brains support consciousness, I argue that such networks give rise to consciousness and define it. Consciousness is not any single amplifier nor any of the flows, but the resulting "quantum" structure that forms when an "unknown" flow of an amplifier is eventually coupled to its own controller, as in such a case evolution of the system is on the one hand ill-defined/mysterious and on the other strictly limited to specific states/quantized (admittedly a very poor argument, but hopefully

[6] another way of saying this, is the amplifier has an effect because its impact on the flow is of a persistent nature affecting its energy dissipation for a long time (and for this persistence to be true, the coupling must be either 0% or 100% because otherwise the flow itself will affect the amplifier and thus its persistence of action will be challenged), while the controlling side evolution does not require any energy dissipation and thus does not have much of an effect on time-evolution there despite its possible persistence. The difference between controlled side and controlling side is that the controlled side has the capacity to dissipate energy continuously while the controlling side does not. Consider a portable music player as amplifier: I press a button which results in continuous playback of music - only possible when energy/entropy is discharged/dissipated and evolution takes place - the play button either allows or disallows certain routes of evolution

[7] such open/uncoupled systems must remain idle, the eerie brainless body of a machine without its human operator

[8] once I could hear oscillations (otoacoustic emission) which I didn't really control but which I felt were an effect of my thoughts - alternating between 2 tones - this really made me feel like a CPU with a clock source, a bit surreal. Based on this I believe a "brain frequency" of around 1kHz, a paper lists maximal nerve fiber fire rate at 2kHz.

bolstered by subsequent comparisons). In such a system, evolution is decidedly non-linear and discrete possibilities/chaotic systems/attractors can be set up. There can be many external inputs into this system which change the course of evolution in a non-linear and self-affecting way (as opposed to a linear effect: open-loop, once-through, decaying), and such inputs will be considered as qualia "felt" by the conscious system. [9]

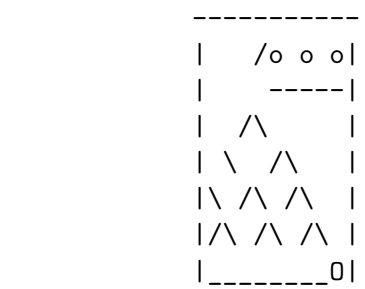
Thus qualia felt can be of any wide variety depending on the complexity and structure of the system, and yet are limited in amount and extent, and affecting the system in different ways. And, for time evolution of the system to occur, finite energy/entropy is required for the amplifiers to operate; inanimate objects at thermal equilibrium are then conclusively non-conscious. [10] Referring back to the similarity between an amplifier and quantum observables not being observed, perhaps the network of amplifiers becomes in essence a system capable of hosting an "unobservable" (by specific amplifier design, not accidentally) quantum pattern that is a big "elementary particle" which is the unitary consciousness we experience. If an amplifier is written as $a = f(a, b)$ where a is the flow and b is the controller, but then many amplifiers are hooked up such that eventually we reach $b = f(a)$, we then have a completely solvable system of equations but nothing to observe or couple to the solution - this "isolated self-interacting" system is then consciousness. We can identify a potential "consciousness" and its boundaries in experiment by observing what changes lead to a non-linear impact as opposed to a linear/classical effect (decaying vs non-decaying). Perhaps we can call control theory "consciousness design" [11] seeing the use of self-controlling amplifier systems this entails. Consider two simple systems: one inspired by the mechanical computer in

[9] An unconscious system is "open-loop", inputs to it have a single effect that eventually reaches equilibrium. A conscious system is "closed-loop" so an input produces continued perturbations on itself.

[10] seeing an amplifier as an extension of gear/lever, an "infinite" gearing, we conclude that any finite (not 0 or 100%) coupling leads to an attainment of thermal equilibrium and death of dynamic processes. A continuous energy/entropy source is required to keep a consciousness sustained in a real dissipative system.

[11] or maybe even programming, but it may not be easy to establish a CPU's consciousness - from what I understand there aren't complete loops in a CPU and it is instead externally driven by a clock+data; the clock itself may be an elementary consciousness though, as outlined below. If this is believed then any consciousness must have its own, internal time basis - which is certainly supported by our subjective feeling of time that is situation-dependent.

MIT Stata Center:



Balls fall down and hit a "slider" which changes direction each time, and when the ball gets to the bottom it hits a lever releasing the next ball; and one everyday control system: the toilet flush tank/valve where low water makes the valve open and then close when the tank is full. Are either of these mechanical systems conscious? They both can reach an equilibrium state, and in such a state I believe they are "dead" (ie not conscious), not supportive of a "conscious particle/construct". Yet the ball machine shows a feature I outlined as a requisite: its time-evolution will affect its own time-evolution in the future. The balls act as a source of energy/entropy falling from the same location at the top, and in any case they end up in the same location at the bottom - the perturbation of the balls is linear or less (entropy-generating) so the balls are not part of consciousness (except perhaps when they are already en route to hit the slider and haven't yet hit the "bifurcation point" at the bottom where their trajectories all combine and lead to a single location) just as we don't consider the electrons/ions/hormones that are a critical part of the brain functioning as actually being conscious or "bits of consciousness".

Switching brains (or bodies perhaps), while an interesting movie plot, cannot happen because the structure of the brain itself along with memories is what determines the consciousness carried within; if at bedtime consciousness "disappears" or even dies as the loop is opened, the new consciousness that arises in the morning is indistinguishable - I still feel like the "I" of the past was the same "I" as I am now - so the process leading to the rise of consciousness must be consistent and indifferent (so if "I" were re-incarnated as a frog, I would feel and think like a frog, with no memories of being a human. But this is the same ontological debate as saying all electrons are equivalent/indistinguishable, and doesn't really accomplish much. All we can prove is that consciousness depends wholly on memories and brain structure to give any experimentally verifiable data on itself). When the system is not set up with balls as an energy source, any perturbation on the slider position will be standard linear, yet with balls the perturbation will cause a sudden nonlinear flip between one phase

or another right at the point the slider crosses the midpoint of its travel range. Such a change from one state of evolution to another is what I believe produces a "qualia", and here perhaps even a transient consciousness that "feels" it. So, the basic unit of consciousness, and the simplest conscious system, is an oscillator - unstable, it alternates between two states indefinitely, with a qualia at each discontinuous transition. In the ball machine, I can hold a ball in place for a long time - throughout this time the rest of the machine is in thermal equilibrium - dead - so the consciousness in this system must be of a transient nature. Same applies for the toilet flusher - it only changes states nonlinearly twice in a flush, with no activity in between, being "transiently conscious", a mode of being that I believe is alien to us - from all I can tell my experiences of wakefulness are continuous, even though it is believable that in sleep the consciousness "shuts down" while the brain reconfigures itself. This continuity cannot be explained simply as a "time delay" of qualia (like an after-image of a bright light) because (1) any such time delay, as well as time experience (speed of time) seen by consciousness must have a physical basis and (2) the afterglow of light is only seen because our receptors are slow vs our ability to process light levels in the eye, but what are we to compare consciousness speed with, except for itself? (As mentioned above, consciousness likely has to supply its own "clock" or time basis). A computer CPU is also a "transient consciousness", at each tick of the external clock quickly configuring itself into a new equilibrium state (this change being non-linear and creating qualia) but then "dying" as the system reaches equilibrium. [12] In the brain, the "loop" is closed so the system doesn't reach equilibrium, and we experience a continuous life. Yet using this perturbative approach to determine what element of a system can be considered conscious (as the one whose motion/state affects its future state), while effective for the ball machine case (even down to selecting atoms in the slider and associated bearing/pin, vs ball, vs base board) requires an explicit time axis and bidirectional time exchange of information - both of which I refuted to try and make sense of the moment-to-moment time evolution we observe. The only way this allows for defining consciousness is then physical-based: it must be distinguishable from a "snapshot" in time where consciousness can arise and what it will feel. Consider the interaction between a conscious human and other potentially conscious systems (even other humans): as far as we experience, no "joint consciousness" occurs, even with lovers/close friends, and less with machines and equipment (such as excavators, computers, cars). While we learn how to effectively interact with other systems, such learn-

[12] this might be a definition of life: counteracting natural forces to keep itself away from thermal equilibrium. Then a flame is "alive" even when its constituent atoms/molecules reach thermal equilibrium and dissipate/"die" eventually (?)

ing does not change our qualia experiences nor our sense of self. [13] This is interesting as it places some requirements on what sort of coupling a consciousness requires to exist. Interactions and information transfer through qualia/senses does not join distinct consciousnesses; their coupling must be more intimate, perhaps even on a basic information level such that the coupling does not "collapse" on being observed like the qualia do.

If consciousness really involves a self reinforcing control loop, then what happens when we let consciousness interact with another control loop, such as a video game or another person? From all I can feel it seems that I still experience conscious existence as my localized self; I still feel "inside" my brain and I still feel the same types of sensory inputs (ie interacting with a car uses my known/learned motions of the body and is not "implicit" like moving my arm/leg), only higher-level abstract features of the qualia (ie appearance of the road at given orientation vs color 'red' or 'green') are affected by the external control loop. Which suggests that consciousness must be coupled directly at least on an electrical level (?) thought this seems too arbitrary. Taking our muscles as amplifiers and car controls as more amplifiers which eventually couple through the eyes/motion senses to the driver, why shouldn't we see this system as a new consciousness? Based on my own experiences there can be 'sections' of the brain switched in/out of conscious experience such as when falling asleep/waking/various drugs, so such expanding or contracting of the extent of consciousness must be possible at some level. As a kid, I remember playing many hours on my Gameboy, which was quite addicting and as my parents say made me withdrawn/angry when unable to play continuously. Could this be because as children we don't have as strict boundaries on how to impact our consciousness so we are willing to "become" the game - which is addicting by its virtue of being simple, closed (completely defined by known rules), and fun (providing new challenges that are timely and skill-appropriate)? Or perhaps this is an illusion, the addiction stemming from the brain's aversion to boredom (especially in childhood when we crave experience/learning) and as a kid I was willing to invest in the game as an escape. This sounds more realistic/amenable as it doesn't include the mystical consciousness expanding, and also explains the popularity/addiction of non-interactive shows/cartoons/films. Yet something as simple as a piece of paper (this one!) can complete a feedback loop externally: I write something, and then read it later (or even in real-time) and adjust my thoughts and actions accordingly, from something as simple as keeping the script in a coherent line

[13] yet on the other hand it does. Using a machine, in any moment we may experience 'normal' qualia of the body, but the succession of qualia over time is unique to our use of that machine. The feelings I get when riding a bicycle cannot be recreated any other way except riding a bicycle, and those feelings are a unique consequence of coupling to the bicycle as an external conscious system; same with driving a car.

to something more complex like establishing and elaborating ideas by writing down many complex facets, sequentially. In this sense can even works of art/craft be considered an extension of consciousness? After all, one hears the phrase "that painting has a piece of my soul in it", or "when those photos were lost, I lost some part of myself" and perhaps this isn't entirely a metaphor. There are some things we really cannot remember or think of without a "key" which may well be an object that is a work of art (this is discussed later as the hash table model), and if that object is lost there is a real sense those memories are also lost to inaccessibility. Does it make any sense to say that this constitutes a reduction of consciousness? Or that, making such works (recordings) is an expansion of consciousness? For now it seems most intuitive to say there are clear boundaries to consciousness and qualia experience, but where are these boundaries and what is their nature? We make scientific instruments and devices that must inevitably connect to us via an e/m realm we experience. If the data from the instrument comes at the expense of potential other inputs of the senses (ie reading a monitor means that much of the visual field cannot be used as vision per se) then the interaction must be an augmentation rather than expansions of consciousness, and this is in line with what I feel from introspection. Expansion of consciousness would require keeping all I experience and then experiencing even more on top of it, metaphorically 'adding another dimension' not just modifying the existing ones. Since all our body sensors are already wired into the brain in preset ways, any bodily experience and interaction through these means will not change the scope of conscious experience. But factors like education/maturation, self-reflection, drugs, mental conditioning, and brain implants, can indeed modify consciousness and this remains consistent with introspection.

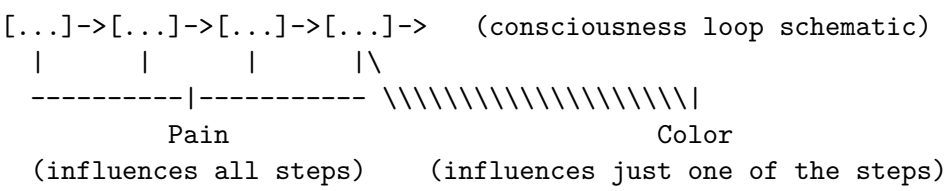
Earlier I wrote of consciousness as somehow being related to "amplifier loops" where the overall state of the looped system becomes able to evolve in a complex fashion. Then pretty much everything could be seen as conscious: computer chips, molecules, mechanical machines; does such broad applicability make any sense? If I look at something and interact with it, is a new consciousness created for just that moment? I want to try to be more specific about my own consciousness first. I mentioned earlier that electrons/ions in the brain are all transient and thus not part of consciousness. Now I have rethought this point. Consciousness is clearly spatially bounded, so we ought to be able to outline the limits of consciousness. I propose this definition: if the change or absence of a certain spatial element causes a change of conscious experience, then that element must be a part of consciousness. But this is still too broad: it means things that I see all are a part of my experience and thus part of consciousness, so everything in the world (that will affect past/present/future things I see) is also consciousness. Maybe there is some wisdom in this view, but it is too broad for

me to accept yet. So I will narrow it to: the elements the change or absence of which makes consciousness impossible (ie "conscious actions"). I will arbitrarily draw a boundary around the head: changing our memories will change our responses, changing stimuli that enter the brain will also change responses, and to keep stimuli from becoming an extension of consciousness I will take them as being outside the brain. Things that we have no capability to see/feel (like neutrinos) then really are not part of consciousness. What about oxygen? Removing the oxygen in the brain would lead to quick death, but moments before death the brain would still be alive and conscious, running down remaining ATP reserves. So oxygen is necessary for not dying, but it is not necessary for consciousness to function. In a similar sense, during a beheading the head remains alive after being chopped off - the spinal cord connections to the rest of the body are useful but not an integral part of consciousness. But the electrons and ions of the brain - even though transient and eventually made to participate in many reactions that change their state - really are integral to consciousness. If they are somehow removed or stopped the consciousness immediately ceases to exist/dies. Similarly integral are the complex links and networks in the brain - if disrupted, the consciousness immediately changes or dies. So what determines what we feel? I believe it is this (genetically and environmentally defined) structure. Children raised in isolation and who do not learn language [as the case of 'Genie'] cannot have a feeling of enjoying a good book, because their brain does not have the proper structure for such feelings due to poor development. Similarly things that every human feels - like sensory inputs (touch, color, sound frequencies, temperature) feel exactly the way they do because our brain structure is genetically designed to support such feelings. Some people have a reduced sensitivity to some stimuli, and it should not be surprising that such differences are *genetic* in origin. Conscious systems have feelings corresponding to their complexity and structure: we process lots of information in different formats (video, audio, sensory, motor, taste, odor) which means whatever 'loop' underlies our consciousness must be very complex and able to accept many independent inputs in choosing its course of action/evolution. [14] The loop structure is encoded genetically so we can expect that even blind people have spatial memory like people with sight, just no visual inputs into this part of the loop, so they might have random or sporadic "visions" which to them will be a normal occurrence. Similarly, amputees or people born without limbs or paralyzed/spinal cord injuries, people will still have a "body model" in their brain and in the absence of actual data from the body to fill the space in that model may feel

[14] rudimentary computers could be said, in contrast, to operate purely on binary data, which is relatively less complex - only we interpret different binary data as sound or video or text, the computer handles it all the same. Yet modern computers are more complex: they operate on whole 32-bit and different varieties of data structures simultaneously.

phantom pain/itching/senses. This is to say, the brain determines what we feel and how we feel, its structure determines the "spectrum" of feeling we can experience, and this is independent of the body or any "sensors" we have available.

While we mentally represent feelings as properties of objects or of our body (taste of chocolate - originating from chocolate, pain in the wrist - originating from the wrist) really all feelings "originate" from our brain structure - the feeling of tasty chocolate and our ability to localize it to the tongue comes from a particular arrangement of the brain's amplifier loop (chosen by evolution because the feeling's effects led to increased survival), and similarly the pain in the wrist and our ability to localize it comes from some other aspect of the brain's structure. There are feelings we can never experience, just like there are colors we will never see - some things lie beyond the capabilities of how we are made, and this in turn defines what it is that we do feel, and how it works. So if there are no specific laws I can uncover, there is at present no chance of me ever understanding how a computer chip "feels", just like I can't understand how infrared looks or how ultrasound sounds. This is because I cannot *simulate* a computer chip (maybe?). Still I hope there is some order to this, so I can understand whether the spectrum of feelings is truly unbounded or has well defined characteristics that allow ordering. An easy first distinction might be painful vs non-painful feelings - it would be comforting to know that our electronics aren't screaming out in pain, though I have a feeling it's a 50/50 chance as we don't even accept that animals (or sometimes even other humans) can have feelings just like us. But what is pain? It is another feeling, like seeing the color red, except unlike seeing color red, it can be localized to our body (instead of the 3D visual world model where colors "exist" and are felt), and it is distinctly unpleasant. Pain changes the operation of the whole brain in trying to find solutions to avoid pain, in a way that seeing a color does not, so pain must be an input that has a big effect on the consciousness loop whereas colors are only a small input that makes local changes.



But not every big-effect input is painful. Pleasure and anesthetics can also cause big scale changes in brain operation, but do not cause a painful feeling. I think pain is not a physical necessity, it is just another feeling in the realm of all possible feelings, and nature happened to stumble upon it

in the evolutionary process as it helped the organism learn to avoid painful stimuli - a valuable mechanism for optimal adaptation to the external environment, as there are undoubtedly things and actions that an intelligent organism should avoid - like eating itself.

There is still the question of what is it that feels the feelings - just because a brain is structured in a given way, why should we expect that a conscious loop "feels" anything? Who is doing the feeling? I believe the loop itself does the feeling, it "feels itself". Every iteration of the loop gives rise to a feeling that represents and includes all the information that the loop processes/uses to decide on a course of action/evolution. This is fully in agreement with [Dehaene]: conscious feeling occurs only when a large and complex "tree" in the brain gets activated, forming loops and interacting systems. In sleep and anesthesia stimuli decay and no loops are formed. There is no "I" that is doing my feeling for me, rather with every thought I have and at every instance of conscious awareness, my brain forms complex patterns that encode *all* I feel in that time - including a sense of continuity/who I am, a sense of the 3D world around me, a sense of my body position, a sense of what I am thinking right now, a sense of audio/music (actual+mental), a sense of smell/taste/balance/temperature/hunger and everything else I feel. There is an error of speaking of distinct qualia, say of sight vs taste vs hearing, because one then has to ask who feels all these different qualia at once, where is the "I" that serves as a unifying agent? At a given time there is only a single "qualia" defined by the brain structure, and this includes our thoughts and sight and taste and hearing and all we feel in a given moment, including the mystifying question of "where is this I"? The distinction between "I" and "feelings" is an artificial one - truly the "I" is the brain itself but I can never feel what that is like, though I might be able to look at it on a computer screen. Even though I am defined by my brain structure, I can only feel the feelings enabled by my brain structure, and feeling the structure itself is not possible. I remain ignorant of the intricate mechanisms of the brain even though I really am most affected by them. Each waking moment a loop springs into existence in my brain - the loop is designed to remember its past, to process different varieties of input information in different ways, and to react or update some internal information/"thoughts" and it has access to memories and muscle hardware as required for such actions. And when this complex loop springs into existence, it ends up creating a feeling that it itself feels, before once again decaying away. "It feels itself" - the very essence of a loop, that its state is passed to itself. We split feelings into touch/sight/audio and more, but really there is just one big compound "feeling variable" that has our whole body state+memories+thoughts+emotions all in one, and it is this big feeling that we feel at each instance of the loop's activation. This implies the feeling "spectrum" is very complex indeed, yet I still retain hope

for order at least on the notion of spatial positioning we can associate with feelings, and generally spectrum-like nature of feelings (yet color doesn't seem to be a spectrum but a cycle in its appearance, so really I'm not sure at this point). Maybe there is some clue in the length of words - same across all cultures (though technically we could speak/write continuously, we make natural divisions of information into words and phrases - any continuous stimuli are eventually filtered as noise) and I find that I end up thinking one word (or phrase) at a time - perhaps this is the time scale for a single "feeling loop" to exist and process its information. [15] It then passes the info in a highly codified form to the next loop instance to process/understand sentences. Each loop's existence is intended to conclude with a course of action (including mental action). So the loop feels itself as it settles on the thing it should do, given it feels the way that it feels.

Colin McGinn in his [book on Consciousness] raises an interesting point: are there problems whose solution is beyond our reach? Are there fundamental limitations to what we can solve? I think our intelligence is not just "more smart" than that of monkeys, but has an ability to create machines that solve our problems - for instance Turing machines and math (which makes us the Turing machines). We can make a computer to solve problems far beyond an individual's grasp, and by doing this and defining the problem purposefully, I believe one can say that we do indeed solve the problem. So our mind is able to reach quite far, coupled with language/math to record data and computers to evolve/transform data. Is the reach theoretically infinite, or are there definite hard limitations on what we can solve? There are definitely limitations on what we can process - these are also a side effect of the conscious finite memory construct I mentioned above - we can only feel and think the things that our brain is capable of feeling and thinking by virtue of how complex the consciousness variable is. So, in the moment I can feel vibrant sensations of pain/pleasure/stimulation, but looking back these sensations are dull, abstract - why? It is because in our conscious memory, there is a reserved 'feeling' space for current emotions/feelings, but only an abstract space for reasoning and reflection on the past. The state that defines the conscious loop, the information that it actually represents, makes current feelings stored as patterns that cause feelings, but memories as patterns that cause thoughts or other qualia that are not as intense. Evolution has made it so I do not have control over the feeling state, my brain always sets that to be the current (in the moment) body state, although there is no fundamental reason why I shouldn't be able to control my feelings (ie try to set my own pain level) if my brain allowed this possibility, the same way it allows me to control the words I think of

[15] this places the loop lifetime at some 10Hz - this is how fast we can consciously process information

and ideas I choose to focus on/pursue. [16] So then there is also a limitation in terms of how much I can know about myself. As an illustration:

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[Body State][Memories of Self][3D visual space][Audio]
          [Emotions, drives, goals][Abstract thoughts]
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Imagine the above is the total information content of the conscious loop - it defines what it is I feel every moment that this information gets processed by my brain circuit. It defines the "I" that feels as well, the existence of that information transiently in neuron firing creates a feeling that feels like that (to itself); [17] because of the 3D space within that feeling, I imagine that "I" am localized within my brain/body, but really this feeling that feels itself has no intrinsic location, it only feels that way because it itself has the 3D space info arranged in an appropriate pattern that evokes the feeling of localization. Simple looped systems like amplifiers do not have such 3D information, the feelings they generate are very primal urges to change, something I don't really have the ability to understand (I don't think). So, this feeling can feel itself while being processed, but to what extent can it consciously analyze itself? As alluded in the above diagram, to consciously process my own experience I must somehow codify all my real state into the tiny part that represents conscious thoughts:

```
[Body State][Memories of Self][3D visual space][Audio]
          [Emotions, drives, goals][Abstract thoughts] (time t0)
\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
    ->       ->       ->       ->     [Abstract thoughts] (time t1)
```

The left is all I feel in a moment t0. To analyze it at a later time t1 I must represent all that information in the smaller abstract thought space, of necessity losing ability to fully self-reflect [18]. The moment to moment feelings (including abstract thoughts) are the real information content of me, but all I can describe to others or to myself is the tiny part that I manage to get into the abstract reasoning space of my own mental state. Thus we have the inherent inability to explain or codify or analyze or relive feelings - even our own ones.

What would it mean to be a self that is made of a "self-feeling" brain pattern? This means that the sense of permanence that I feel - that I

[16] Drugs can help alter these abilities temporarily, leading to "spiritual experiences".

[17] to be more explicit, the feeling of an "I" feeling itself is a feeling (like abstract thought) that is enabled by the brain structure/loop complexity. The brain generates feelings, and they don't need an observer - just like an atom in space exists+interacts whether someone sees it or not. Most feelings are simple and not nearly self-aware, but the feelings our brain generates have the ability of self awareness and thus feel as if there is something that "is feeling" them, while in reality this is all part of the feeling space/spectrum.

[18] again, because if I could then I could overcome the universal computing limit

continue to be me - is illusory. The feeling of me being me, of having a permanent thing called "me" that gets modified and takes actions, is a consequence of the brain pattern structure. This structure always includes a feeling of my present body state, mental state, as well as personality and interests and mood and preferences and historical experience and beliefs - ways in which I define myself and the reason I feel I am now the same (or similar) person as I was when beginning to write this - not just the same physical situation but the same conscious/emotional being just at a later time. In reality there is no solid "me", it is a transient feeling that takes energy to keep re-creating and which gets slowly modified by the environment in small ways I don't even really notice from moment to moment (because in between these moments I don't exist - I first feel myself as "A" and next feel myself as "A+B" and unless I have some way of externally finding the B - for example by writing down my thoughts and experiences and comparing at a later time - I won't have any way to measure the B and certainly won't feel the change [19]). There's no particular theoretical issue with this, though it is certainly non-intuitive (earlier I wrote that "transient life" must be utterly different from us experience-wise simply because I feel like there is a definite solid "me" that retains itself from moment to moment, and other body feelings are inputs to this "me" who has the task of feeling them and responding). But then the question arises: why is it that I feel as myself, no more or less? Why is it that my short term memory is limited to maybe a phone number's worth of info? Why is it that I don't control my heart rate? Why can't I feel the 'experience' of a muscle, or the constant motion of my eyeballs, or the complex visual processing that my brain does subconsciously? There must be some hard physical limits that define what a consciousness is, that determine its boundaries of existence in space and time. I will focus on spatial boundaries first: it seems logical to say consciousness is within the brain, but it certainly isn't the whole brain, even though it is electrically linked to (more or less) the whole brain. Information theory says info exchanges are bidirectional and coupling, but surely there must be some special exchanges that serve to separate the conscious experience from the rest of the brain, body, and world. Not all exchanges are made equal, apparently, for otherwise I should argue that the whole world is part of my conscious being for I am able to see and interact with it. And maybe there is merit in this, but I certainly don't feel another's pain or have the experience of being any object other than myself - I interact with others mostly by sight and muscle activation while I myself can feel much more vibrant experiences that are private to me and inexplicable to others except in the same abstract

[19] this is why animals, without language, cannot be self-aware in the sense of understanding their own actions and growth

language that I use to represent interactions with external systems. If I controlled a robot, Avatar style, the feelings from interacting with the world through the robot would be my own, not the robot's. Would the robot have its own feelings/experience? I don't know but I certainly can't feel it because it is solidly decoupled from my vivid conscious qualia experience - even though we interact, this interaction does not create an increase in my conscious experience, at least it doesn't seem very vibrant or vivid. My experience is limited in extent - like a fixed length byte array - with space for visual, audio, smell, taste, bodily actual-moment feelings, then all my personality traits/memories/preferences that define me feeling like I am still myself, then only a tiny small space left out for abstract thoughts like words/numbers/actions that don't really feel very vivid but are still qualia that are easily differentiated but just neutral/bland (perhaps necessarily so, in order to allow rational processing of different arbitrary symbols without the qualia experiential quality causing undue influence). As I write this I have the experience of the next word/phrase coming to fruition within my mind, a decidedly neutral qualia similar to remembering something someone said to me/mentally talking to myself. Neutral, but still a distinctive qualia of "hearing" the word in my mind. Then I get some qualia of my hand's movements and the appearance of the ink after my pen, but I have no feeling or qualia as to how exactly the muscles in my hand move (or should move) - even the connections to keep me writing on the same line using optical input from my eyes happens automatically without an associated qualia (or only a very vague one of continuing to write on the same line - I can choose to actively deviate from this if I want). If I had to consciously control a hand model with strings to pull to move "muscles", I would never be able to recreate my writing motions because even though I write regularly all the actual motions of writing really happen automatically, with maybe some vague and completely bland/neutral, barely perceptible, qualia of "I am currently writing this word/letter" that co-exists in my mind along with the actual writing, but *never* the individual muscle motions or extents of force required, the latter being automatically determined with regular feedback by my brain but with literally no awareness by me. And yet kids must learn writing consciously, so there must be mechanisms by which repeated actions become engrained to the point where they can be repeated *without* conscious qualia experienced. Thus in the process of learning, conscious qualia-felt actions shift over to unconscious qualia - unfelt actions which can nonetheless be called up by virtue of other inexplicable but very bland/neutral but distinguishable qualia - for instance the will for me to move my leg up is a sort of experience that doesn't actively feel like anything and yet is definitely different from the will to move my arm up (of course, because otherwise I couldn't control them independently) - so they are different, and yet I can't describe how, they just feel different even though

both don't really feel like anything at all (compared to, say, visual qualia or pain or pleasure, these 'wills' are neutral but localized to the body). Similarly I can consciously will my eyelids to close, and if I do my visual experience becomes muted. I argued earlier that the visual experience is already highly processed - when tired I misinterpret things, generally lowering complexity/seeing more familiar shapes, but it cannot be wholly processed for then we would never be able to see/learn new things. I believe it is processed to stabilize/focus automatically (then again, maybe this is early "training" in effect, but no doubt some features like edge detection and tracking are "hardwired" even in babies), and this is what we see in the visual experience variable, with an interpretation layer (ie tree there, sign there, building/person/dog) overlaid by unconscious but trained/trainable mechanisms, which find unfamiliar objects and make us wary of them so we can learn more - we cannot be "blind" to new objects for then we could never learn. This interpretation is another variable feeling under the visual field but certainly much less vibrant and more abstract/neutral while still having a spatial arrangement. When I close my eyes, I don't see an empty room or feel floating in empty space, although that is theoretically what I "ought" to see. I still have a virtual model of where I am in my room, and this qualia is combined with visual input but still exists in the absence thereof, separately and abstractly. I have an expectation of what I will see if I open my eyes again, and I will be surprised/scared if the expectation is not correct. The absence of visual qualia when my eyes are closed is not like a spectrum flattening, but more like a collapse to a point - I don't visualize a blank space surrounding me, but just feel like I'm not seeing anything. I can imagine the room around me, which uses similar visual qualia but is an extremely minimal/limited/bland way but yet different from the qualia of what I expect to see when I open my eyes again. And still, actually seeing the room with my eyes is the "real thing", imagining it is not, seeing a photo is kind of close, seeing a full 360-deg projection is really close, almost indistinguishable. So what it takes to achieve that visual qualia/experience is optical/photon input of the right type. We can control this aspect of our actual experience by external photon input. Same with audio, and really all other senses but they prove more challenging due to their spatial distribution. I can more simply affect this by closing my eyes.

And here we have a little loop - I close my eyes, this makes my visual experience change, this change affects whether I open my eyes again. All of these proceed in an "amplified" way, so is this a consciousness? Have I sprung up/fragmented a separate conscious being from my own conscious experience? I can choose to close my eyes when I see light and open them when I don't, creating the oscillator - the simplest consciousness if my earlier writings are to be believed. But I don't *feel* like an oscillator is doing

this - I feel like "me" but undertaking arbitrary actions, one after another, step by step but not at once as a whole. There is no unique qualia when I do this, it is just a completely predictable variation on things I have already felt before and can expect. Maybe if I do this enough, the feat will become automatic, like seeing upside-down, and soon enough I won't even notice the familiar qualia that I notice explicitly now. Yet I don't feel like I've expanded or changed my conscious experience by creating this loop, so maybe consciousness isn't as simple as a loop - again if it were then it should extend to the whole world but it is firmly localized in my brain. The feelings it gets are made by other parts of the brain which process data from the sensors (eyes, ears), and yet the feelings are *not* the actual data processing but very specifically limited to the actual data itself. How? The conscious experience must be bound by special "isolating" links/exchanges, which can transfer information but *not* qualia. Thus qualia are spatially bound even while information can be globally exchanged. This is not a problem theoretically - even information can be locked/localized indefinitely with the proper barriers (ie nuclear decay), the crucial point here is that consciousness takes in and puts out information, while keeping the qualia strictly localized but yet able to interact with the information when the information is spatially available. The information itself (ie photons, air vibrations, electrical impulses) has little relevance to consciousness and incites qualia only through special processing and change into localized neuronal firing, and even this information is not necessarily or strictly related to the qualia that the consciousness ends up feeling. Where is the boundary between qualia and information, between felt and unfelt, experience and absence thereof? [Dehaene] explored the temporal bound, but there must be a spatial one as well.

To try and approach this consider the following: my consciousness does not distinguish (in the ideal case) between 'actually' seeing something and having a super high quality hologram/projection beamed in my eye - the qualia and experience are the same, because the photon fields are the same. Therefore we are still at an information level and not a qualia level. Next going to the optical nerve from eye to brain, I imaging I could make a device that perfectly simulates the eye signals, so this is still information. Next there is some visual processing/shape recognition that happens unconsciously and sends signals all over the brain. An appropriate link into this section can still reliably re-create qualia so it is still information. When does it become qualia, when is this barrier penetrated? I argue this will be when the same signal does not produce the same qualia, ie when bidirectional exchange actively changes the signal - at this point we are in the realm of consciousness. If we continue to recreate these states, we won't be just making an illusion of a vision for consciousness - we will be modifying the consciousness itself, making it relive the same moment over and over

or otherwise significantly changing the nature of its qualia (psychedelics). Experimentally, this should be seen as a noticeable and significant/massive increase in information input compared to the photon field in order to recreate the same qualia - some of that information will include other conscious qualia then. In terms of information theory this actually makes sense - a 1-1 mapping from photon field to optical nerve signal (for instance) means an "infinite" or "one-way" coupling exists along the way, and so long as we follow one-way couplings we cannot be in a consciousness "loop" which must use bidirectional exchanges. And what better boundary for qualia than an infinite coupling - as shown earlier this really *decouples* information while still letting one system affect the evolution of another, so this is perfect to keep qualia contained. Consider:

```
[Photon field] (1to1 map) -> [Eyeball receptors] (1to1 map)
       -> [Optic nerve] -> [unconscious processing] ->
-----------------------------------------------------------
| [Desires] <-> [Memories] <-> [Consciousness Loop]     |
|               <-> [Processing] <-> [Other responses]  |
| (exchanges are not 1to1 but affected by system state) |
----------------conscious/qualia barrier-----------------
                                              -> [Muscle outputs]
```

I imagine it like moving walls in a wave pool [https://www.youtube.com/watch?v=WffR6HrEqTA]. Within normal operating conditions, the walls are programmed to move effectively independent of what the water is doing. I can move the walls by hand or by mechanical means and achieve the same effect so this is still 1to1 mapping. But the water motion itself becomes very complicated even right next to the wall, because it depends not only on the wall motion but also on other walls' earlier motions and motion of water at present and motion/level of water nearby and probably more. Recreating that state is much more difficult than just moving a single wall. This fluid, oscillating, interacting, dynamic state is then the consciousness hidden behind the "one-way" barrier, and able to act on "one-way" barriers of its own to output actions. A critic will say - if the motion of the pool here is complex and affected by other walls, then I could argue that the processing of one-half of the eye's receptors is also affected by the other half in a complex way, so this is also conscious - while the processing does require both halves this processing still happens unconsciously. Why? It must be because the "main" and "big" consciousness representing "me" is yet behind a few one-way barriers to this level of visual processing and thus does not experience it directly. It is only this big consciousness that has memories of itself and use of language and control over the body, so it can only describe and feel what is accessible to it via bidirectional exchanges

directly. A similar fucky issue with this picture is the "little consciousness" question I raised earlier - I can look left or right, and this conscious move leads to a direct 1-1 change in my visual experience. So I have made a loop of one-way connections - does this constitute a new consciousness?

```
--------Big consciousness (self) behind a barrier---------
| [Desires] <-> [Memories] <-> [Consciousness Loop] <->  |
|                     [Processing] <-> [Other responses]  |
-----------------------------------------------------------
  ^ -> [Move eyes] -> [See new object (photon field)]
      -> [Photon processing] -> [Visual processing] -> ^
  ...is this a little consciousness loop?
```

Again I certainly don't feel like I've expanded my conscious experience nor created a new consciousness, and I don't feel new qualia either. So I am tempted to say no little consciousness exists. Yet if it did exist independently it would be far from self-aware and thus never able to explain its existence to me. Still, unlike my brain which keeps cycling/creating conscious states, the little loop is not a physical inevitability like a true clock or oscillator, I can decide to stop or slow down at any point and I form an integral part of the loop, so maybe there is no true loop here. But overall I don't have a good answer yet. It certainly seems likely that systems that have either a clock or memory are conscious ones, because their response to inputs are not a 1-1 function of the inputs but also a function of the system state, just like I argued would be the mark of the consciousness boundary in the human brain. Are all little loops conscious and forever separated by infinite couplings? This I cannot answer yet; one possible alternative is that consciousness *requires* non-infinite (ie 50%) or 'true' bidirectional couplings all along the loop, this is different from my initial conception but might be a necessary distinction that could also be tested by brain studies/fMRI. [20]

Generally systems can "fail" - parts break and the system loses its stable state of operation. I can build safeguards such as a "watchdog" to check everything is working according to plan and try to counteract potential failures or otherwise not crash. But the safeguard itself can fail - and if *it* fails but the underlying system is still fine, a crash can result. So let's

[20] 50% bidirectional couplings all along the loop is also an intrinsic property of the field, further suggesting that the field itself is a good candidate for consciousness

say we have:

```
1 - no safeguards
[Running]-{99%}->[OK!]-> ...
         -{ 1%}->[Failure]->[Crash!]

2 - with safeguards
[Running]-{98%}->[OK!]-> ...
         -{ 1%}->[Failure]-{97%}->[Safeguard works]-> ...
                           -{ 3%}->[Safeguard fails]->[Crash!]
         -{ 1%}->[Safeguard erroneously arms]->[Crash!]
```

So above, with safeguards there are now 2 modes of failure instead of just one. Have we made anything safer with this addition ultimately? How do we deal with this in real systems? Something like cars - thousands pass by me each day and not one has any component fail that causes them to run me over. This is not to say that nothing fails, but rather that there is no single catastrophic point of failure. This is done by splitting the system into isolated/low-interaction segments so the fault of one segment only has limited influence on the rest. Whatever happens to a windshield wiper motor, the car engine will still run fine, because the two are quite well isolated (still of course not infinitely). This is the same concept I think applies to consciousness: as I mentioned before, strict isolating/infinite connections define the bounds of consciousness, and within these bounds a fully interacting structure is created - a structure whose nature and goal is the solution of a complex optimization problem consisting of all the data making up our qualia/conscious experience. The experience is moment by moment (as continuous time experience poses again Zeno's paradox and a question of why we experience time at the rate that/as quickly as we do), each moment that we feel, what we feel is the complex intertwined structure formed inside the brain as it solves a new optimization problem. Drugs maybe change the nature of some brain interactions, potentially actually affecting the boundaries - nominally "infinite" couplings, thus temporarily actually expanding or changing the conscious experience itself.

I continue with the viewpoint of conscious experience as the result of a loop-like system within the brain creating a "feeling that feels itself". The idea of a loop is mentioned in [Smolin's "I am a strange loop"] and also gets nominal support in [Dehaene's] MRI studies which show back-and-forth information exchange between brain and sensory regions when a stimulus is conscious vs when it is not. Consciousness is bounded not by atoms but by infinite couplings (I propose). Within the infinite couplings of sensory inputs, our brain is set up to solve a huge optimization problem with a tremendous system of interrelated feedbacks, and a single step of

this optimization when carried out creates all the feelings associated with my "self" - including seeing what I see, thinking what I think, remembering my past life experience, and keeping in mind my values/goals - all this factors into the optimization problem my brain constantly keeps solving. And note my brain can be reconfigured to solve different problems which actually changes my conscious experience in its nature: when I play a sport I set up my brain for rapid motion tracking and muscle response with minimal need for complex thoughts or distant memories, whereas for writing I'm quite the opposite. I cannot be both at once, I am a different person in the two cases because my brain literally works differently - the infinite couplings bounding consciousness can shift over time and change. This can also happen with emotions and drugs - literally changing what I consider "me", at least for that instance in time. [21] So the "self" that sits at the brain's controls and has qualia happen to its stable nature is an illusion - there is no "self", the qualia feels itself by virtue of its complexity, and this qualia can change not just over time as experiences are gained but also in response to what it expects (ie writing vs sports), it is continuously recreated as long as I am awake and only the consistent memory of my past thoughts and experiences keeps the illusion of "self" alive.

I wrote earlier of the yellow line on the road - an arbitrary feature that thanks to human action and cleverly designed infinite couplings can control huge powerful vehicles without ever touching them. A sentiment is "pedestrians have the right of way according to laws of man, but cars have the right of way according to laws of physics", and this sounds forceful but then I came to the realization - we are physical beings, and just as our feelings are physics phenomena, so our actions are also guided by physical laws. So the distinction between laws of man and laws of physics is an artificial one - it is all physics, the reason humans follow human laws is their want for a good life and want to avoid punishment, and both of those wants are inherently physical phenomena like light oscillations or water waves. If we make a robot that drives, we will have to instill into it the appropriate wants by complex programming and wiring/hardware, and then we will have a conscious system that not just is capable of driving, but wants to drive. For how could it be otherwise? Without a want that defines its own satisfaction as an inherent good, what reason is there for any physical system to do anything? An electron flows from one place to another - why? We can say it follows the electric field and write all sorts of formulas to describe its path, but we would only get a better idea of how, the formulas remain static and lifeless symbols, the why is mysterious, inexplicable - we only know it exists and is real by being able to observe its consistent actions and effects

[21] In survival situations, people end up doing things they would have never considered normally - they literally become different people, just with the same memories [for example Life of Pi]

on electrons, just like we only know other people are conscious by observing their consistent actions and comparing them to what we experience - the experience itself being inexplicable in any of our means of communication and perhaps physically impossible. The robot that I programmed to drive - why should it drive? It could just as well not do anything. Energy conservation does not help us here - all this says is inifinitely many statest that have a net different energy are not allowed, but there still remain infinitely many states of the same energy that are allowed, and why should any system want to go from one to another? I must introduce the notion of energy (information) flow, an inherently dynamic (time-based, not divisible into separate moments [22]) phenomenon, to continue, and then it becomes clear that I've wired the robot in very complex ways such that its current energy state can only change in very specific ways and not arbitrarily. The most basic constraint is insulation on the wires: this prevents the electrons from immediately getting a dissipative outlet as heat, forcing them to flow through the microchip and logic gates. But the "forcing" is misleading: they are not forced (for this is not possible, like pushing a string or pulling from a vacuum), rather possibilities are removed so the remaining ones are all ones that are useful to me for calculations/satisfying my programming. [23]

And I can measure the current/present state of this robot and record it. So now I have a point where the robot is, and I have the possible paths that go from this point outward into the infinite configuration space. Which way to go? And why go anywhere at all? It may be that physical conservation laws limit us to exactly one path through this point, and then we still have the question of which way to go. [24] Entropy claims that systems will go towards a more probable/more common state, but the system's state being a point, how should the system know which direction leads to a more probable state? And more probable by what metric? Determinism, if accepted fully, gives no answer here - in determinism one state leads exactly to the next with no hesitation, as a logical certainty - determinism doesn't care whether the progression leads to low or high entropy, so cannot answer the arrow of time. It also cannot answer why we should have any experience of "the present" in a fully solved universe. Determinism is appealing, yet in the lab I find entropic laws to hold. How can a system move from one state to another except by perturbation? And how could the system know which moves lead to more probable/spread/dissipated energy staqtes except by doing a local optimization and itself picking the most-entropy-generating direction moment to moment? And could it be that such an optimization

[22] perhaps even the basis of time itself

[23] there is a relation here to the ascetic lifestyle developed in spiritual practices seeking enlightenment

[24] how quickly to go that way is a constant based on speed of time/information evolution

- just like in consciousness - results in feelings, the actions that increase entropy feeling inherently good and those that decrease it feeling inherently bad? There would be a testable hypothesis: a brain experiencing pain will use more energy than the brain experiencing pleasure, in the former case up-converting energy into "brain waves", in the latter doing the opposite. Physicists say entropy must always increase, could it be possible that it sometimes decreases? Could the suffering of learning be a necessary price of structuring the brain, reducing its internal entropy and turning it into an improbable state? So, when I program a robot to drive inside the yellow line, the yellow line becomes a physical law. By virtue of controlling a conscious system's operation, I am able to "design" my own laws of physics - like the law of the yellow line. This physical certainty with which the yellow line is treated somehow appears more obvious in the robot, but it is just as true in the human - the difference being that the human follows even more complex laws which may result in the yellow line being crossed from time to time. The yellow line itself is not a law, but given the correct vision+processing circuits+hardware system, it becomes law. As far as feelings go, note the distinction: the yellow line is not "good" or "bad", rather the robot is wired such that staying inside it is felt as a good thing. And we as humans all seek good feelings for their inherent goodness; no one would voluntarily undertake a painful experience unless there was a benefit for them, a good feeling to counter it: perversely similar to entropy increase required to be overall positive even if it is locally negative. And yet not the same: the brain's feeling good or bad is dependent on how the brain is designed, not necessarily related to external actions, ie feeling good does not mean I am actively increasing entropy with my actions (setting everything on fire won't magically make me feel good, similarly atoms don't spontaneously transform into the most stable isotopes), but rather that my brain's machinery is effectively increasing entropy inside the brain, and this could be arbitrarily associated to any action of the body. Same with pain: it is perverse that in torture, it is my own brain's mechanisms that create the feeling of pain that I experience, and this is a big argument of anti-natalism. Yet what this argument does not cover is that other people/animals may well have brains wired to experience more positive feelings about life overall, and those brains will not see life as mostly suffering, even under the same external circumstances they would get more pleasure out of life. Then is it any wonder that they will procreate+survive? Evolution will select for those who can't help but stay alive, and in the realm of feelings that means life is more or less pleasurable and dying is more or less painful - because the brain+body are wired to feel this way (by controlling *internal* entropy generation of the conscious part of the system) when these things happen. So even at the base physical level we are driven by feelings and we all seek selfishly to experience good feelings for ourselves - even in altruism and

martyrdom. Feelings are the real driving force - a physical one.

Reading a book on internet protocols, I notice many incorporate a checksum to verify the integrity of the message. But what does the checksum do? If it is invalid, the message is discarded. But an error could happen to the message or to the checksum or to both! And if it happens to both, or to the message in a specific way, the error will be undetectable. Consider a simple message of 5 digits: 13192, then a checksum of the sum mod10: 1+3+1+9+2=6 mod10, so we add the checksum: 131926 and transmit the message. What can the receiver expect? Without a checksum, it will expect any of 10^5 possible messages. With a checksum, the expected space is not simply 10^6 but since the last digit is fully determined by the first five, it is perhaps 10^5 and a 10% chance of verifying success. Let's simplify further for easy processing: one-digit message and same checksum: 77, if the two are equal then accept the message. Then we have 10 acceptable messages (00, 11, 22...99) and 90 unacceptable messages (01, 02...98). An effective checksum must function such that a change from one acceptable to another acceptable message is highly unlikely - otherwise errors won't be effectively detected. With the 5 digit message, we have $1 * 10^5$ acceptable and $9 * 10^5$ unacceptable messages. So, instead of transmitting 6 digits of information, we reduce the info rate to 5 digits and in turn get a 10% assurance this has not been randomly altered. We change from a full 6-digit configuration space to a constrained one, still with 6 digits but now only specific states (10% of previous total) are allowed. The 10% sets are useful to us, the 90% are discarded, and knowing everyone will send a 10% state, if we receive a 90% state we can assume some communication error. This is like the noise elimination inherent in digital (binary) vs analog circuitry due to discretization into far-apart states, but taken to the next level of sequences of binary data so now only specific sequences are valid, these sequences are far apart from each other from the view of random perturbations, and anything in between the valid states is discarded as noise (or corrected when it is possible to find the closest valid state). Because of entropy spreading, a random effect on a message will be more likely to put it into the 90% than the 10% category (equipartition: if no states are preferred, all are equally probable), so we have the chance to catch transmission errors. If the effects are not random (ie impulses, 60Hz noise), the checksum algorithm may need to be tailored to be effective against those effects. We have the same sort of configuration space reduction in electronics and machines and possibly conscious optimization/operation as well. Imagine the microchip as starting from a solid block: in it, holes are made and thus all possible electron configurations are reduced to those useful to us, through spatial limiting. Transistors on the chip further limit or expand spatial pathways so the electronic configuration inside the chip changes in a useful (to us)

way. The more complex the constraints (the more intricate the checksum algorithm), the more complex changes are required to shift from one allowed state to another one. Here I belive consciousness comes into play: it arises from the optimization process that is constrained by physical requirements (energy finding ways to dissipate along specific allowed pathways). Can consciousness exist in any form? If I make a robot that looks and acts exactly like a person (including claiming to have feelings) should I be certain that it indeed has feelings similar to what I experience? I suppose that's a bit tautological: is it even possible to design a human-like consciousness with electronics? We say "I can program a robot to act perfectly like a human" - but is there any evidence that this should even be possible? Matching all the complexity of the human brain while still looking like a human brain might well only be possible using the very mechanisms of the brain itself - DNA/cells/bio stuff, an electronic brain would be entirely different in operation no matter how much we program it (or it programs itself) so maybe the feelings it has, or claims to have, are utterly different from ours, something we can never experience or understand. There is then a physical identity of what it is to be human, that can only happen in the human brain - this is not to say that only humans are conscious, but that a (say) detailed simulation of the brain and all its atoms and electrons would actually have a different life experience - but then again, how can we tell what others' life experiences are like except by asking them? This simulated brain will swear it feels fully human. [25] Maybe it is impossible to simulate a brain like this - maybe the entropic optimization has to take place in a "real" system interconnected appropriately to allow this optimization, and any system which does this really becomes conscious (by virtue of having the same connections), not merely a simulation. Maybe the human brain's optimization steps cannot all be encoded in a computer but must take place in chemical reactions, live. Otherwise, I have to concede that any system that does this optimization - whether biological, computer, electronic chip, or even hydraulics+levers, must have a similar range of vivid qualia to what I feel, a unifying life force as it were, because there is no reason to suppose a difference when all observable physical effects are the same.

So what is the self? One thing I can definitely say is that the self will avoid pain. What pain? Pain that makes the self feel bad. There is no pain if there is no self, the pain is not an object imposed upon the self like a person put in handcuffs - if there is no self there can be no pain just

[25] here we see again the effects of 'invisibility' of a consciousness towards its own experience in a simulation. The physical laws are such that a simulated being in our universe cannot see the nature of what simulates it - like relativity blocks us from gaining any absolute reference point. So it could very well be that a simulation of a conscious brain leads both to 'weird' qualia of the computer doing the step-by-step simulation compounded with the 'human' qualia that the simulated brain will claim to feel.

there, waiting. Pain requires self, it is a part of self that can be made active or inactive by external factors (like nerves on the skin). So, the self that exists/arises in a brain configured in a "pain" state will do anything in its power to attain a non-pain state in the future, and to not return to the pain state in the future. If there were no pain, there would be no reason for the self to avoid or do anything to deal with the pain - no driving force to keep the physical body from harm+death. The pain state of the brain is an inherently bad state, it is physically repulsive, it is to be avoided just because of its own nature. Pain isn't very practical without memory to learn to avoid pain, but I doubt pain requires memory to be active. All I can say objectively is that a self in a pain state will try its best to either take actions to exit the pain state or (as in babies who still don't know any actions) learn what does and what doesn't cause pain. Why the vivid and unpleasant experience of pain? Because if it weren't, we wouldn't take it seriously amongst other optimization concerns and would break our own bodies out of curiosity/carelessness. It must be serious and unmoved by our words/pleas so that it plays its role of forcing us to learn to stay alive. But there is a snag here if the world is truly deterministic. If all my actions can be fully described by atomic collisions (or whatever level of theory desired), evolution will still work, the strong and fit will still survive, and those organisms that procreate effectively will be selected for - abstract physical configurations that act in given ways so as to procreate. Very amazing, but there is no mention of feelings. There is no *need* for feelings in a deterministic world because everything is already determined. Feelings are extravagant, superfluous, a useless pattern imposed on a fully robust and self-standing structure: but I believe physics has no room for such pointless extravagance, I would claim physics exhibits elegance: what is necessary is stored once, and only what is necessary is stored. Then, feelings as physical phenomena (since we are physical beings) must have a real physical purpose: whatever our brain does, it could not do that without feelings being involved and required for that action. And if it did not have feelings, it would not be a brain at all, in its function or structure or effects on the world. An anesthesized person, a sleeping person, is a stark contrast to the awake, feeling person. One is not possible without the other. Are feelings localized? I can experimentally verify they are somewhere in my head, because as soon as some anesthetic chemicals reach the brain my feelings change or disappear. Yet a numbing agent can be injected into the skin, and I will lose that local feeling. Even further, my surroundings can be changed and I will have a different feeling of what it is I see.

So as before I argued that the conscious mechanisms are not reached until one is deep in the brain and behind numerous infinite couplings, it is very tempting to say the same thing about feelings. But the argument doesn't hold - if I see the world and something in my sight changes to the

extent I consciously notice it, my feelings actually change. Thus if feelings really are to be taken as physical phenomena, how can I say whether feelings are to be localized to the brain? Two arguments: numbing agents in the brain produce the most concentrated effects on feelings we have found, numbing the skin has less and less effect the farther away we go - so the brain is at the "center" of a set of extending connections reaching out into the physical world, and if we are to claim any localization point a center would surely make a good choice. Second, as I argued earlier, our feelings (and *possible* feelings) are determined by our brain structure, not by our sensory organs or anything beyond. So "red" is not a property of a photon, nor of the eye cell sensitive to it, nor of the optical nerve, but rather as a result of the way the brain processes and stores that specific sensory input signal/pulse. It is a property of the structure of the brain. The infinite couplings all along make everything related to each other, but ignoring the couplings leads to a basically infinitely smeared/extended and intertwined set of feelings, selves, and optimizations that would be excessive even given the computing power of the universe - not to say, I don't feel like a "doubled consciousness" when with another person nor do I feel others' pain: there is a real localization in effect. So, feelings are localized to the brain (to the conscious part specifically): what do they look like to an external observer (like fMRI or ECG)? Could I draw a schematic of where this feeling is and what it is? Since I have claimed feelings come with energy spreading/entropy increase, consider a simple system:

```
[Gas 1] |Barrier| [    Gas 2     ]
```

In this system, gas 1 and gas 2 are at different pressures and a moving barrier is between them. When the barrier is released by an infinitely-coupled external system (which also did the initial charging) the barrier moves, oscillates, and eventually stops in the central position, its momentum energy being dissipated as heat as the oscillation dampens. This system dissipated energy: did it thus experience a feeling? If it did, I would claim all the atoms of gas 1+gas 2+barrier were involved in this feeling, it could be localized to the system above. If this is the case, then entropy increase is the sure sign of feeling: anything warm has feelings, and the good feelings arise when the system seeks equilibrium while bad feelings arise when the system goes away from equilibrium. [26] Then feelings are conserved in a way: not the obvious I feel better means you feel worse, but on a physical level between cells/atoms/infinitely-coupled systems. Properly coupled systems have their own feelings, and these feelings are conserved with their neighboring infinitely-coupled systems. IE if my brain feels pain,

[26] neutral feelings, like a color or thought, do not affect equilibrium either way

the nerve receptors actually feel pleasure at being able to dissipate their energy. The sun, and fusion reactors, then have very intense feelings.

I found an article on the [Integrated Information Theory] of consciousness, and it seems that this theory is much in agreement with my conclusions regarding the nature and extent of consciousness. It figures prominently that consciousness requires self-interacting systems: one conclusion is that such systems have intrinsic memory, another is that inactive (but *capable* of activity) elements contribute as much as active ones - leading to a quantum-like entanglement of probabilities picture. A concern I have with this theory is it is applied to logic gates and I think reality is "messier" than the neat diagrams - the question remains, how do I determine where the boundary of a real consciousness lies when in a real system every element can (eventually) interact with any other? Or is this assumption false? I will start with the memory aspect. Consider a 1 to 1 system: [A]→[B]→[C]. The state of A determines that of B, and in turn that of C. This system can only have one state, that of A, and is considered non-conscious. Similarly with multiple parallel chains:

```
[]->[]->[]
[]->[]->[]
```

Even though there is twice the "information" above, the two chains are fully separate and thus not conscious. Even if the two are ‘tangled’ but still strictly feed-forward this remains unconscious because the information content is the same.

```
[]->[]->[]
  \   /\
[]->[]->[]
```

There must be 2-way (loop) couplings to achieve a conscious system.

```
[]->[]->[]
  <-   /
   \  <-
[]->[]->[]
```

With 2 way couplings, the system forms an amplifier, which I argued is conscious, and which IIT treats mathematically. But what happens in a 2-way coupled system: why is it different from the feed-forward system? The single difference is that the 2-way coupled system responds differently based on its pre-existing internal configuration, while the 1-way coupled responds the same way to all inputs, wholly determined solely by the inputs. In other words, a conscious system must have a sense of self - memory,

a state that it maintains in time. Just as transitions of electron levels yield photons, transitions of conscious system levels/states yield qualia of experience. [27] It is strange, sure, but so is anything - that we see stars, or that gravity exists, or that we have 3 dimensions. That's just how physics works. This fact of system memory is significant also in the "usefulness" sense as I argued earlier: feelings like pain and pleasure must be physically meaningful tools rather than 'extravagances' and for feelings to be useful they must be coupled with a sense of self and a *memory* to either seek pleasure or avoid pain. It is senseless, physically, to have a disjoint sense of "pain" as a physical entity, and it is similarly physically senseless to have a system experience pain if it cannot take any action to avoid it (this is not to say that the *human* can avoid it, but rather the brain/neuron firing entangled system in its internal memory). With a "constellation" as in IIT system states, we see indeed that high-order feelings like pain would require a complex system of experience (ie cannot be "disjoint"), [28] and with my above interpretation we see that all conscious systems have a "memory" that is inherent in driving the system state, ie its urges and search for pleasure. There is also an interesting connection here in terms of "tangled" systems: because conscious systems are tangled, their output can be sensitive to small changes in the input, unlike 1-way systems where outputs must change in direct relation to input. Namely, in a 1-1 system, changing 1 bit of input changes 1 bit of output. In looped systems, changing 1 bit of input could change the whole output, and this is *because* of the looped system's internal memory. This is seen commonly in hashing algorithms: they are designed to be sensitive to small changes, so small alteration of input leads to large change in output. This is not to say that hashing algorithms are conscious, but that our consciousness can act like a hash function. Indeed it is this action which is unique to conscious awareness - generating and using words and symbols as ideas and ways of action is in essence a hash algorithm as I argued earlier - and here is proof that we are capable of this physically. I cannot categorize an object or consider a word/idea if I am not conscious - and such categorization consists in fact of a hash function: I discard the "irrelevant" components and find "what matters", the words I end up using being only tangentially related to the physical-level input my brain receives. The next point, of real entanglement, is physically significant: in saying that the silent (but capable of activation) neurons contribute to the qualia shape as much as the firing neurons, consciousness takes on a mysterious quantum-like entangled state, "feeling" things without physically "touching" them, like the one-photon 'bomb' experiments where

[27] and as photons cause electrons to rearrange themselves, qualia cause complex systems to rearrange themselves from one eigenvalue to another

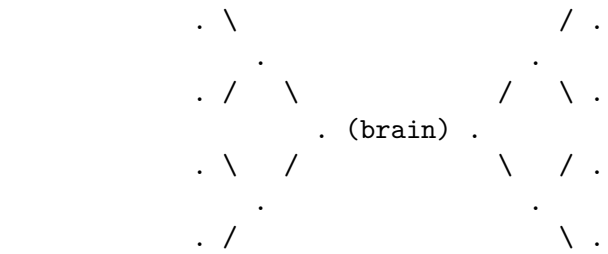
[28] this is argued more convincingly in a paper on [Geometry of Qualia] by the IIT authors

a photon is used to tell whether or not a detector is in the path without ever activating the detector. This seems acceptable in that it gives justification to qualia being a "vivid" experience of actively taking control, and suggests a response to the "why should we even feel time" argument if we are truly deterministic.

But here my criticism begins: I argued long ago that based on all observable evidence, we are deterministic and live in a deterministic world. I can simulate a looped system on my computer. It doesn't seem right that consciousness can be "nested", ie if I mentally simulate a looped system I don't magically expand my qualia possibilities. Does the simulated system experience qualia? Because I am simulating it, shouldn't I feel the same qualia - where are the simulated qualia spatially located? I think simulated systems shouldn't experience qualia as this could lead to qualia runaway and is physically even more difficult to define than the mysterious probability-entanglement that is our consciousness according to IIT. Then, it is either impossible to simulate consciousness, or we are in a tough situation - either deny the simulations swearing their feelings are real or find a way to represent thous feelings as caused by our (non-simulated) physics, allowing qualia nesting. Then again, simulating qualia-experiencing systems, just like evolving non-simulated conscious systems, requires also specific physical actions, and it is these physical actions which give rise to consciousness in the first place. As claimed by IIT, consciousness expands to cover the biggest integrated-information block it can take (like grain growth or solidification of a supercooled liquid), so perhaps a consciousness simulating another consciousness really does expand its qualia state - then again, to even be able to simulate a decent size consciousness, the simulating consciousness must already have enough resources/memory to do the simulation [29] - and thus the simulation becomes inherently a part of the bigger consciousness - the two cannot be disjointed magically (ie to simulate a consciousness I must add physical elements to the real consciousness doing the simulation, but in doing so I satisfy exactly those criteria of creating entanglement that leads to qualia). I argued earlier that all systems eventually interact with everything else. The flip side is that as a piece of information interacts with more and more systems, it becomes less and less potent - the $1/r^2$ rule roughly, thus total information is conserved but individual information always fades exponentially in non-100% interactions. But maybe not all information is alike: maybe the brain's configuration is a filter, in the firing of neurons allowing only select types of information to interact. As in a steam turbine at a power plant, only $\tilde{3}0\%$ of the steam energy is in an appropriate form to be useful as electricity, the rest

[29] it is fitting here to consider our place in the bigger 'world consciousness' as simluations made by and taking computing resources from it to turn towards our goals

is just dumped as heat. And of the electricity, only few select states are appropriate to do computation inside the CPU, the rest not satisfying the requirements being dumped as heat. Requirements are set by the CPU circuit wiring. Similarly, our brain could act as an information pipeline/filter (recalling the fractal diagrams from earlier):



as in this diagram, only some states will pass, and all the ones that do, contribute to our qualia, make it unique.

Then, not all information is capable of interacting with any other information - in fact these interactions are highly selective, which is why barriers and circuits work at all. Then the role of consciousness is relatively clear as maximal integrated information representations. Our qualia are then what the information that our brains selects for *is* literally. Feelings are the stuff of the universe. On the other hand, if all information can interact with all other, it becomes more difficult to draw the boundaries on consciousness. As I said earlier, I can close my eyelids or use my hand to move something, and thus create a 2-way coupling with the external world. Even if this coupling goes through infinite gearings, I could argue the coupling between two distinct neurons is also of an infinite gearing type, certainly not a physically elementary object. So why shouldn't I say that my eyelid or hand or everything I see are also an active part of qualia? Why stop at the brain? Why not consider every action I've ever done and all the reflective effects those actions have had on me? This would create a vastly bigger consciousness that eventually covers the whole world. I certainly don't feel this big, then again maybe time scales matter - because my actions take place on the scale of seconds and effects may take hours or days to reflect back to me, the resulting qualia may be very faint and just something I easily categorize as memory ("oh, I remember writing that earlier, I see how it affects me to read it now" - an abstract feeling but perhaps qualia?). Though if this is the case, the entanglement of all possible consequences of all actions would be gratuitous even for a universal simulation machine, and again my consciousness certainly doesn't feel more capable of new qualia due to such long-term 2-way interactions. It seems a certainty that all my qualia are defined by my brain structure solely - ie the scope of all things I could ever experience is well-defined, even though I only explore/experience one tiny

point at any one time. The only way to enhance my qualia is by a 2-way coupling into my brain, or by removing some (as in injuries/lesions), and so far as I can tell I wouldn't be able to ever compare my feelings directly - with an enhanced qualia space, I couldn't comprehend or imagine what it's like to have a smaller qualia space. There is a true difference here between an "add-on" device, like a bark-prevention collar that shocks a barking dog. This device builds an association in consciousness, like biting our tongue teaches us to not bite our tongue, by rapid coupling of output muscle motion+input nerve signals. A brain implant to expand consciousness on the other hand leads to true new experiences - like "seeing" new colors, or feeling new types of pleasure or pain, or "visualizing" 4D space, or anything else. It would be inexplicable to another conscious system not configured the same way, like I can't describe colors to a blind person. The vivid experience itself would also be inexplicable to myself unless I have the brain implant activated: I can write about it but cannot feel how it is to have it from the viewpoint of not having it, the qualia experience can be one or the other but not both. Again I must bring myself to remember all our qualia experiences are real and physical - experiences like "floating" or dissociation or feeling "spread out in space" or light-headed are real physical artefacts and maybe they arise from some critical moments when our consciousness somehow gets coupled to states it normally doesn't have interactions with. Maybe there are some natural occasions where consciousness really gets coupled to "real-world" objects outside the brain or even us, maybe these are the strange life-changing spiritual experiences some people proclaim, maybe drugs somehow help reach such states because even the experience on drugs are still real physical qualia just as much as sober experience.

In further consideration of expansions of consciousness and its role, recognize that it has evolved in us to allow us to handle laws of physics - thus it is in a real sense a reflection of the outside physical laws/physical world structure, since a fit organism must have a consciousness which has prediction and control abilities with respect to the physical laws that organism has to follow. Perhaps this extends to design and shape of qualia: in an effective consciousness, the feeling of "cold" (for instance) will lead to actions which helpe the body eliminate the cold, by taking advantage of the appropriate physical laws (ie increase activity). We learn lots of things from society, but responses to our own qualia must be intrinsic and instinctive. Pain that cannot be properly handled is then an evolutionary mistake and represents a non-ideal consciousness arrangement, but evolution isn't too careful as long as breeding is not affected.

One thing we may hope for but haven't achieved is the ability to feel another's emotional/mental state - to get a full snapshot of what they are experiencing as opposed to the limited and ill-defined words we use today. This would be a revolution similar to the ubiquity of radio and TV

now. When I say "this is frustrating", how frustrated am I and how does it compare to what another person is feeling? What do chronically ill patients have to put up with and how would I respond to that? Do two people really love each other and how do their feelings compare? Even if we had a way to connect two minds together (which we do already, in rudimentary form) such an ability may be out of reach - for to experience another person's thought, I would also need that person's memories, values/preferences, earlier experiences, and state of mind - in other words I would need to *become* the said person; but in doing so I would lose my own memories/preferences, thus not being able to truly compare the two - experiencing life as both myself and another. [30] This will be true as long as thought requires a closed-loop system that defines itself - which I believe is the case. We may transmit and manipulate qualia, but we cannot experience another's mental life without losing our own, just like reprogramming a computer chip/FPGA. Since regular world experiences can change our mental lives, we then conclude that the "I" of today is a different person from the "I" of yesterday, and the two can never be compared - not even by me, the closest person to them. So perhaps our existence is a transient one - the "alien" thing I earlier called transient consciousness - where thoughts and qualia can arise and end, with periods of unconscious existence in between. [31] Consciousness, when it arises, has access to all my memories and brain structure, thus it always feels like it is a coherent person although perhaps the conscious structure is only a few seconds old and will soon die. This certainly deals a blow to the cult of I - this time from the inside vs from the outside as considered earlier. The transience makes it easier to accept death in a sense - as we already experience it all the time. The key is to reduce suffering in our experience, and perhaps also to increase entropy to better fulfill our purpose in the world.

I am led to think of a computer based on a water-pressure circuit. What is there? A high pressure (voltage) water line and a low pressure one, and valves (arranged like electronics in a CPU) to switch it around. But switch what? In the limit of infinitely good valves (transistors), [32] the actual water flow goes to zero. What is being switched is not the flow but the *potential*. A pure consciousness is pure potential switching, for us to have it real we have to employ some flow, but with modern electronics this

[30] maybe there is a non-trivial connection here with similar limits in quantum measurements. Both come about from intrinsic epistemic difficulties of a desired measurement being incommensurate with physical restrictions.

[31] There is an argument [Unreal Universe] that our vivid experience of time is only possible because of this strictly temporally bounded existence of conscious activity.

[32] that this infinitely-good computer is *not* possible is an important universal property: there is some minimum energy dissipation/flow to do computation/gradient shape shifting

flow gets smaller and smaller. A consciousness is potential field switching. This really works with the water computer because pressure is another representation for electric repulsion potential - effectively more crammed electrons thus a field gradient. Same happens in the brain - electric field receptors around the brain give consistent signals - the consciousness is the field shape (3D) inside the brain, at a neuron level of fine resolution in its specific warping. Going back to the water computer example, what controls how the water potential changes shape? With infinitely good valves, an observer watching this computer would just see different valves continuously opening and closing of their own accord, as if by magic. It is the potential itself that controls how it triggers other valves. In other words the potential affects its own shape. The system affects itself. It evolves. It performs a computation/optimization. It is a field interacting with itself, just like a particle. Maybe then particles are also conscious, at least when changing states/shape. [33] Looking at the universe like this I feel a sense of awe at the tremendous computation/optimization conscious experience of the universe around me. Yet it is strangely appropriate: we interact with other people, who we assume conscious and who obey deterministic laws of nature, and so as well we interact with objects, and it is a nice unity to say they are also conscious and obey their respective laws of nature. And how could it be otherwise? A competition of forces is a competition of physical will, of who has the most urgent need to move one way or another. It is we who make the mistake of thinking we are free actors and that inanimate things don't have feelings, or that feelings are not physical/quantifiable. My only experience of the world *is* feelings, so maybe it is logical to say that the world *is* feelings, at different levels and looking for different things. Unclear and vacuous language describing feelings leads to the mistaken notion that feelings are made-up flimsy stuff rather than rigorous and consistent physical phenomena.

What delineates a conscious system? That is what type of complex shape-shifting the potential field can do. A tiny consciousness cannot act like a large consciousness by merely using lots of memory because its experience at each time instance is of a more limited nature: high consciousness operations/optimizations/qualia must use all of their variables *simultaneously* so as to not be split into smaller consciousnesses. As with IIT we can draw some rudimentary boundary: in the water computer example, if I connect the high pressure pipe to water main so as to have a steady

[33] again assuming as in [Unreal Universe] that a sensation of time is based on bounded experience, our qualia are felt as such because the nature of the brain ensures that the spontaneously-arising 'conscious particle' within can only live a short time until its available energy is dissipated. Meanwhile physics particles like atoms do not dissipate energy and are effectively 'immortal' thus they have no experience of time (in an equilibrium state).

pressure supply (just as plugging in a computer) it is logical to assume the computer consciousness has *not* expanded to include the whole water system, because its only linkage is 1 point which it can't really affect that much (since its flow is internally limited and ends up being degenerate: flow through any complex path within the computer system all must come through the single connecting link from the main water line, so the effect of the main line on which evolution shape is chosen is symmetric with respect to any shape, a bit of a Feynman integral mental picture). Then, I claim the "universe computer" takes an optimization step to simplify computation of complicated potential shape evolution: it splits the potential shape according to connectivity (similar to [IIT]) and then evolves each part individually, giving rise to individual qualia that only feel as themselves rather than as the whole universe. While I don't agree at this point with quantum mechanics metaphysics (too muddy and convoluted, not clean what is real) it is at least interesting to think of a qualia as a sort of very complex multi-parameter-optimizing wavefunction collapse following the potential shape of the brain/CPU/water-computer system. Then all consciousness must be associated with entropy (as already claimed earlier). I would emphasize that the *field* once again serves the unifying purpose of consciousness - just as it unifies millions of electrons in an antenna to send a coherent signal, it unifies the millions of neurons in the brain into a coherent qualia experience. The *field shape* is what determines what qualia feels like and also how the field evolves: any computation that matches the brain will then experience the same qualia (but perfectly matching the brain is no trivial task). And surely, if a simulated brain says "I have feelings" then we have to take the report seriously. So consciousness is everywhere in the world underlying every action we take/every interaction with other matter. [34] My brain can interact with itself *much* more effectively than I can hope to interact with the world ie by speaking or moving my limbs vs neurons firing at ms rates and in a hugely complex network. So my brain feels more or less like an "island" separate from the universal consciousness, but to the tiny extent I can couple with other systems, my consciousness also ought to expand. It would probably require thorough brain implant connectivity to actually let me feel expanded qualia ie "extra limbs" to do/feel more. I can exert control over many things by going one at a time (given these things don't change when left idle), but this does not expand conscious qualia as alluded above - for big consciousness optimizations must be simultaneous, this expands the real-moment qualia possibility space, ie greater consciousness.

[34] when I die my brain's computational ability is returned to the greater world. This ability is the 'freedom' (as in degrees of freedom) of the brain network to perform optimizations, which comes at a cost of excluding other potential optimizations.

Part II

Society

8

Determinism in Society

main message: it is possible to apply physics to society since we are all physical beings following physical laws. This shows clear signs of determinism in society, from which I posit we should be able to explain many aspects of our society with systems and with evolution

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We have already based most of the previous discussion on determinism - the idea that every observable action has an observable consequence, and vice versa, and that the relationship between the two is consistent over time. In other words, it is possible to formulate rules or "laws" that will be strictly followed. This is a key requirement in conserving information [1] . There is no random occurrence, and the appearance of randomness is due to our ignorance of the causes of the occurrence. This seems to be true in all of science [2]. Given that physical matter follows rigid physics laws, and knowing that humans are made of physical matter, a logical conclusion is that humans similarly follow rigid physics laws. Even such essentially human constructs as personality, character traits, love and soul and inspiration, have a deterministic cause. This is not obvious, least of all because we feel like we have "free will" to choose as we prefer, so determinism is difficult to point out on an individual level. However, looking at society as a whole gives an ensemble view of human actions, averaging out individual differences and revealing general patterns of deterministic behavior - to

[1] the observation of macro scale determinism could still occur if micro scale events are uniformly random (divine intervention in quantum probabilities), but due to the inelegance of imposing a scale separation and the dubious question of the information content of random events, I will take it as an axiom that events at all scales are deterministic

[2] though it has to be taken on faith for the cases of "wavefunction collapse" and its close neighbor of radioactive decay, for which we have not yet found clear causes. My view is there are local causes for decay, and there is no collapse (or wavefunction)

prove this point I will enumerate some real-world examples of determinism in the human world around us.

What might be the cause for a human to act in a given way? "Nature and nurture" is a common response, meaning a contribution from genetics (nature) and from interactions with other people (nurture). Yet we don't talk much about the genetic differences in stomach and liver function (for instance), while there is somehow a belief that brain activity is significantly influenced by genetic effects. I expect brain differences to exist, just as physical differences exist (height, muscle tone) but to a similar extent and influence, with the rest of individual differences being due to upbringing and environment. The brain is a complex organ and DNA has been evolved to attain high replication accuracy to develop such organs. Ultimately most brains work well enough, just as most stomachs and livers (also complex organs in their own right). Thus genetic effects on "normal" brain function must be of a subtle nature: not smart vs dumb but rather more/less impulsive/emotional/creative/interested/dedicated/loyal. What is a more likely cause of differences in human behavior is "runaway processes" - ones that reinforce themselves and grow dominant even if starting due to some arbitrary event [3]. These runaway processes also have the ability to amplify hard-to-observe genetic brain differences into vast cultural differences. Examples presented below can be found in [Child Psychology]. For some reason a baby acts shy (genetic or due to some particular one-time event), then the parents (who have a more stable memory) will begin to treat the baby as if it *were* shy, thus in turn the baby may grow comfortable in situations where it acts shy, thus it will be increasingly labeled as shy, and the cycle reinforces itself. Similarly with gender identity: parents will interact with a baby differently based on whether it's called a boy or a girl, reflecting existing societal distinctions between man and woman, and the baby in turn will come to expect being treated in a certain way or being exposed to certain stimuli. Boys like cars and girls like dolls because parents and relatives wouldn't give a baby boy dolls or give a baby girl cars; the joy of receiving a gift toy combines with the notion of what the toy is (a car or a doll) and thus the child begins to like the toy for its own sake. Baby toys and books are designed to appeal to adults, not kids (it is adults who buy the items after all), perpetuating a notion of what we feel a baby should be interested in, for instance bright colors and whimsical fables. Babies don't really care whether they play with a fancy colorful toy or some old household junk - they are curious about everything, and don't even know what toys are. How the parents interact with the baby will have a strong influence on its character - will it be allowed to explore, or kept to a limited set of activities? The baby's brain performs tremendous

[3] the significance of these processes is further explained under Systems

statistical computations to make sense of the world, and tiny factors of the adults' actions and their surroundings that the adults may well be unaware of will have significant ramifications. The above examples are fairly blatant differences, but for instance the baby's appearance and temperament will influence how often the parents will check on the baby and how willingly they approach/interact with the baby, probably without the parents even realizing it. So there are insidious ways by which the essence of parental culture is transmitted to the baby, far before the baby is even aware of its surroundings (for instance babies can differentiate their mother's voice at birth due to continuous exposure to this voice while still in the womb). This is how a society maintains its identity over time: even though individual humans die, the culture gets passed on to new generations. I would argue that the essence of society is such deeply-held and unquestioned (even invisible to ourselves) beliefs and actions and worldviews. These are never taught in a classroom, but instead passed on implicitly, in the actions that the adults take (based on their memory) and which children eventually copy without ever questioning why.

So, we have a deterministic explanation for how humans become "human" - gain their personality and language and concept of self, with the cause being innumerable interactions with the larger society (and, just like with physical particles, such interactions will be bidirectional - babies will affect their parents just as parents affect the babies). A human will be essentially a mirror of their combined past experiences. A child, having spent most time with its family, will be a reflection of its caretakers; along with spending time away from home (later school and college years) the child's personality will change. Can we see similar effects at play in society as a whole?

Inspiration, creativity, spontaneity, imagination, all seem to be completely contrary to determinism and its cold, logical progression. Yet inspiration will only come to those interested, and interest will come to those able to cultivate it, and the ability will come to those born in the appropriate circumstances. All of our stories/fables/myths, UFO abduction claims, and even religious texts, inevitably contain elements of the culture of the person generating such stories. They are not random, and - satisfying the essential deterministic principle of information conservation - they contain no truly new or original information, only manipulations of existing human knowledge. If someone claims to have been abducted by aliens, I would check whether this is true by asking for exact details of the event. A description of a real abduction would be so unanticipated and new that our imaginations could not generate it; there would be significant 'real information' in such a description. A fake abduction would contain lots of references to the person's earlier experiences of perhaps a doctor's examination (up to lying on a bed under some bright lights) with obvious changes that make it more

eerie (such as huge eyes and long fingers of the 'aliens' - but inexplicably they were of a human form and height/proportions and communicated by speaking?). All our "aliens" and "monsters" are based on animals (it seems like the best some of these people could do is to combine different animals - the head of an eagle and the body of a dog [4]), or even simply on people ('aliens' are just people with big eyes and green skin, rather unimpressive performance if our creativity were a truly random process). The process of creating a new work - of art or of science - can be seen as a brain's deterministic combination of societal and personal knowledge into an 'original' form [5], one which follows societal and personal expectations for what it should look like. Indeed, we cannot consciously generate random, or even good quality pseudo-random, sequences: try to write down 100 random binary digits or letters or dates or names or words simply by thinking of them with your brain (no coin tosses/dart throws) - the list will inevitably contain patterns. If our brains were capable of random action, any of the above would be as easy and obvious as (say) imagining a square, yet consciously coming up with random (or seemingly random) items requires our full concentration and even then results in predictable patterns.

The deterministic view can be easily witnessed in society. We don't really question the role of determinism in science, solely because we have evidence of scientific successes as real physical objects all around us. In manufacturing, if the right steps are taken the final outcome is guaranteed, so we can produce millions of CPUs, each with billions of transistors, and each one works perfectly for decades at GHz rates. This is no small feat, and it would not be possible unless determinism was a key element of physics and of our world. Determinism means that given some initial condition and some laws, the same final condition will be reached time and time again. If we find different final conditions have been reached, a non-deterministic view says that the system has chosen to act one way or another, while the deterministic view says that we haven't yet understood the initial conditions and laws. The deterministic view has proven itself correct with every new scientific theory (in fact, without the very structure that determinism gives to the physical world - allowing consistent experiments to produce consistent measurements - we could not have built up science as we know it. Men knew, before any mathematics, that objects tend to fall down; this consistency drove the earliest scientists to find rigid mathematical laws to describe the pattern.). So what of society? In science, there are numerous

[4] that we can readily combine such features mentally without too much concern for the obvious physical discrepancies (at least that the eagle's neck is much smaller than a dog's) is indicative of the structure of our memory and mental processing as being uniquely capable of linking arbitrary concepts in 'node networks' at multiple hierarchies

[5] I am no art historian, but it seems that modern square-like abstract art arose about the same time as large industrial square-like cityscapes

cases of nearly-simultaneous discoveries and publications - found independently and enabled by the discoverers' exposure to similar information at that point in time. In engineering, similar contentions arise as inventors independently discover some new mechanism at nearly the same time. Artists and composers are not invulnerable to determinism - the similarities in artworks in any given time period, and even the ability to classify art by style or time period is a sign of similarities in artists' thought processes.

In a human relationship, such as husband and wife, the two have similar experiences and after years together might complete each other's sentences or even think about the same topic at the same time (due to a common response to some earlier stimulus - which may be subconscious, leading to the idea of a "telepathic connection"). Traits and habits and emotional patterns that run in families are transmitted from generation to generation in subtle ways as outlined above, a sign of intellectual/behavioral determinism. And the recent susceptibility of all natural (and supernatural) occurrences to scientific explanation, justification, and repeatability, leaves barely any room for truly random processes or free will. When we see determinism on all scales, except for ones we don't have very good tools to explore, it seems most convenient to just say that determinism applies everywhere - that we live in a deterministic world.

In fact I argue that the comprehensive study of developments and trends in history, with the view that "exposure to x results in discoveries of the nature y", is an extremely powerful tool that will show how the brain processes, organizes information, and generates ideas (assuming common everyday variations - like what food people eat - can be statistically filtered out). To help with this program we have an extensive history available - for instance by seeing where (in which societal/living conditions) certain scientific or artistic achievements were attained we can attempt to clarify the controlling variables of human performance and creativity, as well as the necessary ingredients for "original thought". Then, by looking at variables present in modern society we can make predictions as to future progress and trends in the population. This is something that modern companies like Google/Youtube/Facebook can achieve, with the internet's enabling of rich feedback and 'mini-experiments' (for example, Google can track how likely a person is to search term x if they searched term y previously; it can also try including term x in results for term y and check how often the person clicks the new term, in effect manipulating or predicting people's thoughts even without their awareness).

If we are inclined to think every event has a cause, it is deceptively straightforward to conclude that everything must be easy to understand. How could our brains be deterministic and do so many amazing things? In fact deterministic systems can be very complex - the very testament to that is how long it has taken humans (the most advanced intelligence on the

planet) to uncover the "simple" underlying principles of basic mechanics. These principles are very far removed from everyday perception - plants, clouds, rocks, rivers, bugs and animals - the things that early humans interacted with were very complex indeed. To see the deterministic principles, the complex system must be 'distilled' to essences on which the principles clearly operate. Of necessity, in this process the complexity of the system is lost. But because we can explain *any* small part of the system deterministically, we can also explain the whole system, meaning it is also deterministic. We can track the stock trades and individual decisions of each investor in a stock market and know the exact outcome. At no point is there a true random process (to an observer that can examine everything desired). The perceived 'random' nature of systems is due to the combined effect of: - Observer ignorance - not all experiments can be done, so the outcome of a complex action that relies on things not directly accessible can actually be unknown to the observer before it happens. This may be seen in most 'random' events like throw of dice or shuffle of cards, or even asking a person for a favor. - System interaction - even if we could carry out all relevant experiments to predict a system's evolution, the necessity of bidirectional information exchange in all experiments means that our experiments will perturb the system. If we do not have a clever way of including the perturbations in our model [6], we will not accurately determine the outcome. So it is not possible for a system to predict its own actions, because in seeing the predictions its actions will change. [7]

Randomness is thus an entirely human construct, based on something happening that the particular human was not able to predict. Consider the decrease of illness incidence once hand-washing was realized to reduce germ transmission - the earlier humans believed illness to be effectively random, while the modern humans have found that it can be systematically controlled.

Having perhaps accepted the role of determinism in all of life, we come to some tougher questions. First, how can anything "new" happen? How do new artistic movements, scientific advances, or engineering achievements occur in a deterministic world? Second, if everything is already "set in motion" why is there any need for the progression of time? If "God" already knows everything that will ever happen, if all information is conserved, why do we see a rate at which things progress, why do we have a feeling of "now"? How is it possible to pick a "now" out of a system that is fully known and determined?

[6] whether this is even possible is a deep question that I don't have the tools to address yet

[7] this is another incarnation of a 'universal computational limit' which I alluded to earlier; a system cannot predict its own evolution as this is equivalent to sending information back in time/infinite computing power

For the first question, we recognize that humans are always exposed to "random" occurrences - illness, war, natural disasters, and numerous interpersonal conflicts and discoveries on the individual scale. Genetic mutations also have a "random" effect on human development. Of course these "random" occurrences could be traced to causes, and the causes to their causes, and so on. Ultimately the artist of a new generation will have been exposed to a different life/environment than the previous generation - if the culture allows it, the artist will see the earlier generations' artworks but at a younger age and under difference circumstances, and thus will have a different view resulting in different artistic outcomes. Mozart could not have composed an electronic music piece because electronics did not exist in his time, but modern electronic music composers may use Mozart's works as inspiration to create 'new' melodies, even if each step along the way has been deterministic. Even in a 'static' society things always change - the scientists are able to build off the explorations of past inventors who tried something because they were curious because of the way their parents raised them and some object they had lying around "randomly" and so on. I only stop because I don't have enough insight to describe cause after cause after cause, but truly for any event we can find a cause. Even if we claim that all minds operate the same way, we can still expect an evolution of overall society as progressive generations change what they have been exposed to into their updated interpretation of life.

The second question is probably impossible to answer in a satisfactory manner, as any attempted explanation of time at this point would be self-referential. Perhaps the question itself is misguided - a system which is "fully known and determined" may be a pure mathematical abstraction. I can solve the equations of motion and find out exactly how a particle will move, what its position will be at any time t I desire. These equations do not create a system that evolves from moment to moment, since they can give me an answer for any t. But these equations are only of any use because I am able to solve them - step by step, in my time-based universe. If I did not have a concept of time, I could not solve the equations in the first place, and they would remain meaningless symbols on a piece of paper. The equations that fully describe a system as a function of time are only relevant to the extent that they affect my (human in a time-evolving universe) actions and to the extent that I am able to solve them as my brain manipulates symbols, requiring finite time and evolution of the brain over time. We see something similar in the "game of life" - an algorithm where a 2D grid is evolved in time, step by step. To see the 'future' of the grid, you *must* iterate - there are no shortcuts and no guaranteed end states. Generalizing more, we arrive at the halting problem. What I claim is that systems must be iterated to advance - so even "God" does not know the future state of the universe until the universe gets there. Mathematically

this means there are no analytic solutions that will evolve the universe, any such process is necessarily recursive. What about the analytic solutions we are taught in physics class? These solutions describe individual objects, and it is the interaction between objects that makes the real universe not mathematically tame like the simple models for which we write equations. Note the difficulty of solving even two-body and three-body interaction problems analytically, compared to the immense complexity of the universe. And note the unique use of computers in solving multi-body interaction problems by evolving the system, from one moment of time to the next. The sequential progression of interactions is the only way we have to define time, and the only way we have to solve real physical problems - even analytic ones.

Accepting determinism is unsettling. It suggests that, given a specific goal, there is an optimal path to achieve it - even in fields like art and literature [8]. It suggests that we are fated mechanical systems even in spite of our lively feelings and experiences, and it suggests that we're by far not the only ones capable of such experiences. It forces us to face our own limits in the face of new technology that can do things considered "human" such as self-driving cars. We may find that the successes in our lives are mostly due to luck and circumstance rather than the things we are taught will lead to success (studying hard, being a good person [9]). We may find that deterministic chains, intertwined, leave no room for the self beyond a mechanism that accepts and responds to inputs from the world and other 'selves', forming a larger interconnected society, all carried on by deep undercurrents of emotions/subconscious memories/repressed desires/chance encounters and connections which we don't at all comprehend. Determinism shows our lives as so many particles adrift in a stream of time swirling and moving steadily towards the highest entropy state [10], yet it leaves no room for doubt in its clarity and exactness. So this is how the world works.

So far, I have argued that determinism applies in human society just as it does in physics experiments, because humans are bound by physical laws. Determinism conjures up images of logical progression, algorithms, rationality. Rationality? Our society is far from rational. Even while we laugh at earlier humans' misconceptions, we still have a lot of work to do in achieving a more rational lifestyle; work on such big concepts as 'self'

[8] it is no accident that some works of art are well known, and it may well be due to factors beyond the work of art itself, such as the artists' ability to garner fame and publicity

[9] good is relative anyway, everything is relative

[10] it would be interesting to map evolutionary success of an animal vs. its ability to increase entropy. See also Maximum Power Principle `https://en.wikipedia.org/wiki/Maximum_power_principle` and Rod Swenson's original argument on `http://lawofmaximumentropyproduction.com/`

and 'death'. Rationality relates to determinism, because a rational decision can be clearly and uniquely justified by valid logical statements, similar to the rigid laws of determinism that select one specific course of evolution out of infinitely many. An irrational decision is based on poor logic or incorrect assumptions, so while it selects one specific course of action, this selection is largely arbitrary and not logically justifiable in relation to the stated human goals. How can we have irrational actions in a deterministic world? It turns out the actions we call 'irrational' or impulsive also have clear deterministic causes - just ones we often remain unaware of. So, let's dispel the notion that human beings are rational/logical/good/honest with a few examples:

- People are willing to speak (and often speak a lot) about a concern, while not working to address the concern in any coherent way. So you may hear a person complaining about company X's terrible pricing and customer service, and then find out that this person continues to be company X's customer, paying them for their service. You may hear complaints about the government from people who don't bother to vote or write to their representatives. You may hear complaints about building maintenance issues from people who could voice their concerns to the building manager and actually get them resolved. Perhaps it is complaining and contemplating issues that people enjoy more than actually working to address them (the 'jouissance' of Bruce Fink / A Clinical Introduction to Lacanian Psychoanalysis; I think such people are a bad psychological influence - and if you're like that, start taking action).

- Global warming is a big topic now, but as above do we really want to take action or do we just like lofty goals? I have an easy solution to global warming that can be implemented right now: stop using energy. People lived for thousands of years without fossil fuels, and they can live that way now just as well. We have to move to farms, not use electricity or cars, grow/hunt/cook our own food. We already know how to live sustainably - but is that what we're really after? If we use the remaining fossil reserves for limited medical facilities, we could even live sustainably and free of pain - we don't have to give up all modern conveniences in going back to a sustainable lifestyle. The solution is staring us in the face, so let's be clear - as a society we are not out to stop global warming/reduce pollution/make a cleaner world. We are out to preserve and improve our current living standards, and to make money. We like to discuss changes that will make us feel good while maintaining our lifestyle - changes that don't change anything (like changing from incandescent to LED light bulbs, instead of just turning off the light bulbs).

- Killing is good/honored/rewarded on the battlefield, yet the logical extension of war - genocide - is considered the worst moral violation of mankind. Killing is a crime if done outside the battlefield (murder) for which there is serious life-long punishment. Killing is religiously abhorred if done against an undeveloped embryo/baby, yet killing is religiously supported if done against a fully conscious human raised under a different belief system. Killing oneself - suicide - is generally impermissible, or a sin sending you to hell, or a ticket to paradise/valhalla, depending on who you ask. It seems we have rules, but these rules are an incoherent mess - at the end of the day, one person kills another, so what is it that should happen?

- Christianity is the true religion, except for Hinduism, Buddhism, Muslim, Judaism, and other beliefs. People are willing to kill over an imaginary belief/set of living guidelines, and readily trust an authority just on the claim that it should be trusted (along with the belief (or apparent belief) of their neighbors and fear of being labeled a heretic).

- Professions which most readily affect people (plumbers, carpenters, sales clerks, waiters/cooks, bus drivers, janitors) are considered 'low' and uninteresting (also reflected in their pay) while unnecessary/ luxurious/ far-removed professions such as pro athletes/ superstars/ CEOs/ "leaders" are admired and paid well. And this money comes from people who aspire to get these revered professions like one big lottery - seen for instance in college students paying tuition so they can study to become professors.

- We mercilessly raise and butcher millions of animals for meat and other products (in cramped steel cages, not on green farmlands as the advertisements suggest), while putting 'cute' cartoon-like drawings of animals on the products and even using them as mascots to promote the product that is their dead flesh. At the same time we pamper our cute-looking pet dogs and cats and take them to special animal doctors, and would be willing to get in fights if someone hurts them.

- We set aside dedicated land for indefinite storage of buried dead bodies, meanwhile nearby living humans are left at the mercy of the elements without ownership of land or shelter. We go through considerable legal effort to send volunteer groups thousands of miles away into violent countries where they risk getting killed, meanwhile homeless and impoverished people in the local community are left to fend for themselves.

- We take actions for our loved ones, for our children, or even for our future children - for other humans. Ask someone what is the most precious part of their lives and the answer is bound to refer to a human. "Stay safe at work - your children depend on you!" reads a sign at a construction site. A mother works long hours to pay for her daughter's tutoring, so she can do better on tests. But if all meaning to life is given by other humans, then there is no ultimate meaning, only the society itself existing for the sake of its own existence. So seemingly harmless statements like "my children are my life" are reaffirming the meaninglessness of existence and life itself. It is irrational that people maintain - and vehemently - the cognitive dissonance of believing these statements and also believing in a greater meaning/purpose in the world.

- We educate children in the school system - removing them from a caring family environment for most of the day and replacing it with an impersonal set of classroom lectures. It is easy to experimentally demonstrate that true learning comes from interaction and rapid feedback, not from an 'information dump' like a lecture. It is also easy to experimentally demonstrate that most children don't care about what they are learning and don't use most of the learned content ever in their lives, and that schools are just about the opposite of what a child needs for emotional development. So can we really say the goal of the school system is to educate children? More likely, the (unconscious) goal is to make them content with following arbitrary societal rules, and to encourage parents to work instead of caring for their child. Education in the present system happens as a side effect of children spending more or less time/effort on the content presented in class during homework or other projects requiring their input.

- We proclaim how wonderful the democratic government is. But consider it in information terms: if I participate in local, state, and presidential elections, I might put out 1 byte of data every 2 years. Imagine if this was an internet plan: it would take you a few hundred thousand years to download this book. With this almost nonexistent rate of information transfer from public to government, is there any justification in saying the government is actually representative? If I don't like the current president, I can vote him out in 4 years, until then tough luck. When it took weeks for messages to get delivered by horseback it made sense to have representatives - individuals who could make decisions quickly and avoid communication delays. Today, we could have a web server poll the whole country in a matter of minutes, and we know enough information security and encryption algorithms to ensure to-the-person accurate vote counts. We

> could be doing this right now, as easily as we have bank ATMs, and achieve the age-old dream of true democracy: everyone can vote on every bill/law. This was physically impossible earlier, at least that was the excuse. Now consider the current messy process of a single presidential election. Do you really believe that democracy is what the government is after? Do you believe those who have real political power would altruistically let themselves get replaced by some popularly (randomly) chosen candidate?

There are two more irrational notions that deserve extra space. They are: our sense of self or 'I', and our approach to death. In society, the notion of the individual is taken for granted, as certain truth, shaping our views and actions. This notion, like "I think therefore I am", claims that there is something one can call "I" or "he" that has the same real existence as a physical object. Even in the debate of free will vs determinism, the notion of self or individuality is preserved. I call this "The cult of I"; the main telling sign of this cult is the worship of the individual as a god-like power: the individual decides what to do, and is rewarded or punished according to his actions. [11] Science fairs and sports events award first place prizes to individuals, these individuals are then praised by others and books are written about their lives. Parents tell their children, "you want to be successful like x". The justice system blames individual persons and punishes them as criminals. The criminals, thus labeled, are at fault for the offenses they committed.

Yet if we are to carry through the deterministic viewpoint that a person's actions are determined by their external environment, the above picture seems all wrong. The individual is then only an abstraction - the real causes of any action are in the external world. What are we really saying when we award a prize to a well-performing athlete? We are not rewarding his individuality, or effort, or hard-working personality, but rather we give credit to the myriad circumstances that led to this athlete performing so well: genetics of his parents (and associated random factors of how they met), his consistent training (aided by his coach/family/own psyche - in turn based on life experiences), his choice of meal that morning (and the companies that made the meal possible), as well as other athletes' worse performance and luck (didn't eat as well, experiencing family issues and less concerned with training, got a 'random' injury). The individual cannot take the credit for everything that has gotten him to a given point in life - in fact he can take credit for not much more than his genetic-based

[11] our language is filled with emotionally invalidating phrases like "cheer up" or "don't worry" or "don't think about that" which are implicitly reinforcing the 'cult of I' as the power of the individual to control his emotions and thoughts. This is further considered under Self

appearance and physical properties. For each successful athlete there is an extensive support network, without which the athlete's performance (or even choice to be an athlete in the first place) would be different, and that network in turn has its own support network, extending eventually to include the whole world population and natural resources/events. All that is what we acknowledge when we award a 'first place' medal, but due to the "cult of I" it is only the individual athlete who gets the medal (and fame) which seems quite an injustice.

Worse, the cult gets us to think wrongly about responsibility; it biases people to take too much credit for their own (and others') accomplishments. This works for both success and failure - when we punish a criminal, we are really punishing the living conditions that lead them to commit crimes (and those living conditions in turn a result of past political changes), the availability of weapons or other tools that aid in the crime (and the factors that lead to this availability), media that encourages crime or makes it look cool (and factors leading to such choices by the producers). Yet it is the individual criminal who gets the charges and the blame. Can this really be called justice? After locking away the criminal for some time in company of similar-thinking and probably even more experienced criminals, in a unique position where he doesn't have to work to earn a living unlike the rest of non-criminal society, we let him back into society and again placed under the influence of the same external factors that led to committing crime in the first place - should we be surprised to see repeat offenders in such a misguided system? Why don't we apply known behavioral findings to our justice system, making it rigorously effective - are we really after reduction of crime or after retributive punishment? Is the goal of modern jails to help 'criminals' find a way to become part of non-criminal society, or to keep hopelessly poor/unproductive people off the streets and out of sight while creating money flows that benefit those in power? A deterministic view says that by placing our trust in the 'cult of I' we routinely misuse reward and punishment, applying them to the result (athlete or criminal) rather than the cause (support network or lack thereof), the "tail wagging the dog" as it were, treating the symptoms instead of curing the disease. We may expect overall sub-optimal performance and increased personal stress when we leave it to the individuals to figure it out for themselves under threat of punishment or promise of reward.

Why does the 'cult of I' pose such a tempting belief? Because this seems the most obvious conclusion when we don't have the ability or patience to see all the external influences on what we are. Without a well-developed psychology and physics we may not even have the tools to trace such influences. When explaining actions or events, we are content to look 'one step back', or if more detail is requested, to the earliest 'random' or unantici-

pated event, even in science. [12] Why did he do well? Because he trained hard. Why did he train hard? His family told him to (this is a 'random' event, so is good enough to be called an 'original cause'). What happens in a heat engine? Heat is taken from hot to cold, with some work output. Where did the heat source come from? External circumstances (arbitrary) - this is how the engine was built, no need to go farther back (why was it built this way - or at all?). Where does the heat go when it reaches the cold source? It is dissipated (becomes 'random' - so we no longer care about it), no need to question what that heat will do, or why or how. The 'heat engine' is the individual that does the work, so we can ignore all other factors and focus on 'engine performance'. It takes discipline to keep asking - and answering - "why?" to reveal the real original causes. But since all is interconnected in the deterministic world, such questioning will reveal that there is no such thing as an original cause.

This is a frightening conclusion which does not fit at all with the common view of the world. Our brain is designed to think in terms of cause and effect, actors and actions (take for instance the structure of myths and stories in all cultures - a protagonist sets out to achieve some goal and takes action to achieve it), so we do not know how to interpret a world of intertwined influences, with no clear beginning nor end. Without better tools for the purpose, this conclusion means that we are all caught in a vast current that we do not understand or control - even those of us "in charge" (for they can only make their decisions based on the existing state of society and on their own mind/memories/life experiences). This lack of understanding is displayed almost sardonically in our approach to death.

Death is not just the absence of life but the end of a life, an upper temporal bound on a living organism, necessarily imposed at birth and inseparable from it. If death is the end of the physical processes that enable my feelings to exist, then I don't think death is painful or even observable to me. In a sense I 'die' every night (or under anaesthesia) and return to life in the morning [Death, be not proud.. John Donne]. If I escape from the 'cult of I', it is easier to see there is no reason to fear the permanence of no afterlife, since the world and all its rich systems will continue to exist. We are biologically programmed to avoid suffering, and evolution has ensured that actions which ease suffering also tend to prolong life, so we rarely think about death directly and somehow come to the belief that dying of "old age" is desirable, and the older the better. But in reality there is no dying of old age - it will be a death from body failure or disease, with all of the associated suffering and pain; death does not get easier just because one lives longer. In the 'cult of I' we religiously believe that a longer life

[12] in addition there are certain words which seem to be thought-endpoints, like 'God', 'Bible', 'family', 'legal', 'studies'. This is discussed more under Self

is a better life, so today people wither away in elderly homes, left alone by families, perhaps unable to take basic/intimate bodily functions like washing themselves without the aid of employees, who may try to hide the fact they're only helping because they're paid to but it wouldn't be effective. Then when the elderly are too sick they are transferred to a hospital bed, kept alive longer and longer by impatient doctors and nurses, in an impersonal hospital room. Family visits from time to time, but the elderly are never quite sure if it's out of a sense of guilt, or maybe they're too sick to care or remember them.

One day they get too sick and die, perhaps alone at night, with no one to support them or say goodbye. Family members don't want to think of saying last words, so the real last words end up being something arbitrary rather than what the family actually wanted to say. The death culminates in a funeral - a day of sadness when the dead body is lowered into the ground. Family members are frustrated at having to leave work on such short notice and quickly (and with considerable expense) arrive at the funeral, while also being saddened by the untimely loss, wishing the person could have lived longer (but why?). Nobody is really happy about any of this, and maybe someone says "Oh I wish we could have done more together". We try to delude ourselves, hope that the dead person can hear us in heaven, hear all our last words and things we wish we could have said, but the truth is they are dead and they don't hear us. They died without ever hearing our words of care, without seeing the outpouring of love and support that everyone has put up for their sake during the funeral - if only they could be alive to see it. They died alone in a dark room and we make a mockery of our pretense to care by trying to sound loving when talking to their dead body. Whatever experiences you wish you could have done together, you should have done while they were alive. It's too late now. You won't see them again because there is no heaven or afterlife, you will soon be gone as they are. They're dead now - they don't care how many people are at their funeral, or how sad those people are, or whether the body gets eaten by maggots. So why even bother with all the emotional and mental difficulty of planning a funeral? Maybe it just ends up an emotional self-flagellation, a feeling of having 'paid' in suffering for all the time you wanted to spend together but didn't, and now can't. The same notion appears in religious services - just think hard enough about how sorry you are about your sins, and you will be forgiven. Well it's pointless suffering now, because they're *dead*.

I wish it were different; I wish instead of a funeral we would have a 'parting day', a celebration of a person's life while the person is still alive, where family members and friends could plan to attend, reminisce on the

good things in life, complete the bucket list, and share last words [13]. Instead of fading away in a hospital, I would feel comfortable in knowing the people who truly love me and care for me are literally at my side. Instead of slowly losing bodily control and autonomy, being taken over by other people, I would face death strong and on my own terms, proud of it all until the very end. My friends do not leave with emotional guilt over not having spent enough time together, but with a sense of closure and awe of spending such a life-changing moment together with me. Because everyone planned in advance, they don't feel anxious about having to get back to work and can see the whole event in a positive light, as one they chose to attend rather than being societally forced to at a bad time and with short notice. I would pick the weather of my last day, and a picturesque spot to spend my last moments alive. I would be scared of death, but accepting that my time has come, ready and willing to face it, supported by my loved ones and closest friends. My body would be quickly transferred to a medical program, to be used for organ transplants or research. Doesn't that sound, objectively, better for everyone involved compared to what we actually do today? We are unique among animals in being able to understand and even bring about our own death, but we make no use of this power to better our existence. It is our evolutionary drive for survival which keeps us blind to such solutions.

[13] encouragingly, today this is not a fantasy. A number of short documentaries show individuals choosing to end their lives (mostly in northern Europe where such choices are legal) and spending a parting day with their loved ones. This is still limited to those who go out of their way to prove they have some terrible disease

9

Evolution in Society

main message: a lot of what we do is irrational but is carefully selected by evolution to keep us surviving. Evolution is not just of the body/DNA but also of the cultural beliefs, heritages, morals, and customs. Oftentimes these are designed to silence our own doubts by rituals of certainty. This shapes our view of the world as more orderly than it actually is

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We already explored how society shows signs of determinism, and how nonetheless many aspects of it are irrational, not truly aligned with the proclaimed goals. How do any of our societal customs arise, rational or not? Why is it that we find ourselves in the present society, with its customs, morals, and traditions? Are certain values or behaviors 'right' and others 'wrong'? I argue that evolution is the driving force for society. Evolution as survival of the fittest is an accepted doctrine for how living organisms have developed to today's variety and sophistication. It is tempting to think that evolution leads to intelligence, and by inference that higher intelligence is more preferred by evolution. But evolution doesn't really have any preferences nor goals; it does not lead to conclusions and outcomes; it is simply a numbers game (just like the entropic spreading of information to all available states is a numbers game). And it is always in play - there is no way to exit evolution, whether an organism lives or dies or tries to use science to 'overcome' evolution it still contributes to evolution; this is a driving force as real and immutable as gravity or entropy [1]. If conditions exist for an organism that can stay alive (prevent its decay into constituent elements/atoms), given enough time we might expect such an organism to arise. This would be any stable chemical reaction, the basic unit of life.

[1] in fact, evolution is closely related to entropy; as the creation and life of an organism is a 'one-way' process that therefore requires energy dissipation

Once an organism somehow gains the ability not just to stay alive but to create offspring, that organism will grow exponentially, quickly outnumbering any non-reproducing organisms. Over time the exponential growth will slow, maybe the organism will die from lack of resources, so evolution does not simply select for highest population of organisms. What it selects for is a combination of population and survivability: given a population size N how will it change over hundreds/millions of years? Organisms stable for millions of years are more evolutionarily fit than organisms that quickly die out. We can define a metric of 'species lifetime', which is the sum total of hours lived by every organism, roughly organism lifetime * number of organisms that ever existed. This metric allows the evaluation of even extinct species in terms of their evolutionary fitness. So evolution does not select for intelligence, nor lack of pain, nor philosophical or mathematical abilities. Evolution selects for organisms that are resilient (resist attack and find sustenance) and have offspring in a stable manner (prolonging the integral indefinitely vs overpopulation and rapid extinction). The 'selection' happens because over time the less stable organisms die out, by definition. What we see around us are the stable results of evolution (for the most part, since random variations always occur and are at the heart of the evolutionary process).

Intelligence gave humans an advantage in avoiding attacks, finding food, and fighting predators, so here we are. Humans who enjoyed loneliness were more likely to be attacked and did not survive, so we have a biological drive to seek social interaction and closeness. Humans who did not care about sex or raising their children did not survive, so we have a drive to seek intimacy and protect our babies (others' babies? not so much - the instinct is biologically programmed and passed on). Pain helped us learn hard lessons that kept us alive longer, and those humans who happily felt no pain did not survive - so we are subject to pain that we can't control [2]. This survivability and stability applies just as well to human affairs - the fabric of society - which significantly impacts evolutionary fitness of the individuals within the society.

Nations and religions that focused on medicine and giving care would tend to survive better than ones focused on murder and hating each other. In that sense, modern ethics and treating one's neighbor as thyself are 'right', because they lead to increased societal fitness. Killing everyone around you is 'wrong' because it leads to poor evolutionary fitness. We live in a lawful society and not in a wild anarchy, because the former is more likely to survive and prosper over long periods of time. The advancement in quality of living and reduction of pain that are seen in today's life are

[2] if we could control our pain, it would cease to have its desired effect of ceaselessly driving us to some action, thus again evolutionarily unstable

just happy side effects of such survival in societal experiments and trials over thousands of years. A stable organism's life could well be miserable, as long as that organism is resilient and has sufficient offspring. Birthing a baby - objectively a terrible experience for a woman - must have somehow gotten ingrained into societal expectations and biological drives of women, for if it did not those societies would have died out long ago; this doesn't reduce the pain or dangers of birth but just makes it accepted societally, something that is celebrated and respected. [3] Nations that develop warfare capabilities can kill and destroy peaceful nations, so truly peaceful humans are eventually wiped out by evolution while aggression wins. But excessive aggression destroys a society from the inside out, so we have a 'healthy' level of aggression and violence in our stable society. Cultures that encourage lying/bribing/unwritten rules generally lead to stifled communication, and thus cannot respond to challenges as quickly or effectively as cultures that are more transparent and 'free', as long as the latter freedom leads to better defense/food production/reproduction. So we might find ethical rules: lying is bad, bribes are bad - why? Because societies in which the rules encourage lying and bribes do not do as well and eventually die out. Did we abolish slavery because it was a terrible human rights violation, or because not having slaves proved to be more effective economically and in warfare (a person choosing to work for money will do better work than one forced to work for the same money)?

Religions and beliefs that people accept will perpetuate and spread while those that people ignore will die out, so plainly illogical and incoherent beliefs are not found today. Religions that actively encourage followers to convert others will spread even more effectively than religions that don't care what others believe, so it is no coincidence the former are dominant today (and that there is a concept of heresy or excommunication) [Baba Brinkman - Religion Evolves `https://www.youtube.com/watch?v=Alxrbs0xPI4`]. Behaviors that lead to low social acceptance and reproductive opportunities will die out, whereas ones that lead to increased reproduction and survival will be stable. We can see this in family traditions: why celebrate weddings, baby showers, birthdays? Why care for your elders or children? It must be that cultures with such traditions are both physically (many offspring are encouraged and supported) and mentally (teachings of elders are easily passed down and help in physical survival) evolutionarily stable. So perhaps a culture in which marriage is celebrated will lead to more babies and devoted parents, resulting in physically more

[3] from `eqi.org`, "If the mother did not feel adequately loved, safe, secure, protected, appreciated, valued, accepted and respected before giving birth, she will, in all likelihood, attempt to use the child (and later the teen) to fill these needs. If she did not feel adequately in control of her own life as a child and teen, she can be expected to try to control her son or daughter as compensation. This is the recipe for emotional abuse."

offspring who in turn perpetuate the culture.

People who lose their will to live (before their children are self-sufficient) and accept suicide, or take careless acts, or don't enjoy sex, will also die out. Thus we have a biological drive for self-preservation, intimacy/sex, and a continuous glimmer of hope even when unwarranted. Indeed we have evolved psychological defenses to protect ourselves from the most powerful and direct threat - our own intelligence. Kids initially don't know any better than to not hurt themselves, but eventually learn to avoid pain and thus limit their actions to ones that don't cause pain. Similar experiences arise with emotional/mental pain or suffering. Even the dumbest human today could easily figure out how to kill others or themselves. In our advanced society, one could even set up a situation that leads to a quick and painless death. Why don't people take such actions? "A permanent solution to a temporary problem", says the suicide hotline, but doesn't a permanent solution sound nice? I cannot physically set up a situation leading to my death - not out of a primal fear of pain, but because of powerful psychological defenses that force me to stay alive. Our brains are designed to find logical, unyielding solutions to complex problems - this is necessary for continued survival and prosperity - harvesting food, fighting off predators. Yet if our brain had no limits on 'staring into the void', we would readily conclude that death is an optimal choice, and the sooner the better, to minimize risk of potential future suffering and pain [4]. Does this sound crazy? Does it sound crazy because of your societally-instilled beliefs? Of course societies that believed this would die out, so today's society supports/caresses us/shields us from the void through life-affirming social connections, family gatherings, traditions, and religious beliefs. [5]

The emergence of religion and mythology universally in all cultures is indicative of a general human function for religion. Perhaps it truly is a psychological defense to keep us from realizing how small we are and how much we don't know and can't control, an acceptance that everything is OK because there is a fatherly, strict but caring and powerful, figure (or multiple

[4] "Cultural history, as well as observation of ourselves and others, allow the following answer: Most people learn to save themselves by artificially limiting the content of consciousness." - The Last Messiah, Peter Wessel Zapffe

[5] These are all 'rituals of certainty', designed to show members of the society that they are, for the most part, in control of their lives and the world around them - by minimizing the infinite space of all possible solutions to the comfortable well-defined space of societally approved ones. Why do we work 9-5? Why do we have 2/7 days off and in such a rigid manner? Why do we have 3 meals/day? All these little unquestioned rules and structures impose order on our lives, giving predictability and a sense of control, therefore gaining the name 'rituals of certainty'. In truth, nothing is fixed or absolute except the laws of physics. Any of societal customs can be questioned by anyone at any time, but such questioning is very difficult because without the guide of certainty there are infinite ways to try and reach an answer, one is venturing into the fog.

such figures) watching over us, just like our fathers when we were little kids. To make us strive to do our best, learn from the environment and survive, evolution has given us an urge to learn new things - a curiosity - which is an urge as real as hunger and avoidance of pain, though less sharply defined and harder to identify. It is a strong urge, strong enough to force us to explore and learn - perhaps the most difficult intellectual function that any animal undertakes. This urge must lead us to keep questioning: why? Why does it rain on some days and not on others? Why is this year's harvest worse than previous? Why do people behave the way they do? Why do we exist? Religion arises to fill this spiritual gap and thus satisfy our curiosity for learning and understanding the world; it is undeniably comforting to have a coherent set of explanations for how the world works and why, and what we should do in this world. Answers to these big questions that support spreading of such knowledge to others in society will then come to dominate the people's thoughts even if originally society had started out without such answers (which it must have, many thousands of years ago). The answers don't have to be correct, they just have to be evolutionarily stable - leading to improved survival of the society. [6] They don't even have to be coherent, but most people will find plainly inconsistent explanations difficult to believe [7] and will replace them with self-consistent explanations. The specific nature of the self-consistency will of course be a consequence of human brain structure, so we might not be surprised that religious texts follow a similar format to epic works of fiction or mythology, the stories within are all appealing to and created by human minds. [8]

Religion also comforts people and justifies their existence by playing to the evolved need to be part of a social group - and what better way than to be part of the ultimate power group (god's chosen ones/heaven). Conversations with others and social dynamics are then also a distraction from the void - a psychological resort to keep us busy with interacting with others and meta-problems (ie let's make nice food to celebrate a birthday vs it doesn't matter we're all going to die anyway). Work itself is another effective distraction, keeping the mind busy enough on everyday tasks of life that it doesn't have to confront death; it is often heard that people who don't have any job become adrift/aloof, bored and aimless, and eventually come up with some arbitrary (perhaps even obsessive) patterns so as to

[6] why are religions so supportive of lots of births?

[7] after all, evolutionarily fit brains have to employ accurate physics models to hunt animals and plan for the future, and coherent explanations carry more meaningful physical content

[8] as before, the similarity of religious stories to other fictional stories, and similarity of holy beings to the human/animal world around the culture writing these stories, is indicative of no new information content and that the stories were created by human brains to appeal to other human brains

make themselves *feel* useful - whether it's beating every video game, keeping a well-trimmed garden, or writing books on nihilism - or perhaps they go crazy and never quite recover to being a 'useful member' of society. [9]

Embedded in this evolutionary scheme, our brains adapt and accommodate based on the reality we experience - that is, in a relative way. There is no absolute reference for how we should live and interact with others. This leads to interesting and unjust phenomena that clearly refute any notion of a unified world order ie religious teachings, human control ambitions, absolute morality. While in the USA a criminal is tried in court, in Libya he may be burned on the street and stoned. Who is to say one approach is better than the other? We only have the societal evolutionary survivability criterion, as we did for species evolution - as long as the culture survives and perpetuates itself, its ethics stance is evolutionarily stable. This is the only real-world quantitative definition of "good" that we have. Relativity occurs on everyday scales even within a culture, because children don't know any better than to learn from their parents; an abused child will say his parents are "great" because other kids say their parents are great and the only reference this child has for great parents is his own. It is not a matter of the child not being able to make a judgement or lying, but rather that he has nothing to judge against, as he can only be aware of his own experience. Beyond the potential for unrecognizable abuse in children (and adult) relationships, relativity makes commercial and governmental decisions flawed and provides an opportunity for 'ripping off' others. This can be countered by fair and rationally set prices/laws/punishments, but in a society we have no such means without a governing agency and the governing agency has no reason not to make itself profit above all. Who will govern the governments of the world? Only physics and evolution have this power, so while individual humans compete under societal constraints [10], governments compete with each other on the raw playing field of physical laws - it is no coincidence that the most powerful governments have the most powerful physically destructive and wide-reaching weapons.

Another artefact of evolutionary development in society is the widespread preference for novelty and progress (as opposed to a reversion to the past), creating rather than destroying, reaffirming life, what I would call 'positive solutions'. This is because positive solutions are evolutionarily stable,

[9] there is a similar urge to solve problems/to be useful, which leads to the popularity of 'idle games' like candy crush - there are consistent rules and solutions are readily achievable, satisfying this urge on artificial problems instead of real-world difficult ones with no clear rules

[10] this is not to say that these constraints are any less real and physical in content than physical laws - everything physical happens because of physical laws after all, but just that they are more removed from brute force

while negative solutions tend to die out over time. Consider the use of fossil fuels and its contribution to industrialization, this propelled societies into a much-improved lifestyle (including increased survival and destructive ability) compared to societies that remained unindustrialized. But the discovery of the necessary technological principles and their application to real devices could only have happened in societies which encouraged this sort of exploration and rewarded inventors' efforts. This could not have happened in societies which strongly upheld following previous generations' footsteps and avoided novelty. Will such innovation prove to be stable over thousands of years? Perhaps the societies that stay close to their roots (farming/ hunting/ gathering) will be more stable in the very long run (once fossil fuels run out). For the moment, innovation seems to provide significant benefits onto societies, so the 'developed' societies of today support innovation. The societies that innovate can win against others in competition for resources through technological superiority (even when it's not labeled as such, competition for resources always exists as long as there are finite resources); thus even physical human survival improves in innovating societies, at the cost of the non-innovating. The dark history of North American takeover by technologically advanced European societies provides clear evidence of this evolutionary preference: societies that valued growth and advancement won in physical competition against societies that chose to live in (relative) equilibrium and harmony with nature.

Consider what this preference for innovation means in daily life: a chemical plant is seen to pollute nearby ponds and aquifers, which is troubling to the humans residing in the area. The positive (innovative) solution: develop and install new types of filters, regularly monitor the area for leakage, research new chemicals that are less polluting. The negative (non-innovative/reverting) solution: shut down the chemical plant, or reduce its output. In terms of actually reducing pollution, both the positive and negative solutions are effective, with the negative one being much easier and more elegant to implement. One might argue the positive solution doesn't even achieve the desired goal of reducing pollution: there are new chemicals used in making the filters, more workers' time (and energy) used in installing and maintaining the filters, and once there is less pollution released the chemical plant may as well increase its output for greater profits. There is a parallel in the computing world: if a computer program runs slowly, a negative solution is to not run it (or run less often), while a positive solution is to optimize the program or to make a better CPU. We easily favor the positive solution, but once the program runs faster it incites us to run more programs, or more resource-intensive programs, until we end up right where we started: despite better technology we still face slow execution speed.

Our economy values consumption, so the companies that take negative

solutions to their challenges end up overtaken, chewed up and spit out, by the companies that take positive solutions. Societies that use such a 'greedy' economy survive and prosper more than societies that use a conservative economy; this economy is effective because it is a reflection of our individual greed and thirst for more/better. On a small scale, individual humans who choose positive solutions end up more successful (evolutionarily) than those who choose negative solutions. We have survived with our brains for thousands of years, so we have a built-in bias towards positive solutions. Physics doesn't care about the distinction between positive and negative solutions, so we should see 50% positive and 50% negative solutions to be in equilibrium with the physical world constraints. Yet we have a blindness towards negative solutions, and with our current ability to use more and more resources, we have the luxury of using almost 100% positive solutions. We never have to give anything up while still 'improving'. So we've fought off disease and famine but chosen to keep our reproductive rate, sending the world population skyrocketing. We've realized the benefits of fossil fuel use but chosen to increase rather than maintain our work output, polluting the entire atmosphere. We've designed advanced weapons but chosen to continue designing increasingly powerful counter-attacks rather than live in peace with other nations. We've installed amazing communication and transportation networks but chosen to keep loading them to capacity rather than showing disciplined restraint so that everyone can have faster access. It is in a sense the tragedy of the commons, yet it is more subtle because humans making the decisions do not have to be conscious of the larger impact they will have; evolution will ensure that those who (by whatever logic) choose positive solutions will outnumber those who choose negative ones. And this is another psychological defense, for it keeps us from seeing the ultimate negative solution: death. I could keep worrying about student loans, finding a job, finishing this book, going to work tomorrow. Or I could just die (it will happen sooner or later anyway). But I can't truthfully accept death as a solution, it doesn't feel right; death is a negative solution - one that doesn't seem like a solution at all.

A final effect of successful societies' fascination with positive solutions is an inability to 'turn back the clock', to return to the past. In any call to revolution or change of society, it must be recognized why the present-day society operates the way it does - its historical roots which lead to a given course of societal evolution. Many campaigns for change are thus misguided, focusing on symptoms and not the reason why the symptoms have emerged; pulling off a leaf or two instead of cutting down the tree. Because features of society seen around us today are evolutionarily stable, simply pushing back will not influence the features, or maybe temporarily suspend them just for a re-emergence later on. Consider the agglomeration of businesses: small 'mom and pop' stores getting bought out and replaced

by big, impersonal, national chains. Some vocal proponents call for a return to the past, a dismantling of the big stores and replacement by small, family-run businesses. Sounds doable, right? If the president were king, he could just shut down all the big stores and encourage the creation of small stores. But, crucially, small stores was how our society lived a long time ago. Big stores emerged out of a society which originally had only small stores. So if we shut down all current big stores, we are returning to an 'earlier time', and we know that since such an earlier time we witnessed the emergence of big stores. So we can shut down current big stores, but they will re-emerge soon afterwards because the evolutionary forces are still in place. Why should we call for a return to small stores when the society which had small stores chose to create big stores? It is not the cold-hearted businessmen who shut down small stores, but the individual consumers consistently choosing bigger over smaller stores, in turn acting upon their human nature and desires. Indeed it is easy to experimentally verify that the big stores have better variety and lower prices compared to small stores even today. Isn't it quite short-sighted to call for a return to small stores in such a system? Consider also organic foods. A long time ago, all food was organic, grown by hand. Since that time, we have invested serious effort into developing various pesticides, antibiotics, hormones, and medicines that increased production and profitability. The use of 'non-organic' techniques in farming was preferred over 'organic' techniques by consumers, who gave companies that used the new technologies a greater profit. Isn't it similarly short-sighted to just claim that we should go back to 'organic' farming? Wasn't there a good reason to shift away from it in the first place? One must wonder whether these 'organic' proponents have some monetary stake in the creation of marketable 'organic' brands. Similarly with wealth inequality: at one point there were no super-wealthy individuals in society, and starting from that point individuals have been able to emerge as super-wealthy because of how our economy is set up [The Great Leveler argues that inequality can be traced all the way back to the earliest groups that chose domestication over hunting and gathering]. So can we just say: "kill the rich, that will solve everything"? Unless we truly change the economic and societal forces - and these forces emerged by evolutionary trends because they made the society using such an economy more successful in survival - we can expect to end up, once again, right where we started. Some people even proclaim their want to return to a 'natural life', blithely ignoring that people who evolutionarily thrived in such a life devoted themselves to creating new technologies and comforts that led to the emergence of today's lifestyle. In a society that has evolutionarily developed to value change/innovation/growth, any calls for a 'return to the past' must be seen as idyllic and a bit callow.

From what we see around us in society today, and with the above argu-

ments as to why this is evolutionarily stable at this point in time, we can reason back to better understand human nature: humans enjoy gaining and exercising control over nature and technology (leading to the preference for innovation), power over others (leading to various persistent inequalities), comfort in life (leading to various technological and practical lifestyle advances), and predictability/certainty (leading to religious and scientific studies on the nature of the world, as well as everyday 'rituals of certainty'). Today we are at a point of many evolutionary firsts. We are witnessing the first human generation raised with access to handheld electronic devices - will these children see electronics more as living objects due to such early exposure, will their cognitive abilities be improved or worsened or unaffected by such interactions? [11] For a few decades now, and for the first time in human development, humans can survive without being part of a family or any consistent large group - are we seeing the effects now in greater promotion of individuality and questioning of family/religious values (as in queer and atheistic movements)? We now have increased freedom and ability to interact with the people and media we enjoy (todays' time watching TV shows might have been early humans' time to tell stories and bond emotionally) leading to both ultra-popular celebrities and completely neglected 'lone wolves' - will this help or hurt future generation survival? By genetic evolution timescales, it was not so long ago that antibiotics and vaccines were developed and used in society, saving those humans who would have otherwise faced an evolutionary demise - will this eventually make our society evolutionarily less fit in fighting disease? [12] Humans have, for the first time in Earth's history, found a way to use millions of years of fossil fuel energy in just tens of years of extraction [13] - there are no signs of our growing use even stabilizing any time soon, so what effects can we expect to see? Humans can now access natural sources of various chemicals, concentrate them, and use them for plastics/electronics/drugs/advanced materials, then eventually dump it all in a landfill (in a state much less amenable to future use/extraction, such as metal-coated plastics, microparticles, water-soluble molecules, or circuit boards) - how will this affect material availability and environment quality for future generations? The modern society thrives on novelty and progress, so pondering these issues is not really a concern; even if the issues

[11] keeping in mind that intelligence is a social phenomenon, ie defined by societal/cultural standards and the ways children are raised by parents/society at large; it arose in the first place by evolutionary and reinforcing-cycle mechanisms

[12] while the timescale of vaccine use is short by genetic evolution standards, population has grown exponentially so each 'saved' offspring went on to have many more which effectively speeds up the ensemble evolution

[13] it is an insane ratio, million to one. One footstep to a million footsteps. What can we say to future generations who will not have any fuel for the next hundred million years because we burned it all?

are mentioned from time to time, the money goes to the manufacturers and producers, not to the idly-sitting worried academics. I don't think anyone has the answers to the above questions, so we continue to blindly run into the future.

The picture of the world that this evolutionary view paints is a cold and uncaring, cruel one. In trying to find a scientific basis for consciousness - the one thing we might say defines our lives - we see that consciousness and all associated experiences are simply a consequence of particular molecular arrangements. Given an appropriate brain structure and chemistry, conscious experience will arise. It is an impersonal and uncaring process - if the consciousness can only suffer helplessly, nature doesn't really care. So, we have the terrifying situation of "locked-in patients" who show signs of conscious thought/imagination seen in brain scans [Dehaene], in an otherwise fully paralyzed body, completely helpless yet alive and capable of feeling real sensations. How could this ever be considered just or fair or purposeful? [14] Ultimately consciousness helped humans survive and proliferate so was evolutionarily selected and thus I find myself conscious, and afraid of death and pain, needing to continually satisfy urges like hunger. Our only purpose in life is to increase entropy - survive long enough to raise kids, and all our urges are programmed for this. We've managed to ease the suffering of everyday life through technological comforts, medical treatments, and education. But we haven't changed anything about the point of our lives - or lack thereof. Each one of us would fight to protect our own self, but looking at a bigger picture of all our selves, what are we really fighting for? Why is no war a 'good' thing - because it leads to less suffering - but so would a quick death. Evolution made us afraid of death though, so we live on in this unstable, vulnerable state of easing our suffering yet continuing to exist and be exposed to future risks, while also exposing our children to even greater risks. [15] Evolution has been a cruel and vicious process, where the unfit organisms' death was the typical case - survival into old age was unexpected and rare. Most of the trees and animals and bugs in a forest are young ones, because as they grow their chance of dying increases along with time exposed to such a chance.

Diseases in society - there is a stable level on evolutionary terms. Animals would be 'better off' if all diseases were eliminated and then the immune system would not be necessary, but in such a situation diseases will rapidly evolve and spread since there is no resistance to them. Given a long enough time scale, it is not possible to have an absolutely healthy population... It is similar with government: in an ideal just and fair egalitarian

[14] surely there will be people who find comfort in religion, "god has a plan"

[15] I think it is unnecessary to bring children into the world. We are the one species lucky enough to have the ability to contemplate suicide and sterilization - refusing to play evolution's aimless game.

society, there would be no need to spend resources on a government/police, but in such a situation groups that form hierarchical power-concentrated government structures can fight and win against power-diffuse groups.

Human life was seen as precious because death was common, and societies have evolved to value life above all else, mentally blocking the reality that children will be exposed to suffering in their lifetime. Earlier I had mentioned the "cult of I" and how it leads us, as a society, to irrational reasoning and actions. For instance, being OK with poverty/crime being caused by "external factors" (that we axiomatically don't look into further or care about) and at the same time jailing individual criminals because of their inappropriate actions like they have complete control over their lives. Now I posit another cult: the "cult of life". I refer to it as a cult because the vast majority of people get indoctrinated into it as babies, and usually have no need or desire to question this set of beliefs, nor even to bring it to a conscious level (ie to actually see it for what it is). They can lead a content life of focusing on the next day's tasks, getting a promotion, impressing their parents, taking care of their children. Worrying about consciousness and the meaning of life is for academics like me with too much free time, as for better or worse I do not spend time on marriage or children and the associated daily tasks. It is in a sense a luxury and certainly not what evolution designed me for - not too long ago I would have been dead if I wasn't an active part of a life-affirming group, but now I can be alone and live long enough to think and write these thoughts. Why am I alive? My parents had sex. Nothing magical, not a blessing, just sex and then a kid as a result, like all other mammals. Should I still be alive? Since I am alive now I will fight for my life, but I could have died long ago. This sounds like a bad thing - but why? This sentiment that human death is bad is a core and unquestioned belief of the cult of life. Just as the cult of I claims that a person is responsible for their own choices and their own well-being, the cult of life claims that human life is precious at all costs. Both lead to grossly irrational and self-contradictory actions.

Life is an unstable state of thermodynamic out-of-equilibrium systems, one that cannot be sustained indefinitely even in principle. There is nothing particularly special about a living being, there are billions of humans alone. I argue that because life creates conscious states/qualia that can experience pain and suffering, to minimize suffering it is better to not create [16] or needlessly prolong [17] life. The cult of life meanwhile maintains that every human life (we still gladly kill animals for meat/fun) is a net positive, making it beyond the reach of rational valuation. And without rational valuation of life we become irrationally afraid and avoidant of death,

[16] this view is called antinatalism - avoiding birth. See also [Because I love you, you will not be born - Julio Cabrera + de Santis]

[17] this view is more along the lines of promortalism - accepting death

which just as in the case of negative/positive solutions above is a whole 50% of real world actions (the other 50% being birth). But in our minds, births are 100% the only solution and deaths are to be ignored and avoided. We like to think every life is precious and invaluable, but everything boils down to physics and physics is a quantitative science, thus lives are also measurable and comparable - as long as one is ready to define metrics by which to compare them. It is not fair at all, but some people have objectively better lives than others. Some lives contribute to society and some take away. By forcing a blindness to such valuation we leave everything "to chance", steadfastly proud of our ignorance. These lives will continue to exist whether we valuate them or not, but if we want a 'better' society we are at best stumbling in the dark without such evaluations. Consider the elderly - dying of "natural causes" like organ failure and terrible painful diseases - they will die soon anyway. It's guaranteed that some will never be able to spend a day without care - unable to move or think coherently, in pain, spending their time on TV and distractions. Just let them die already? This sounds cold and cruel, due to the cult of life brainwashing in me. [18] Why devote serious societal resources to keep this person alive another day - society suffers, the person suffers, and all it does is push death a tiny bit farther away, never eliminating it or the associated fear and pain and misery. So does anyone benefit in the end? It is like kids covering their eyes and pretending the thing in front of them doesn't exist - we don't want to accept the finality of death, so we keep persons alive [19], but by this delusion that death will never happen we devalue their lives even more - how many elderly must spend their days in care homes without any love from their family or friends until they die and suddenly everyone is sad (or fakes it)? Why doesn't the family care? It is the cult of life - death is assumed to not exist, the elderly person is fine living their life, we have plenty of time to visit later. Why all this meaningless misery? Just accept it - the old person will die, they are not enjoying their lives, care for them and love them and let them die. Minimize their (and society/caretakers') misery by making their last days great and happy and painless, instead of letting them suffer all sorts of chronic/debilitating pains and diseases so long as they stay alive - again alive for what? So that you don't have to feel sad about the funeral, because now's a bad time for that? In facing the reality of another's death we have to face our own mortality, which may lead to realizing that parents condemn every born child to eventually die -

[18] the existence of the Stockholm syndrome is very interesting, if we assume this shows a certain psychological defense mechanism to "accept the things you can't change" there is no reason to assume this mechanism only applies to kidnappings, it could also keep us "accepting" the state of being alive itself.

[19] readily trading their vivid qualia experiences of pain/suffering just so we don't have to be sad about selfishly losing them

but all thinking along these lines is high treason in the cult of life.

With an adult we have the option of letting them choose whether they want to keep living as they are or to die, which is I think morally respectable (as opposed to killing all old people, which is just as senseless and rigid as keeping all babies alive). What about the permanently ill/ paralyzed/ retarded, those who cannot speak or think for themselves? Some definition-diluting people call them a "blessing" but I will be blunt: they are likely to be miserable for the whole extent of their lives, never being able to experience or comprehend the normal human pleasures and interactions that make life worth living for us. Along with their suffering they will drag down the society around them (of normal people who are capable to otherwise contribute to societal progress) - requiring extensive care, new medical technologies/ surgeries/ drugs, and unable to fulfill family obligations thus tearing apart otherwise stable emotional/romantic partnerships. And all for what? [20] Just so they can live a lonely/alienated, powerless, painful life that ends in a death sooner or later anyway? Call me crazy but I think this is a far more cruel torture than the alternative of a peaceful death, and comes down to a selfish reason - nobody wants to be the "murderer" (because of the cult of life) and many people like caring for others, exercising their power over a helpless patient, having a person as a "pet" [21], or just simply helping along the delusion that death doesn't exist and everyone is alive and happy; playing god over the very matter of life and death, able to create and sustain life. Everyone (and every action) is selfish at the core, but that's no reason to make another living/conscious being suffer. There is an essential asymmetry here: we have no moral reservations about giving a conscious being no choice in being born/entering this existence, but

[20] the reality of self-reinforcing cycles (see next chapters) must not be ignored. Medical institutions function and establish their usefulness by virtue of having patients in need of their care. In a twisted way, providing a cure is not in the best interest of the doctor - but being able to keep continuous money flows going is. This objectification (that also caters to the providers' desire for control over a human) is seen readily in medical settings, waiting on a doctor/specialist (their time is more important than your plebeian concerns), patients indifferently moved around/ bumped/ dropped on stretchers. People become similarly objectified "feel like a number" whenever they play a role of sustaining money flows, for instance college education and taxes and loans/banking and corporate work and taking part in a media/televised event.

[21] perhaps it shouldn't be so surprising that abuse is widely documented in mental institutions. And seeing the parents care for a permanently dependent/helpless special needs child makes me ill, because the parents clearly get a sick twisted primal gratification out of forcing a helpless and always-inferior (ie not a competitor to their status) being to do things against their will, causing pain but having an excuse "the pain is necessary, I am doing this for you, sorry sweetie but this is how it must be". Chances are, the parents will in due time make another kid in the hopes of it being normal so as to 'replace' the abnormal one, leading to the notion 'replacement child', as if saying to the abnormal one "yeah, your life sucks, and it's also worthless. Now let's keep dragging you through your daily routine so we can satisfy our need for control!".

we have the highest moral reservations about giving a conscious being full choice in dying/leaving this existence. In fact, we force beings to live even when this hurts them, as if to say "you will live and experience this world whether you want to or not" [22] - this is at least just as cruel and cold as killing the being forcefully, and potentially more so since the act of killing can be quick while living and suffering can continue for years and the pain of death is never eliminated or even decreased, merely delayed. So disfigured, retarded, disabled, chronically ill and dependent on drugs/machines, newborns and babies are made to live, grow up, and exist as never self-aware dependents, or even more painfully at the cusp of self-awareness and realizing they will never experience huge parts of the world and they themselves are the reason their family is suffering and poor (due to paying for constant ceaseless medical care, more and more intense to keep them alive against the odds). What do these lives contribute? It hurts to see all the pain of this world and the ingenious ways to keep a person alive with no purpose and no point, no one along the line stopping to question whether they are actually creating pain by their life-supporting actions. We all die sooner or later, and if we're not going to contribute to the well-being of society/current generations [23] then we might as well die sooner. Life is just another unstable arrangement of atoms, a large-scale physico-chemical reaction that the cult of life keeps us from seeing for how bare it really is.

In fact there is a secondary damage to society that occurs from the cult of life. When death is de-facto dreaded and avoided, regardless of how bad an individual's life is, life itself becomes less precious, less worthy. If a slave working in dreadful conditions seeks his own death [24], the slave owner loses power over the slave; if all slaves preferred death to succumbing to unjust demands, the slave owner would be powerless. The worth of each individual's life is thus maintained, whoever unjustly abuses people will find that the abused people either fight back or die, eliminating the power base of the abuser. The abuser/ slave owner/ emperor would then be quick to cater his actions so people of his society actively want to stay alive rather than struggling/making ends meet to stay alive because that's the only option the cult of life supports. The ruling class would be always confronted by the real risk of losing their people to suicide if they decide to be abusive and take too much for themselves. But by making death anathema, floodgates are open to exploitation of living people to the highest practical extent - you can either keep your honor and suffer a lot or kiss the boss's feet and suffer less, there is no option to escape. As long as someone else is more

[22] the film Children of Darkness depicts a teenager who impulsively self-harms - he is forcibly strapped down to a bed for most of the day so as to keep him alive

[23] and absolutely not in the sense of birthing more kids, like the cult of life wants us to believe, but by actual work to reduce pain and increase pleasure

[24] or, in less violent circumstances, a birth strike

willing than you to kiss the boss's feet, you get the non-choice of either suffering more or being even more willing to kiss the boss's feet, implicitly reducing your own life worth. Of course having someone else more willing to do this only happens because of the cult of life - more children and a growing population will lead to a more easily exploitable workforce as more individuals compete for limited resources, keeping the poor in poverty [25] It is fucked up. We bring children into this world, and then magically they themselves are made to be responsible for their own (and even our!) survival, at risk of pain to themselves (not us!), so they must do whatever is necessary to stay alive even though they never asked to be alive in the first place. This is precisely what makes it possible for societal systems to exploit lives and turn them into menial chores. This is like being in a store where you are forced to buy something every hour, with billions of other people. Chances are, you will find all the good and cheap stuff is already taken, but you have to buy something, so you pick the least bad option, at the end you end up paying a lot for something you didn't really want. Why would anybody enter such a store, knowing they have to pay with real effort and suffering? [26] Human life is valued only as much as we ourselves value it - mothers birthing more kids and forcing their kids to study so they can impress the emperor will result in kids who genuinely believe their life worth lies in how they are evaluated by the emperor. If these children decided to value themselves, realizing that the emperor only has power to the same extent that all his servants believe he has power, they would not compete with each other to impress the emperor, instead treating each other and the emperor as equals. Death is the one equalizing factor that can keep the brute-force subjugated people from serving a master they despise [27]. Alas the tragedy of the commons applies here in another perverse way; because evolution has wired us to want to fight for our lives, each individual in the egalitarian society stands to gain selfishly by serving an emperor figure, by

[25] here we have a whole confluence of forces working against the poor - on the surface level the wealthy have physical and economic means to gain more money for themselves. Deeper, assuming the poor have more children than the wealthy, the few resources the poor parents have end up spread out over more children to care for, meaning the children will be unlikely to end up better than their parents started. Deeper yet, assuming these poor children will have to compete for similar jobs, the size of the candidate pool for these jobs (as compared to jobs that rich children compete for) will grow over time and the pay will shrink over time, so the poor children will on average end up with lower-paid jobs.

[26] a similar level of abuse is enabled by permanent ties like 'blood family' relations - if a child is made to learn they have no choice but to love their parents, just because they're family, the parents can exercise any level of abuse and children will have no escape. If children are able to act on the possibility to leave their blood relatives and choose their own family, domestic abuse ought to decrease

[27] see [The Great Leveler] for more on how wealth inequality dramatically and consistently decreases in times of great violence and death

being willing to do more than another for less reward, so the inequality of power recreates itself. [28]

The tragedy of the commons will apply on an even more monumental scale in our current relation with the environment. Acting selfishly is a physical law just as the laws driving atoms to take "selfish" actions and find a local optimum. Those who aren't selfish [29] get beaten and outnumbered and used by those who are, until they realize they can also experience personal benefits by being selfish so they become selfish but the society pays for it. Why don't I share my room with the homeless? I don't "use" the whole room anyways, but I want it to remain my own even while the homeless don't have any place to call their own. Similarly, we don't share our fossil fuels with the future generations - because we have easy access to fossil fuels, we can use them for wholly selfish reasons like driving a bigger more comfortable car instead of riding a bicycle. In a rational society we would realize we can only use tiny amounts of fossil fuel to be in balance with the planet's fossil fuel regeneration rate, and we would reserve its use for those tasks that are crucial to achieving the greatest social pleasure. The gallon of fuel burned driving a car to work today could have been used in a society and life-saving mission sometime in the future, so the selfish use of natural resources is even counter to the cult of life: this cult's obsession is not with Life as a holistic entity but rather with surface-level rhetoric that at its core is based on satisfying selfish desires. Our desire for pleasure and comfort is the strongest factor: despite the advances of modern society effectively eliminating untimely death, we procreate much as we did when wolves and diseases killed our children. Instead of maintaining stable population levels (1 child per parent), using new technologies with discipline so as to ensure all future generations have a prosperous and easy life with minimal labor and suffering, we worked our asses off to extract the most fuels and materials possible, as fast as possible, so that - what? So that we could have a difficult life (working 40+ hours a week for most of our lives after being in school 40+ hours a week in childhood) and extract all the resources future generations could have used, leaving them utterly stranded without an energy source and in a CO2-rich atmosphere. Why? Because we are greedy and selfish, because we don't look at the big picture, because we have romanticized views of the future as being somehow always better than today rather than accepting that sustainability means the future should be

[28] such dynamics could be seen in US slavery - slaves were often willing to 'turn in' others planning an escape/revolt

[29] it is questionable whether this is even possible, because all our actions are driven by want to satisfy ultimately self-preserving needs; even altruistic actions are taken because they satisfy some inner need. On what basis would a conscious being choose a state of suffering with no reward for itself? This seems a physical impossibility, like a spontaneous decrease of entropy.

more or less the same - certainly not bigger or more prosperous. We are committing a crime against all future generations by burning fossil fuels and making as many kids as the parents feel satisfies their urges [30]. All because we are separated from the future by an impenetrable time barrier. The future generations have no say in what we do to the fuel reserves and the atmosphere, and just like animals in slaughterhouses that have no say in what we do to them, and just like small countries which have no say in what the global powers do to them, we will selfishly satisfy all our urges, fully at their expense, because we remain ignorant of how they will feel [31]. Again, a tragedy of the commons because the couple that "wants" 5 kids [32] can do so and satisfy their urges or be responsible and receive only a nebulous invisible "reward" of future sustainability. [33]

Society uses specialization to spread mental effort among members of a community, but application of optimization algorithms shows that specialization implies local searches and can lead to convergence on suboptimal outcomes. So the workers extracting minerals from mines don't ask what the minerals will be used for and whether this is the most appropriate application. The workers extracting fossil fuels from ground reserves don't ask what the fuels will be used for. Buyers of fossil fuels don't ask whether there are better uses around than what they are about to use the fuel for. Users of fuels like professional drivers don't ask why fuel should be used or why it should be used to the extent that it is, whether the application is a worthwhile one. And it certainly sounds impractical to ask such difficult questions, for it would require everyone to know everything. Yet with greater global connectivity we come closer to a concept of global optimization, even global consciousness [34]. This global consciousness may like to save itself and there is evidence in its favor: the internet and open access to information has played a huge role in destroying many myths/false beliefs (including religion), making more optimal choices in terms of free market competition, and the prosperous countries have stabilizing or declining population levels. But the laws of physics are ruthless - even if the global consciousness decides to save itself, what can it do against hundreds of years of continuous emissions and destruction, by the past generations, of the en-

[30] ironically it is in no small part the cult of life's short-sightedness that is making it harder for future humans to survive

[31] an incomplete coupling of information, a limited-awareness consciousness

[32] kids and babies are readily treated like objects/property when discussing how parents 'want' them, as opposed to the reality that they are individual conscious beings with their own experiences

[33] in this light it is surprising that religion works as well as it does - maybe this is because in the past religion was armed and capable of exerting real physical force

[34] in the same terms as our consciousness is due to a network of connections within the brain, a network of global high-speed connections can lead to an emergence of a global consciousness as an entity

vironment we evolved to live in? Evolution shows us that no system is truly stable (a closed cycle thermodynamically) unless all energy flows are used up by existing lifeforms, since any energy that is not used is energy that can eventually support another competing lifeform. So if we want to have an indefinitely sustainable human population we must use all the energy flows on Earth to serve our needs - leaving none for undesirable bacteria and viruses to evolve, leaving none for non-productive animals and plants, leaving none for natural/weather events that can wipe us out. This might not be possible with our technology, and certainly not with the way we're using it, so we are left with competition as a necessity. Forests provide a good example of a million-year-scale stable system (and by not using all the sun's energy, they have allowed animals to evolve and cut them down) - it is fascinating that over these millions of years, no single plant has emerged as a dominant one. Forests have different species trees and plants in continuous competition, and it is this competition which seems to be a stable state; maybe there is a lesson here for humans as well. Variety is the essence of evolution - if a single organism dominates, another organism which exploits a weakness of the dominant one now has a ready and large supply of food, so the competition of vicious cycles continues. Humans, and human societies, are part of it. We found technological ways to mostly alleviate suffering - disease, famine, labor - so we bred out of control and took all we could get our hands on, restoring ceaseless competition. The current standard of life is a temporary and unstable result of the exploitation of fossil fuels, and it will disappear within a few hundred years as society globally comes to equilibrium living conditions. It will not reappear for millions of years. The irony is that even now life has been made more meaningless by the competitive societal systems that evolved - we all work secluded and isolated jobs rabidly, ignoring any other alternatives, feeling emotionally unfulfilled leading to increased rates of depression/loneliness/suicide [35].

The same competition is present in social interactions: early humans did not have an opportunity to interact with very many people, so the connections they made were local, likely not their favorite choices but it may be the case that people are more content with their choice when choosing from fewer items vs from indefinitely many [36]. Today cell phones and social networks allow social connections with more people at one time (texting multiple people at once) and a choice of more people to connect with. In addition to other people, we have the choice of all sorts of entertainment - TV shows, movies, and video games. Amidst a growing population, the number of 'top' positions we care about (entertainers and close friends and

[35] people commit suicide in our society, which means whatever they experience is strong enough to overcome the single strongest biological urge of saving yourself at all costs, not to be taken lightly or dismissed with "they're depressed and should seek therapy"

[36] [Myers, The American Paradox: Spiritual Hunger in an Age of Plenty]

politicians) stays constant, leading to greater competition and inequality and isolation. For me, watching a TV show and following the life of a fictional character specifically crafted to be socially appealing, fun, exciting, powerful, all without any risk of judgement/unfavorable interaction is much more enjoyable than spending time with an ordinary and somewhat boring friend, so I will spend more time watching TV than being with friends, and of the friends I have I will choose only the ones I most enjoy being with (because they in some way satisfy my selfish desires). But this means that the already-popular TV show gets my social interaction time while my friend doesn't get anything. It is the same phenomenon that has led to the prominence of huge chain stores and closure of small stores when free market competition is allowed to take place. By being selfish we nominally benefit, yet there are those who end up ostracized by society and longing for connection who end up suffering as a result. Interactions become shallow and easily distracted, it's just not worth all the effort to try and get to know another person and to deal with their idiosyncrasies when it's so much easier to put on a TV series or text other friends/check their social media. It seems that it is only the biological urge for intimacy/sex that keeps us sort of together, but nowadays even couples will sit in front of a TV instead of actually interacting with each other because both find the former more enjoyable, breaking up on a time scale of a year or two when the infatuation disappears. (On the other hand, while the extremes of popularity and loneliness are a product of modern society, competition and inequality in the social realm have been present even since our ancestor monkeys.)

I imagine the experiences of animals are ones of pure urges/desires and seeking to satisfy them, doing the 'intuitively right' action, always following the 'gut feeling' because unlike us they do not have an ability for abstract reasoning to consider this feeling in another context. This is not to say that animals have less of a conscious experience than we do - they still feel qualia (like pain and pleasure) and certainly react to it in similar ways, but without reasoning they can never get an awareness of the bigger picture/patterns - the societies and structures they form are driven by pure evolutionary forces in a more obvious manner than with humans.

In the deterministic world there is no free will, which means there is no morality, just feelings and the world as it is. I am reminded of scenes in Earthlings where animals are skinned alive, pigs/chickens kept in tiny cages their whole life and boiled alive. Humans have certainly used such methods on other humans, and continue to do so. Where is the 'guardian angel'? Who will protect the powerless? This is our world, the tragedy is that we have the capacity to experience suffering and yet are led to benefit selfishly by taking actions that cause others to suffer helplessly. And as I work every day to keep myself alive, hoping for a reduction of suffering in the

future even as I overall contribute to it, still nations stand poised to unleash suffering upon each other at a moment's notice: chemical weapons and blistering agents, weaponized and treatment-resistant diseases, crop-destroying chemical spraying and oxygen-consuming thermobaric munitions. Nature itself is busy evolving organisms that will make use of readily available food sources - humans and our plastics. Evolution is a cruel and relentless competition where it almost seems the winning move is not to play.

10

Systems in Society

main message: being clear about what interacts and how, and towards what actual end vs claimed end, as well as understanding the points of power (does government really care about peaceful protest?) leads to a view of a Realpolitik society

Earlier I outlined the idea of evolution as a force defining society and traditions, even the notion of 'good' and 'bad'. The systems view is closely related, and traces the intertwined cause-effect chains and cycles in our society. In a formally defined system, many interacting entities follow similar rules yet an outcome is unpredictable without actually simulating the interactions - ie it is not a consequence of the rules themselves but rather of how particular players follow the rules. Systems could be the structure of government, business and finance, stock markets, water and electricity grid, academia. In systems, identifying and controlling cycles is key. Self-reinforcing or runaway cycles will tend to arise from random perturbations, so they are expected to be the sole dominant drivers of all we see around us. These cycles are kept in check by other self-reinforcing cycles and influences that make them neutral rather than self-reinforcing at a certain level of prominence. In any call to revolution or change of the system by specific action, the question must be asked why and how the system's cycles were established - whether they are stable, whether they will re-emerge after revolution or modifications because the root causes yielding their emergence are still present, whether whatever it is replaced with is stable, and whether such a replacement is what will actually happen. Interestingly despite the fear of anarchy and apparent ease to break down a lawful system into chaos, predominantly the world is and has operated under stable rulers and organized systems since antiquity [1]. The systems view tells us there

[1] assuming a nominal starting point of anarchy with the earliest humans

is something in human nature which favors lawfulness and keeps anarchy at bay - perhaps a sense of fairness/retribution/justice and the equalizing nature of weapons/intelligence vs brute force. The two-party system is stable, originating without any particular precedent across many societies. Big companies "eating" smaller ones is also stable in capitalism, as is rich people earning more than poor people [2]. Bribes and favors are stable - a consequence of human fallibility and selfishness, they have been observed from ancient societies to modern ones. Bartering and market access are stable, due to benefits to both seller and buyer. Changing such stable systems by brute force is in poor judgement and will just lead to eventual reemergence, as indicated by examples throughout history (prohibition/fights on bribes/communism) so most "calls for action" [3] must be viewed skeptically. Another untenable claim is finding an "ideal" system. All societal systems are "messy" but it is precisely this which makes them stable against the numerous and constant perturbations imposed by the world. Roads are "messy" compared to railroads, but they give great flexibility to the human driver to navigate around obstacles so the roads are stable; lab notebooks are messy compared to strictly-structured databases but they continue to be useful because they can easily handle exceptional/unusual cases; the law system is messy compared to a rigorous logical model of right/wrong but it readily adapts to the circumstances of real-world imperfect situations. Accepting that people will make errors inadvertently, systems must be capable of working despite these errors. Consider sentencing for a crime: an innocent person may be wrongly sentenced as guilty or a guilty person may be wrongly sentenced as innocent. It is impossible to remove all error so mistakes like above will be made, but it is possible to bias the error towards tending to make one mistake vs another. For instance, a society may choose to only sentence as guilty if there is evidence beyond doubt, but this will imply more guilty individuals will be set free, or vice versa. Changes to systems must be evaluated according to this principle. Idealistic claims like "no innocent people in jail" must be viewed critically.

What I referred to as "messy" systems could be stated as weakly-coupled systems: ones in which different parts do not have to operate in strict synchrony, ones which have freedom well beyond the bare minimum necessary for system function, and it is this freedom that makes them capable of handling exceptions robustly. Weak couplings mean failure or inaction of one part of a system does not prevent other parts from accomplishing their tasks. A train on a railroad can only go forward and backward, while a car on a road has considerably more freedom and can even go offroad en-

[2] this inequality is built into (at least) the economic principle of interest rates - have more money=make more money

[3] Such as saving wild animals - we are not gods. And if we were, why would we save wild animals? Which ones will we save - the most photogenic?

tirely - the car's motion is only weakly coupled to the road markings. Lab notebooks allow for drawings/diagrams/equations/stapled pages which is more freedom than a typed and structured database entry - what the experimenter writes down is only weakly coupled to the paper structure. The law system is designed to handle cases of differing amounts and qualities of evidence while still trying to be consistent with earlier decisions, so a sentencing is only weakly coupled to all the specifics of the evidence. Such use of weak coupling is a feature in all complex systems that are designed to be fail-safe: a car's windshield wiper motor is only weakly coupled to the drivetrain, so failure of one does not influence the other. Strongly coupled systems operate very consistently and more optimally (towards its goals) than weakly coupled ones, but they expose more failure points so are not likely to be stable in the "real world".

I've already alluded to processes/features that "arise" in a system that is set up and capable of sustaining them, such as defects in crystals, robbers and diseases and other non-idealities; competition between different 'modes' making any single 'perfect' mode unstable and a whole set of diverse modes stable, just like trees, despite the amount of evolutionary time spent on earth, retain a variety even within a single forest - there hasn't been a single species that is an ultimate champion, because if it were then any species with a slight difference would gain an advantage and outcompete it. [4] Such a constant state of competition/dynamic equilibrium is seen everyday. Here I would like to be more explicit about the example of vacancies in crystals, or why crystals aren't perfect even though that is the lowest-energy form. The key is that atoms have thermal energy and there are a lost of atoms in a real crystal, so effectively (by thermodynamic ensemble) different atomic configurations are always attempted, and in a big crystal somewhere or other a vacancy will arise near a surface just by thermal accident. Indeed hot materials have more vacancies. Once a vacancy arises, it may be a local decrease in energy for it to move into the body of the crystal from its surface, at which point it may be diffusively "trapped" for a long time. But of course other vacancies will diffuse out to the surface and disappear, so there is always a dynamic equilibrium. This is a physical mechanism of the "entropy cost" of a vacancy, and similar reasoning may be applied to non-idealities in society like robbing or lying, which carry a social cost (punishment) but nonetheless occur in a big enough/agitated enough population.

My views on systems are by no means complete or even definitive [5], but

[4] on a bigger picture, there seems to be no true stability in evolution. Even though trees as a category have been stable for millions of years, their nature/appearance has evolved during that time and moreover, they contributed to the evolution of animals so even the whole variety of trees/plants does not make for a closed permanently self-contained biosystem. Perhaps such a thing is impossible.

[5] for additional original insights into systems in society, see [Murder Drugs and Engi-

there seem to be features of systems which are relevant in describing their functioning and nature:

- Stability - a system's ability to stay constant over a long time, where long time is defined as compared to the rate of information exchange within the system or the fastest possible evolution/change (maybe a generation for human societies). Stability is not a preference, a goal, or an attractor, it is simply a long-lasting state and as such one most likely to be observed at any given time. "Stable against perturbations" means that the perturbations are short-lasting states, it would be anthropomorphic to say the system "seeks equilibrium" or "counters a perturbation"; the system has no concept of a perturbation, it simply acts as it does and the state that lasts a long time may be called stable. Mathematically stable states may last forever, but in real systems we can only say that a state is the most stable one at a given time (it might well be replaced by another one later). Stable states may well involve lots of activity/competition, as in "dynamic equilibrium".

- Leverage - parts of a system where a small change leads to a large effect. Small and large are meant as fraction of physical changes in system state. These parts of the system invariably control the direction of flows of energy/entropy/money rather than producing or consuming energy or any material object. It will be found that the people conventionally considered powerful (political leaders, businessmen, army generals) will use and closely guard these parts of the system. Any 'unoccupied' leverage points will tend to be found by random perturbations over time and occupants will join the rest of the power group. With societal evolution already having handled such random perturbations for thousands of years, we might expect that new leverage will largely be a consequence of new technologies.

- Complexity and emulation - more complex systems can emulate/ predict/ supersede/ counter/ control less complex ones. Prediction is possible by faster evolution of a model than of the feature being modeled, such as my brain computing where to move my hand to catch a ball; roughly then complexity=number of processors*time rate of evolution, the latter of which depends on system connections/info exchange speed and is faster for smaller systems due to shorter speed-of-light travel time (this is why modern CPUs are faster than their predecessors even while being much more compact). It is not possible for a simple system to win against a more complex one in competition, because the complex one can *fully* predict the simpler one's actions and adjust responses to its own advantage.

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neering]

- Interconnectedness - to be fully complete, every element of every system must be considered connected in some way to every other element everywhere; for example the almost negligible starlight we see in the sky has been key to developing astronomy and space flight so just because there is little energy transferred the connection of us to stars thousands of light-years away cannot be discounted. I would extend this to bidirectional exchanges of information between all systems, with certain pathways being faster/slower and more/less impactful than others; a high limit of speed-of-light coupling and a low limit of infinitely slow coupling (meaning the distance light has to *effectively* travel is long, not necessarily that there is a large spatial separation) in which case the eventual long-time but nearby in space exchange will use evolved information, as the most elementary physical elements of the system always exchange 2-way information and evolve at the speed of light/speed of time. Viewing the larger system as a combination of exchange (light speed) and evolution (time speed) we can get a parameter of the system's time evolution rate: somewhere between zero (traveling at speed of light) and speed of time (completely stationary with no information exchange). It is this measure of the system rate which is used to define stability.

- Attractors - a system may reach a given state, or nearby states, regardless of variations or perturbations in starting point: can this be called an attractor? This means other states of the system are not just short-lived compared to a long-lived stable state, but also that they evolve so as to get irreversibly closer to the long-lived state. To have an attractor, there must be an "information leak" out of the abstract system model, such as friction/heat bath, where at some point we don't care what happens with the "waste" and cease to track its effect. No "information leak" exists in real physics - only the time-dominance of stable (combinatorially large, ie common, thermodynamically probable) states.

What is a system? It is an interconnected set of physical objects. We find that, the way our laws of physics work, it is possible for the 'information' in a given spatio-temporally bounded area of space to affect/exchange with the 'information' of a distant set. The information here does not blindly disperse to all neighbors, but follows a definite path of influence depending on the physical laws and the arrangement of the system. A system diagram, as defined here, outlines these paths of influence, and this forms the underlying physical reality/invariant of such diagrams. For example, a wire can serve as a coupling of voltage/current between two electrical elements, because of its insulation and spatial extents disallowing

any other possible couplings. We can use different variables to describe what goes on in the system: voltage/ current/ resistance/ conductance/ fields or anything else, which will change the mathematical laws but not what the system "actually does": what cannot change is the amount and types of/channels of coupling. No matter what variables we use or how we interpret the system, the information will not be coupled by the air around the wire or by some faraway arbitrary atoms, but by the wire itself. This is the empirical content of a system diagram. We will distinguish two physical entities in a system diagram: objects/nodes and connections/edges. And also two types of conceptual entities: properties/constants and parameters/variables. A connection signifies information coupling: it may be drawn from one object to another, or between multiple objects, and signifies a mutual inter-relation of some subset of the variables associated with each connected object. The connection both signifies the presence of information (variable) exchange and defines its specific nature (a mathematical equation makes for an easy illustrative example, but it could as well be a conceptual idea or verbal description, extending to more abstract or social systems, as long as it is explicit and specific and objective). It is useful to distinguish between amplified (non-coupled, one-way) connections and direct (bidirectional, coupled, two-way) connections:

```
[A] -> [B]  amplified connection
[A] <-> [B] direct connection
```

It should be distinguished that two amplified connections do not equal a direct connection, as the former has an inherent time delay and ability to vary the nature of coupling by external influence. An amplified connection always requires energy dissipation, as outlined under Couplings in Information Theory, while a direct connection does not. The resemblance of the latter to electrical circuit diagrams may be coincidental but it is not meaningless: an electrical diagram indeed outlines a system of bidirectional influences along wires. The amplified connection is mathematically simple: B=A, but the equality sign is bidirectional so we should be more explicit with an assignment sign: B←A or A→B. This makes it explicit that A must be known first, and B has no impact on this process. The direct connections can similarly be expressed with an equal sign: A=B but here both A and B are allowed to change. To be more explicit about what happens, we express this as a matrix assignment using a transform matrix Tm on both A and B:

```
[A]<-[Tm][A]
[B]<-[Tm][B]
```

While connections signify information movement, objects signify information storage and evolution/processing. Each object must have at least

one variable associated with it (each variable must be a physically measurable/definite quantity), and also some 'rules' for what that variable affects. If a system is modified externally such that connections are altered but its information amount is unaffected, the system's evolution may be modeled continuously before and after the change. However if the information (storage) amount is changed, the system cannot be taken through such a change with continuous evolution - information must be supplied by or lost to the "external world" in this case. What do we make of external-world influences on a system?

Is an open system possible? I think it is an oxymoron: the defining feature of a system is its interconnectivity, within itself and with the outer world. An open system is affected by the outer world but does not affect it back, which is physically not allowed (as outlined in Information Theory). In defining an open system, information is provided by us to run the simulation, and the result is read. An open system monotonically approaches thermal equilibrium and can more appropriately be called a relation or coupling than a system. Thus to be concrete, all variables in a system *must be* 2-way coupled, both affected by and affecting other parts of the system. One-way couplings turn a variable into a constant and thus delineate a system boundary from the external world: "here I don't want to consider the real world changing this part of the system as that gets too complex, so I will assume it to just be constant for finding out what I need of the system model". [6]

The way we differentiate variables and constants is that variables must be coupled to other parts of the system and thus will eventually be affected by the system itself as the system evolves. Constants on the other hand are unable to be modified by the system itself, no matter what its state. Constants thus include both non-alterable connections (ie system structure) and rules of objects (ie how a thermostat operates), as well as numeric constants (ie set temperature of thermostat). For a general theory, we should allow also for the existence of similar entities that can be affected by the system itself: conditional connections, conditional rules, and numeric variables should all be grouped as "system variables". A common application of system theory relies on us (external agents) modifying system constants and tracking system evolution. Consider the thermostat system:

```
[Bath (temperature)] -> [Thermostat] -> [Heater] <-> ...
```

I adjust the thermostat setpoint externally and see what happens. But we can go a step further and quantify the influence of me on the thermostat

[6] a constant here does not have to be a numeric constant, it can well be a function of time or some other parameter; the defining feature of a constant is that the system itself cannot affect it

set point. This will change the set point from a constant to a variable (a reminder that a variable must be 2-way coupled while a constant must not be coupled):

```
[Bath (temperature)] -> [Thermostat] -> [Heater] <-> ...
                     -> [Me reading temp] -> [Thermostat]
```

We could go further and define why I pick a given temperature as a function of how I feel/what I am trying to do, and eventually this process replaces constants with variables but gets ridiculously complex. At some level, I will not know all the variables required to simulate the system, and may find it to be chaotic - a small change in some tiny unknown variable affects everything, and I have no idea what to expect anymore. So it is not always preferred for practical uses to have the most complex system diagram - it is an intuitive "art" (based on practice and statistical inference) to know when to stop adding complexity. Sometimes this is impossible - to truly simulate the system we actually need to know all the minute variables which are impractical to actually measure; such systems are commonly called random: dice rolls, lottery/bingo ball tumbling, card shuffles, stock market [7]. Here system theory can still explain "how", but cannot predict "what" will be in the future. So we see that the distinction between variables and constants is really a choice on where to bound the system under study and consider it independent of the "real world" outside. The ultimate constants are the laws of physics, but if we expand our system to that level it will either include the whole world at subatomic definition or will have to be assumed well-decoupled from the world (which is what we practically achieve in physics experiments, such as an ion in an ion trap) but thus adding its own set of constants to the usual laws of physics to define the nature of the decoupling. For big systems of interest, the laws will be far "above" the laws of physics and thus even the "constants" may all be readily changeable in theory.

This is a useful point for system manipulation and control: the system model may be affected by altering either variables or constants. This distinction arises because the latter change, "changing the rules of the game", has an effect independent of the actual state of the system and can in principle be much more impactful than simply changing a variable in the system. Of course even here the distinction is arbitrary: zoom out far enough and constants become variables, so perhaps this shouldn't be taken too seriously - variable changes can be very powerful indeed, such as the introduction of neutrons to a fissile assembly. The power lies in discovering the least-effort physical change/manipulation that leads to the desired result. Consider again the bath thermostat system:

[7] at least for those without privileged information access

```
[Bath (temperature)] -> [Thermostat] -> [Heater] <-> ...
```

I want to change the bath temperature, which I see is directly affected by heater temperature. Heater temperature has a 1-way coupling to the thermostat, so I cannot change it naively. The thermostat is affected by the bath temperature, so I could change that directly - but this takes lots of effort and is a direct change: I have no amplification of influence, and perhaps even a supression if the thermostat works against me. Perhaps I can break some connections: unplug the heater, and thus eventually achieve my desired temperature. Can I be smarter? I can alter the "constant" setpoint of the thermostat, but perhaps for some reason I cannot. Note the difference: if I alter the setpoint, the system itself will evolve to my desired end state; this is way less effort than trying to directly change the bath temp by myself since it uses the existing power of the heater and control parameters of the thermostat in my favor. Altering the setpoint is a more elegant change than say inserting an external heater/chiller. If I can't do it? A more detailed system diagram may help:

```
[Bath (temperature)] <-> [Thermocouple] <->
  [Thermocouple amplifier] -> [Thermostat] -> [Heater] <-> ...
```

By adding more elements to the system, I now see more points of control: the single coupling of bath → thermostat now explicitly includes a thermocouple so I could adjust the temperature only around the thermocouple with some clever insulation, or I could recognize the electrical signals going into the thermocouple amplifier and modify those as desired, to achieve the system state I want even if I cannot change the thermostat setpoint. Recognizing that the heater uses electric power, I can change the connection there by adding a relay, and thus also affect the system, but to a more limited extent. Lots of effort can lead to unimpressive results or little effort can lead to huge results, all depending on exactly where the effort is directed within the system, this is the power of systems thinking. The amount of influence that a certain change can bring about should be mathematically quantifiable and can be used to find "points of power" in the system - ways to control it elegantly. The tools, machines, and electronics we use are invariably set up to place us at the point of power. What about political and social structures in society? Perhaps the reason capitalism has proven more effective than slavery is that people are happy to earn a paycheck and spend it on what they want, so they willingly go to work whereas under slavery even if they had the same goods they are unwilling to work and must be forced to do so, wasting valuable resources and time - an elegant vs inelegant way of controlling a system to get the desired result of people spending their lives at work.

How is the idea of 'elegant' system control used in society around us? Governments at the highest levels are proficient in this sort of control, they have to in order to be able to call themselves governments. Old spying and political tactics may seem to be made obsolete by new technologies, but ultimately societies are made of people - no matter how well I encrypt my message, there will be a person reading it on the other end in fully unencrypted form so he can understand it. The sort of power to keep stable societies, to understand people, is what I will call "psychological advantage". All our wants and desires are in the mind, and the mind can be controlled - such is the nature of psychological advantage. These ideas come from a reading of [Men Who Stare at Goats], a text about strange CIA activities - conspiracy theories mixed in with real "evidence" such as accounts of army/CIA music blasting used for subliminal control. The premise of the book is that some people in the army psy-ops claim anything is possible: walking through walls, being invisible, staring a goat to death, psychic mind-reading and divination. And this is an intriguing idea: I would normally associate this stuff with quacks, but seeing the army's support in this really makes me tempted to think there is truth in such abilities, perhaps I can even develop them! If these were real abilities, it would be advantageous for the army to have priority in developing them, and to spread the idea that such methods are useless and fake so that most people don't try and those who do are already considered outcasts and not taken seriously. In a way, the best method to cover up real UFOs is to make everyone believe the reports are from crazy lunatics, cementing the non-reality of the concept (it wouldn't be surprising if the intelligence departments actively supported UFO conspiracists, as they would draw attention off the real situation of experimental aircraft testing).

The scientific method has an answer to prediction of the future - it is possible and real, but requires calculations - this is a bit of a cop-out unless we define calculations, which for now we'll define as active evolution/observation of a model system that is smaller in scale than the real one (such that the evolution takes place faster - thus being predictive). The other crucial ingredient for future prediction is thus data - all relevant data to create a scale model. So if I throw you a ball, your brain will create a 3D model and mentally simulate the path - the model being on a scale of the brain size and evolving rapidly by neurons firing vs the slow large-scale motion of the ball, thus the model is solved first in time and you can move your hand in just the right place to catch the ball - there is no way around such calculations if catching from sight alone is required. Fortune telling, having visions, reading tea leaves/tarot cards, do these have any validity or are they just obvious demonstrations of the Forer/Barnum ef-

fect [8]? I side with the latter, since if they worked this would be evidence of faster-than-light computation, something prohibited by definition (as it would lead to both infinite computing power and a system being able to simulate itself). We can also verify the ineffectiveness of such predictions by entropy analysis - can they really give us new and unexpected information, or are they rehashes of things the person already knows? Could anyone predict an atomic bomb blast without ever having heard of such a bomb's existence? Why is it that all our gods have a human form as do most movie aliens? I think the evidence and state of the world (the leading scientists use real data, not visions, and it works - all the time; thousands of years of people trying all sorts of pseudoscientific approaches hasn't even come close to the effectiveness of science) show that divination by purely psychic means is not possible. Still it is possible to train the human mind to subconsciously make predictions - as the brain is a powerful computer that processes meaning, given the proper (and even a bunch of useless) data, it might well arrive at a possibility that is likely to be true, even without the predictor being aware of why or how they arrived at this prediction - a mysterious vision for lack of a better word.

Such a skill might be known as intuition - an idea of what will happen "just because it feels so" - and its development requires both an ability to be aware of and to process large amounts of data (to be observant, to see things that seem obvious or are easy to miss/to forget) and also enough knowledge about what is to be predicted (if a combat situation - combat experience is key; if state of the energy market - knowledge of current state of affairs and "rules of the game"). In other words, an intuitive ability to perform a large scale system simulation to predict the system's state before it actually arrives there. This is how we can easily control animals and living beings less intelligent than us, even without any cages or barriers - they are bounded by invisible walls of our intellectual superiority. This is probably taken advantage of for "invisibility" mental abilities - most people spend their waking hours focused on a single task at hand (becoming unaware of the rest of the world through such focus), and it is difficult or impossible to "see the big picture" and then keep it in mind when so focused on a given task - by knowing how to appropriately blend in one can then become truly invisible, seen without awareness [9]. This works not only in camouflage, but in social engineering - the security company guy is the one who should check/replace the security system, and few will question whether he is really authorized to do so. Then we can get to subliminal

[8] this is when overly-vague statements like "you have a caring personality but may easily get hurt if you are too open with others" are taken by the listener as applying to himself by mentally adding in his own information/memories to make it personal

[9] consider the basketball-passing video `https://www.youtube.com/watch?v=vJG698U2Mvo` and also `https://www.youtube.com/watch?v=ubNF9QNEQLA`

messages - the things seen but forgotten, or heard but unaware (as in MP3 encoding - conscious awareness only hears the louder tone but unconsciously all tones are processed) have a subconscious impact. This is not terribly strong - not zombie-like control - but still scientifically measurable as a slight change in behavior [Dehaenae]. Having an almost spartan, purely functional, lifestyle helps achieve the bigger scale view by eliminating all distractions; perhaps this state is what is achieved by meditation. I think such an ability is a large part of what the book claims the army was trying to achieve by making people think of the impossible - walking through walls - as possible: the brain really does have amazing potential if used effectively, but such use is far from obvious. I have met only two people who seemed to have a child-like ability to question the obvious and make their own rules; these people inspired me by their character alone. They were not afraid to try out new ideas that sounded crazy, and even seemed to seek them out.

Psychological advantage allows for a high level of control and indeed "doing the impossible". This is because people (and animals - we are told to not run away from a bear, this is a psychological tactic that has real consequences for our survival even against a huge animal) do what their brain tells them to do, and if you know how to tell the brain what to do, or even predict what it will do, then you can control systems much larger than physically possible by force. In psychological advantage, you make the brains of people/animals work towards your goal; not merely fitting in or being invisible, but affecting others' perceptions (perhaps outside of their awareness) so that they themselves choose to do what you want. [10] At any moment there are countless things I could do - bite off my arm, scream loudly, jump out the window, play music, send an email, try to touch the ceiling, lay naked outside, climb up to the roof, hide under the bed... Yet my brain chooses one fairly coherent action/path, based on both sensory survival (like not eating my arm) and on my values/goals (like enjoying writing articles such as this and finding it a worthwhile activity). For psychological advantage the values/goals can be adjusted to be in line with some purpose, or the environment can be adjusted such that the already-desired goals require a certain action set. In the first case, the parent teaches the child the association between success, good life, and getting As in school so the child wants to study hard. In the second, the parent says the child gets a paycheck/gift for each A or similar negative reinforcement - this is classical conditioning so I won't cover it further [Skinner]. The environment can be altered more subtly and less explicitly though, leading to a

[10] This is how psychopaths establish their positions of power and influence: because of their improved (conscious or not) understanding/abilities in social interactions, they can get other people to do what they want without those people even realizing it. There is no way to counter this without an improved social intelligence, so the dumb/mentally deficient people will always be susceptible to such manipulation.

similar subconscious effect: for instance many iphone "intuitive" features/ animations/ shortcuts (such as automatic volume level for multiple headphones) are not consciously noted [11] but still factor into people's evaluation of the phone and serve to maintain its popularity amidst a competitive and copycat market. After trying the iphone, other phones just don't feel as good - it's hard to explain exactly why but something is just different - this is subconscious alteration of the environment and can be effective as psychological advantage.

The government certainly realizes this - since governments and even whole nations are run by networks of people as decision makers, such manipulations can have very big implications, turning countries into machines to do as one desires. In slavery, one has control over the slaves but at high cost - the slaves will try their best to avoid work and escape. In psychological advantage the cost is low and the results are self-reinforcing: with a proper system of rewards, the slaves will want to work and even fight over who can work the hardest, making social outcasts of those who are "lazy". This has an eerie resemblance to the modern "glass ceiling" capitalism, and no wonder the "successful" countries are the ones who use this system - it is after all more productive than coercive or bureaucratic/bribe-plagued nations as people agree in their need to be productive - though this is taken as "holy" and never questioned. Yet beyond such global world order concerns, I believe the US does have knowledge of and uses psychological advantage in its operations. First is the popularity of US products - Starbucks, burger king, mcdonalds, most every Hollywood movie, music pop hits, video games - all these can be found internationally practically everywhere and are well-liked by the local populace [12]. Why is it that there is a McDonalds in Kazakhstan but not a Pchelsky in the USA? The exchange here is certainly not symmetric - American culture infiltrates and does not accumulate/accomodate; yet it is the locals who visit McDonalds - they find it fashionable whereas no one's heard of Pchelsky in the US so no one even calls for its opening. US products are seen as fashionable, the US is the "cool kid" everyone tries to copy - but why? It's not that McDonalds is particularly tasty or good, its popularity stems from its first foray into fast food concept and global advertising of such - psychological advantage; getting people excited about the brand name and offering a consistent experience across cities and now even countries. It's really in the name - "McDonalds" tells me I can go in and get a burger with fries, "Pchelsky" doesn't tell me anything as I haven't heard of it before - the known brand is a safe and secure choice, the unknown a mystery with uncertain levels of quality/service/price, so I will more comfortably choose what I already

[11] I was surprised how many people seem to not notice that the Windows 7 taskbar and window frame are transparent while the latter Windows versions are not

[12] based on my own travel experiences in 8 countries

know. Starbucks benefits from a similar brand recognition effect, but also there is a psychological advantage in offering (and spearheading) a "coffee shop" environment which is unique and apparently attractive as a product - it's not really the coffee that makes people interested, but the name, the environment, and the coffee as a side effect. Still none of this explains why it is considered fashionable/desirable for a highrise in China to house a Starbucks instead of a Chinese version of same - such popularity to me seems unfair and arbitrary, but is decidedly a psychological advantage for the US - one that has tremendous impact on its status in the world economy, its GDP, and the value of the dollar. If only by circumstance, the US has emerged as victor not in physical wars but in the psychological world order. It would be wise of the government to maintain this, but such may be too conspiracy-theory-minded.

If not explicitly involved in international affairs, psychological advantage is surely used domestically. The modern spy will not just assimilate and idly collect information, but subtly manipulate and affect the actual proceedings of the organization, to reach a desired goal or gain (willful/authorized) access to more information. With psychological advantage there is barely any need for force or intimidation, with appropriately targeted interactions people will go out of their way to share information with someone they trust. Beyond intelligence gathering, the government can use psychological advantage in public media. I think it's very certain that government has an influence in Hollywood and entertainment, of the sort that advised a specific recommendation in AES that was not understood until mathematical proofs were found years later. It would not surprise me if a "psychological control board" makes subtle alterations to movies, and not-so-subtle votes on what movies will even get made and what exposure they will receive. For instance, misrepresentation of spy/police/terrorist activities, arguably to make the movie/show more exciting and appropriate for the screen, also has the side effect of providing ineffective information to would-be criminals and terrorists, and of reaffirming the inevitable victory of the "good" government, that the "bad guys" have nowhere to hide. Since such media may be most people's biggest interaction with the concept of police work/spying, the representations in the media are powerful factors indeed. By information theory, any authors or artists who write a spy novel can only use what they have learned about spying, and if the only information readily available is from 'controlled media', derived works of art (downstream from 'real' information sources) will also misrepresent the phenomenon in a consistent way, allowing for tracing of influences. The real police force would suffer if the fake one on TV was made to look incompetent - and not in a funny way. So movies regularly show how cool and powerful the US military is - with jet fighter pilots and gunmen always shown in a positive light, undoubtedly encouraging young people to join/root for the armed forces to

do cool stuff - all subconsciously and covertly but ever-present and real. It should not be overlooked that in a large country many ideas and movements will spring up "organically" [13], and the government (or any entity that can make such decisions) may choose to subtly support the ones that contribute to their desired goals - there is no need for a top-down creation of ideas (say, a 'secret board' forcing a director to make a particular film - this is rudimentary and prone to public outcry; vs picking select movies out of the thousands made each year and giving them special attention in the press - the director authentically wanted to make the movie and the viewers really chose to watch it, the influence is invisible). Additional power in this way of psychological control of public opinion lies in realizing the typical discussion topics for friends or coworkers: sports, movies, news. Manipulating the media sources of typical discussion topics may manipulate only some individuals, but in talking with others, the effect of the manipulation will spread through the whole group - now originating from a real live person who is close to their friend group.

Indeed the spread of ideas is an important aspect of society as a system. Diseases spread from person to person and are seen as negative, undesirable things. But nature doesn't see things as good or bad - a disease is then something that is contagious, self-spreading, and affecting a person temporarily or even leaving permanent marks. It doesn't have to be alive (such as a virus), the key is contagious spreading and self-sustaining reproduction. If we look through this lens at communication, essentially all of language is a bunch of "brain viruses" - having been exposed to a new word, we may use it for a while then forget it eventually, in the process of using it spreading it to other people. Another example is catchy music we share with others, or sayings/poems/jokes/idioms/limericks to the same effect. This is how 'fads' and 'memes' spread and live on amongst social networks. What determines whether something becomes 'contagious', whether a video becomes 'viral' (so appropriately named)? I don't have the answer but this is another factor for psychological advantage. Consider the fast spread of news on Twitter - clearly a search for knowledge and explanations, quite spontaneously (I didn't know or care about a hurricane until it showed up on Twitter, and now I want to know its every detail as soon as possible - why? To feel in control, as if I have all the

[13] this may be seen on a small scale in a protest group (readily verifiable in videos of such gatherings): one person may randomly come up with some chant/action and shout it out, and if enough other people feel the chant is appropriate they will join in, eventually the whole group settles on a single chant, this will continue until enough of the group grows tired of the chant at which point another one may be taken up. A similar phenomenon happens with clapping: in a concert where it is unfashionable to clap between movements, any random applause will largely not be propagated by others and decay, while at the end of the performance everyone is in agreement about clapping so 'random' starting applause gets amplified to include the whole audience

explanations, although I am only a distant and not-well-aware observer). Perhaps sharing viral ideas leads to a sort of social reward - this person shared the video, the video is cool/popular (by the sake of its many shares, more than anything, but likely also having something to do with content - perhaps being particularly unusual/memorable/funny and appealing to childlike thinking/views/emotions through simplified displays - for whatever reason, straightforward, exaggerated emotions along with easy visual cues and a clear (not necessarily correct but coherent) explanation are appealing - even to adults), thus the person sharing is now also seen as cool, and this may offer subtle future social rewards which will result in a sort of classical conditioning indirectly. The curiosity instinct, while strongest in children is still strong in adults (though perhaps repressed or atrophied amidst "more practical" concerns/realities of everyday living and repetitive work day experience - the ideal capitalist employee) so this may contribute to spontaneous sharing of informational content/videos or even factoids and trivia - whether right or wrong, as long as it is interesting - perhaps explaining the fascination with gossip and such "juicy" info that may not have much to do with the person's life concerns nor even with the actual nature of events/what's going on.

11

Living in Society

main message: Children are born not knowing what to do with their brain - how to train it, how to learn, what tasks are necessary for survival, or how to interact with others (beyond the most basic biological programming ie breastfeeding). As they are raised in society, a tremendous set of patterns/rules/guidelines is learned by the brain performing statistical inference continuously over many years, and by the time children reach maturity they are fully versed in how to successfully live in their society.

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What is success? Our parents want us to be successful, and this seems like a positive feature to strive towards. Successful people are looked up to. They are the managers, leaders, decision-makers. Perversely, the people who work for the leaders/managers and contribute to their success are not themselves successful (?). Everyone is pushed to "be a leader" or "leader in the field", not a follower. Unsuccessful people take orders and hate their life, successful people give orders and enjoy their life. Success and power go together. But does any of this make sense? Society needs janitors and fast food workers in order to function as it does, yet they are the collective laughingstock and example of failure. The few "successful" individuals enjoy improved options in life because of the respect paid to them by the "unsuccessful" themselves. [1] Society could probably do without a manager in a company making some obscure product, yet this is called success. Emperors and ruling classes of old, like these managers, were respected and

[1] this is an example of societal values being passed on, a way to view society as its own huge organism that programs its "cells" in this way: you are to strive for success but if you don't succeed you should honor/respect those who do while not expecting them to reciprocate. When in reality it is up to you to decide what to honor/value and why, society provides an evolutionarily-selected set of things to value (like hardworking/intelligent vs lazy/dumb) which most people will never question, and this ends up perpetuating society.

given power because they were seen as important, and they were seen as important because they wielded power, and they wielded power because... their servants followed their orders? I suppose in old times the people in power fought their way up in one sense or another, but once they could convince enough others of their importance, the societal reverence of the throne/the state was self-perpetuating as parents taught their children that they should respect their leaders. This is not to say the leaders were not quick to reinforce their power with physical force (consider Napoleon's brutal 13 Vendemiaire attack) lest the government fall apart as the idea of the government as weak spreads among its citizens - the power of the government after all lies in the citizens' belief that the government is powerful, in a similar way that money is believed to have value. But why would the armies listen to their generals? It must have been due to the physical and mental conditioning of army recruits (with smaller expenditures of physical force, such as physical punishments for disobeying commands during drills), it is no coincidence all armies are rigid and hierarchical. Respect for the leaders holds into the present day: the CEOs/politicians may have through some circumstances and luck gotten to their position, after which they are respected just based on their title, and then whatever they do becomes an example of "success" [2]. Elon Musk's hyperloop idea is cool and hip, but some odd college-dropout's tube train idea is weird and impractical (should have finished that college degree! [3]). It is mostly arbitrary, but still with roots in real circumstances (and real physical power/brute force): the extent to which it can be disconnected from physical power is the extent to which our brains are capable of behavioral conditioning/learning. Our parents punish us if we say something insulting, so later on we will consider the act of saying the insulting phrase as inherently a bad thing and won't do it even when it realistically wouldn't lead to any punishment.

Still, a country cannot have only leaders, like a cohort cannot have all As even though everyone is pushed towards such. If they all had As then the concept of A becomes meaningless and not selective/indicative/useful in conveying information because A means "better than B" and this requires that someone has a B, or is then "worse than an A". We might even say more/less successful in this context. Does it makes sense to reward the As with greater social approval when in a real sense the Bs are what make the As possible? This is another blindspot of the "cult of I": should we force individuals to compete against each other when they are inherently affected by external circumstances? Consider a living organism; are its brain cells "better" than muscle cells? Not really, perhaps the brain cells have more influence on the organism's well-being and muscle cells are more expend-

[2] as a sort of epistemological halo effect

[3] I found a tube train prototype, must have been from the 1980s, in a dusty and long-forgotten basement laboratory; the idea is certainly not new

able, but both are key to the organism's prosperity, and when the organism is well-off all its cells also benefit. Muscle cells don't try to compete to become brain cells; rather all cells cooperate towards an overall goal (as they were programmed to). I imagine society would benefit if the economic pressure for rabid and unending growth was instead replaced by a pressure towards prosperity for society as a whole through effective use of workers' skills. What this reflects about human nature is that without the pressure and stress of competition (being placed in this external environment) we do not seek societal definitions of "success". One could argue getting an A takes extra effort and thus should be rewarded better than getting a B, otherwise there would be no incentive for an individual to put in the extra effort. But the very idea of extra effort=good is under question here. Brains differ in their abilities, not in terms of dumb vs smart but in the way people do things 'naturally' [4]. Some people are good at math and others at drawing because their brains have developed differently, so putting the same amount of effort to pass some academic test will yield very different results. There is clear empirical evidence of such differences in that worker specialization in our economy increases productivity and brings a net positive effect - if we really could do anything, like society always tells the impressionable children, specialization would not be necessary and would have no impact beyond administrative effort reduction. Introspectively, no matter how much effort I put in I will not be a rock star - I don't have a brain that composes music or controls voice finely enough for singing, but if being a rock star is successful then I guess I must be a failure. All this stems from the cult of I - as if people consciously decide how much effort to spend on productive vs unproductive affairs [5] (but are rock stars/football players really so productive to society's well-being?). Just like rewarding individual winners and punishing individual criminals, we reward the hard workers and punish the lazy bums (through monetary incentives), all instead of focusing on the larger systems and support networks which lead to given outcomes. And I suppose knowing this keeps people working on things valued by others, but it also keeps them in line, mentally blocked by their own inner policeman to keep the order and know their place within it, either as a success or as a failure. It also helps understand others' societal status, and this is perhaps necessary in a stable society [6], just like the "pecking order" in monkey groups, which arises naturally and keeps the group stable despite differences in individual monkeys and internal conflicts (easily elevated to physical fighting) over food/resources.

[4] this is based on some meditations which have allowed me a very brief and temporary glance at what my brain could do in theory but does not normally do

[5] just to be clear, such a view is contrary to determinism

[6] all later human societies developed jewelry and other items that serve to distinguish social classes

It is not really the police that keeps me safe in society (ie others don't drive over me or beat me up) but rather a controlling voice inside each person around me telling them it's not OK to hurt someone randomly. This is then what society really is - it is a set of deeply held, mostly unquestioned and perhaps never even explicitly seen, beliefs and thoughts that get passed on from generation to generation not through any classroom but from how the people around a child always act. Similar with money - it has worth because we all agree that it has worth, this is a societal belief. This is powerful stuff - it is very difficult to change, as it is deep within all our actions and underlies peer pressure - I don't walk around naked because others don't - and we can see in governments where corruption reigns just how difficult it is to do something that should nominally benefit everyone and be a logical/rational decision. So beyond caring about physics of objects (ie typical 'physics'), one should care about physics of people - how society determines people's range of actions and what they will do or dream of or be interested in - perhaps all without realizing that it is all due to environment/surroundings, instead blindly believing that our personas develop "randomly" or are "divinely chosen" or are of "free will". And this societal action is real physics - an object like a ball follows simple physics like $F = ma$, while an object like a person in society follows complicated physics like reading a road sign while driving a car in order to change their driving in a specific manner and later on tell their friends about the experience - but both are ultimately describable by rigid laws. Society should be seen from a high vantage point as a system which enables certain self-reinforcing patterns to emerge and become stable while other patterns decay; whether the patterns made stable by our societal beliefs are in line with our proclaimed goals is questionable, and I think looking at these patterns in detail would fall outside the realm of "political correctness" - ie society tells us these things are to be described (and thus thought about) in vague unclear contradictory language ("differently abled", "a blessing") so we don't analyze the reality too much. As one case, in old societies single motherhood was an impossibility, because there were not enough physical resources to allow mothers to raise a baby without a husband. With modern laws and living standards this pattern is made stable, but the result is we let evolution run wild - men can impregnate multiple women and not actually participate in raising the children; is this really in line with societal goals? [7] The irresponsible couples who don't plan for the future or worry about birth control are precisely the ones who will make more children and at a younger age than those who carefully pre-

[7] single mothers also have less concern with raising their children, and the children tend to be socially maladjusted. Just as happened in the Mouse Utopia experiment, leading up to population collapse. [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1644264/pdf/procrsmed00338-0007.pdf]

pare (and those children will in turn make more children and at a younger age relative to the careful planners, as their parents' culture gets passed on). Certain cultures are in line with what society claims as its goals and other cultures are not, different cultures (and people) are not equal, and claiming they are just means the most compassionate (those who believe others are equal/respect others) will be overruled by the ones less hesitant to manipulate their way to power. [8] Again, inaction and "letting everyone do as they please"/"freedom and equality" is also a type of action in that it will lead to the evolutionary selection for whatever culture/mindset is best benefited by the current societal laws in place. [9] Turning a blind eye to evolutionary forces does not stop evolution.

In today's society we do not compete for food, but we do compete for social status as well as money. I've avoided the issue until now because it is tough to state cleanly or prove, but there is a real sense in which success=money, or namely that money given to an individual (as paycheck) is an indicator of that individual's success, his valuation by society at large. [10] The homeless begging on the street are minimally valued, the big failures of society. The high-payed CEOs are maximally valued, the big successes of society. But money itself, and its distribution, is arbitrary. When the gold standard was in place, money was a substitute for barter trade, a physical object that could be saved for later even if the barter goods could not. It would also allow mutually beneficial "barter chains" between more than 2 parties even when the complexity of organizing this by barter only would be too much/impractical. We still talk about saving money, like it were drops of water or nuggets of gold, something to be collected and stored under the bed for later. The bankers saw that while money can do the above barter simplification, it is also its own field [11].

The point of today's money is not to save it, but to spend it. Money only has value when it is flowing - otherwise it is an idle concept. Thus

[8] Unenforced rules create an "asshole filter" [`http://siderea.livejournal.com/1230660.html`]: this is a mechanism where people who don't follow the rules or ignore them stand to evolutionarily benefit vs those who follow the rules - eventually the only remaining people will be 'assholes'.

[9] consider how viruses evolved. they are inanimate molecules, but they exist because the necessary conditions for their perpetuation, the living organisms that can get infected, are in place. similarly, given specific societal laws and human behaviors, inanimate concepts like specific cultures and ideas will tend to prevail.

[10] society is driven by money flows, money flows driven by human desires, human desires driven by evolutionary fitness (mental and physical survival - food and fun), evolutionary fitness driven by laws of physics.

[11] perhaps it is no coincidence that the major religions prohibit interest collection on loans - since then the rich always get richer. But we fully accept this now as an economic fact and are OK with it - OK with giving *our* money to the rich, knowingly and willingly, with each interest payment. Why did the rich get richer? Because others paid them.

rich people don't put money in a safe - instead they invest, letting their money flow to others with the expectation that sometime later more will flow back [12]. The businesses they invest in, for their side, use the investment money to buy equipment and pay employees. In turn employees buy food/housing and the equipment manufacturers buy raw materials and pay employers. The cycle continues all the way and assuming everyone has to buy food/housing the money eventually flows to the food/housing employees and owners, who spend it somewhere else starting the cycle anew. [13] Perhaps we can represent money flows as a simple cycle (for the case of a food-industry employee buying their company's food):

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[Employer]->[Employee]->[Food]->...
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With this it is clear that such cycles will tend to split into different non-intersecting loops: a rich person's money cycle may never touch the above food-industry employee's cycle because the rich person buys luxury goods - then we can expect the emergence of specialized luxury businesses only utilized by the rich (which do exist), namely monetary stratification. But if the rich get richer (which they do) there must be some transfer of money from the 'poor cycles' to the 'rich cycles'. For this transfer to happen, it is a requirement that workers are (continuously) paid less than the value of the goods they produce, or pay more than the value of the goods they buy. So this includes: unequal salary, loan interest rates, insurance[14], and inflation. The government ensures that it gets a share no matter what, through tax collection, including a property tax so even the self-sufficient farmer needs to pay. Because everyone has to eat and have shelter, all money eventually goes to farmers and landlords, but even here the price of the items is arbitrary - note how rent can quickly rise in big cities. It is surprising that food is relatively cheap compared to rent - I guess food is a more competitive market because foods are essentially identical ie all vegetables are same regardless of where a person buys them [15] which is not true for housing. The government is (of course) a key player - it "double-dips" by charging (levying) tax on both income (money flow to individual)

[12] it is no coincidence that the highest return interest rate investments are systematically limited to the wealthiest individuals, because the only reason they can give high returns is that someone else is paying the bill - this someone else is the poor populace which cannot make such high interest rate investments and instead have to take on negative (money-losing) interest rate loans to pay for education/housing/cars/living expenses

[13] The farmers/food producers must be the 'ultimate sink' of diffuse money streams similarly to how outer space is an 'ultimate sink' for diffuse heat energy from our planet. What are the 'stars' (highly concentrated money stream sources) in our economy?

[14] how do insurance companies make money? By paying out less than they bring in, just like the lottery

[15] food also expires if not used/sold

and spending (money flow from individual), so even if at the end of the work month the worker is in the same financial situation as at its start (having spent all earned money), the government has collected its share of money from the transactions that were involved. Another sense of arbitrariness here is the conversion between different currencies - on what I earn in USA, I could live much more comfortably in China. In other words, workers living in China will do the same work for fewer dollars while still meeting their basic needs, simply because of the currency conversion effect - not that they don't need as much food or such physical differences. Similarly in "humanitarian" international aid, for example where a US resident pays $2 to get a family in Africa a cow - the cow was already there (existing) and the $2 helped transfer it to a family while the seller makes a living wage - does this really make sense? Does a country have to rely on foreign money to survive? Or is it just a quick way to get money from those who don't know any better? Doesn't the charity-bought foreign food/shelter/animals also "price out" other residents who don't qualify for charity, because the seller can keep an artificially high price with foreign aid always coming in? Why should we think it is our responsibility or even our right to meddle in a developing country that may well have a different definition of success? [16] These are all tough questions that point to the need to define exactly what money is - something I can only wander around at the moment. To me the use of money (setting prices, tax amounts, and interest rates, printing new currency) all seems arbitrary, yet given the actual stability of the global monetary system there must be other forces at play that I'm not yet aware of, no doubt forces that are thoroughly protected and overseen by governments.

Putting aside the difficult question of what money is, we can still make use of it in evaluating success - after all if people give me money I will assume I am a worthy member of society who is appreciated. By this metric, the adage of working hard to reach success falls apart. Hourly (or any time-based) pay workers can only increase their earnings in a human-limited linear fashion - a person can only work so many hours in a day, and each additional hour requires so much additional expenditure of effort. But those who invest money and make monetary decisions can increase their earnings in an effectively unbounded (no maximum money limit) and exponential fashion. The two cannot even compete as long as the latter has enough initial money to invest. People rich enough can make an investment on which the interest exceeds the hourly worker's wages, and by doing this they earn the same monetary amount but do no material work beyond simply

[16] this is like those charity expeditions that give LED lights to remote villages and then are surprised when these "essential" items are abandoned by the residents - who have been living just fine with their own customs built over the years and didn't ask for any LEDs

shifting their monetary weight around. Not only that, but the interest rates insure that their returns automatically keep growing faster and faster, while the hourly worker may only hope for a raise sometime later on. The "work environment" is *not* a place for growth, it is a place for repetition and submission to overall company values (making money for the CEOs). There is a quip that even random stock picking (monkey throwing darts) does about the same as "investing experts", so as long as the economy is on the rise (the meaning of which is quite dense until we understand what money is) the investors will make tremendous profit, whether they "work hard" or not. Their money "works for them" - but really I suspect this means they're taking advantage of 'free' work done by those who are paid on an hourly basis - at the end of the day *someone* has to actually do the physical work, and they are the people who end up working and bringing the benefits of "money working" to the investors - even as they themselves get a paycheck at the end of the week (money working is just other people working). Assuming total money is more or less conserved in a given time frame, the investment profits have to come from somewhere - from someone else's account. This grand duping of the workforce is only possible because the nature of money and its flows is well hidden behind economic complexity (sometimes almost comically artificial, as in the latest 'designer stocks/bonds').

Our economy is based on consumption - an artificially high demand for some product means more people are put to work in manufacturing it, and those workers all get paid, and whatever they eventually buy with their money can eventually cycle back to those who will maintain this artificial demand. The high demand increases money flows, and this is the real "health" of the economy. But this is not always humanly or environmentally wise. On one hand it seems that this means the government can effectively just make up public service programs "out of thin air", to the benefit of all - consider the National Parks and Lunar Missions of the US as such 'artificial' demands that are typically considered worthwhile causes (in a public good sense). The government's lack of any such programs in recent years as well as pay freezes and other measures is troubling from this point of view - surely the government is big enough to create its own demand and support this demand with taxes, say for instance by mandating sidewalks on all US roads, or solar panels on all houses. That it does not indicates that (1) money is channeled into private rather than public contributions, such as salaries and benefits of individual employees (employing underqualified/inefficient workers, as well as more blatant corruption) [17] and (2) such spending is already placing the economy at strain (limited

[17] this could also be an effect of coarsening/big getting bigger at expense of small, where maybe the army/defense budget has taken up all others' funding

by available manpower, for instance - perhaps combined with policies such as weekly hours limits/typical "standard of life" expected by workers - not that everyone works 24/7). Nonetheless the true explanation for why the government doesn't create more public welfare programs is hidden behind economic and political complexity and will require careful analysis of not only what money is but what the government can do to/with money, as the government is certainly in a position to change "the rules of the game".

So, to be successful, one shouldn't work hard - that will only help marginally with money and will instead take away valuable time from more impactful possibilities. One should instead take advantage of every chance to take more for himself and give less to others without getting caught, cheat and lie his way up the hierarchy. One should make connections with powerful people - the ones who (for whatever reason) make decisions and get things done - one of the big tasks of government is creating a clear sense of who can do what, of who is in charge - and in countries where the government is ineffective, a violence-based system will emerge (not to say that government isn't violent - at the end of the day it will punish and kill any threats - but government is the "only" boss in town so there is no need for constant territorial conflicts). One should exploit the system to get unfair amounts of money from others (not only quant stock traders using insider information and algorithms to take other investors' money (which is ultimately money not earned by the physical laborers), but also superstar performers getting paid on an artificial basis of how much they're worth/how many viewers they can attract - or basically how much others would pay them rather than any intrinsic/absolute amount). One should strive for positions which handle the flow of money - such as investors/CEOs - thus being able to benefit from more than personal assets' worth. The big irony is that the "honest" workers who actually do all the material work that makes the economy possible are not just paid disproportionately less than the decision makers with no way out - but that because money is tied to success, such workers are also seen by society as "subpar", looked down on and made fun of, insult to injury. [18] Parents push their kids to become doctors and astronauts, but a world with only those will be quite poor indeed. We need cooks, janitors, plumbers, and factory line workers to make our everyday lives possible - yet we both pay them low money and treat them poorly in social interactions - once again[19], just because we can (it is

[18] Similarly, "caring" businesses that (say) give discounts to people who ask, will be monetarily punished vs "rude" businesses that don't give discounts and in fact impose extra fees. Similarly, "nice" people that go out of their way to help others are socially punished vs "asshole" people that don't help others and in fact take advantage of others if they can. It is surprising then that people help each other at all; perhaps there is a biological/genetic level urge to "feel useful" that drives us to help others (but ultimately to satisfy this selfish urge) as such a thing would be evolutionarily preferred.

[19] just as with animals in slaughterhouses, just as with future generations, just as with

the decision makers, after all, who decide how much money they themselves should get - no wonder it's not quite a just division [20]).

I am shaped by my experiences and my hopes/dreams for the future (if any) are based on my sense of self (what do I seek in life?) so in turn based on my experiences and environment. What of the children who want to become firefighters or doctors? If they're not just saying it because it is socially expected/elicits some reaction (do kids know enough about themselves and the jobs to really believe what they are saying?) such a statement represents a sense of the child's desire, relative of course to what the child has been told and has experienced (if taught that doctors are bad, the child wouldn't want to become a doctor). Over the next years of dredging through the systematic crushing of the "self" in grade school and college, the relation in which the child views his dreams are lost/changed - few kids actually become firemen. By the time to begin "adult" work, these kids have lost sight of their aspirations and are content spending their life at a subpar job, maybe even with the hope of a raise becoming an everyday coping strategy. The brain has, over the years, accepted that a 40-hour work week is OK, and even that the next promotion is what matters - ie what the person *actually* wants and lives for. Dreams are washed away by relativity and there is no reward at the end of the journey. In that sense, does society actually value lives? Just as an organism values its cells - to the extent they help it survive. Of course if asked directly whether they value life or not people will answer fervently in the affirmative but their everyday actions show the real answer. Like a repeat offender saying "sorry won't happen again", it is the physical actions and not words that must be taken as reality. I think the US society values money over lives. If you're poor, you fend for yourself - nobody will come and give you aid. If you're rich, you can pay others to do services of value to you. A company does not value an employee as a living being, but as a number in a formula where the result is a dollar amount. The church and family may have provided a sense of individual value in past times, but these increasingly are fading from today's society as atheism and divorce rates increase - in a real sense the next generation of children will have nothing but their friends to reaffirm their individual worth (and those friends will tend to be distracted by more exciting things on social media). Of course humans are resilient and will adapt such groups

anyone who cannot fight back. On a bigger scale, the countless organisms/plants/animals that do the 'hard work' of converting solar energy into human-usable products, the things we depend on for our very lives, are treated wholly with indifference and pure exploitation by the humans: they're just chemical reactions, it's insane to consider there are any feelings involved, just use them and don't provide any recognition/respect for their usefulness - respect the wealthy people of society!

[20] and they cannot just take all the money, because if they do so then any people who helped them will start planning ways to take over power.

to be well suited to this purpose, but I believe nonetheless the near future will be less humane to its workers and employees as the drive for efficiency and profits is contrary to personal/emotional relationship needs.

In a sense, what a country does is harvest its people. The farm lands are spread out, they provide sustenance, schools provide education [21] /indoctrination, then an army can draw off the recruits and send them to war. A company can take new generation workforce and use them to continue making profits. And it is not some terrible conspiracy by the bosses - in capitalism the whole company profits; while the 'top' owners profit more than the workers, even the workers end up better off than if they did not work. With the historical setting, company founders could expect it to grow because of a growing consumer base (population increase) and in turn a growing employee base. But without population growth, company growth (hiring of new employees) slows down as do sales. Companies which may have been stable with high growth (just about any company) will be unstable in stagnant times, so only the largest survive (happening now - a rise in big business). But in a downturn in population, the largest will get hurt and increasingly business may be done in barter-like settings (this I imagine will happen in the later future). All this is not a physical inevitability, it is predicated on the way our economic system is set up to reward unconstrained growth, and there could well be a better system that can lead to human welfare even amidst decreasing production and consumption - but it is questionable whether such a system will be evolutionarily stable (ie can someone benefit by being selfish). I increasingly see closed businesses, business units for lease, across small towns in the US. What are people raised for? What purpose does the country's new generation serve? The answer is somewhere between increased war ability to protect and continue

[21] and not really textbook education ie algebra, but the more important education of how to approach problems by repeated logical steps and what is expected of children in society - children are not born knowing this and have to be taught over many years of repetition/reinforcement while their brains perform statistical analysis of the situations they encounter. For instance, young children who have the ability to comprehend and solve a problem, will usually not do so because the mental process itself is unnatural and long and frustrating, they will have to be guided step by step, over and over. It is an interesting insight on how much of our 'human nature' is actually due to social programming (all of which has evolutionary roots, and this evolution is fast and ongoing) - it takes many years of forcefully 'molding' the brain to get a child to a point of understanding and participating in society as well as using reasoning and logical judgements (this is why child caretakers have to be patient and consistent in their interactions - the children really don't know any better). For something like bugs their offspring just grow independently of any sort of societal structure - the newborns don't ever need to interact with parents. For humans, the vast majority of what we can call uniquely human, comes from the interaction with societal structure. I reason then that the bug's instincts guide it to individual survival while human instincts (primal urges) guide us towards actions that tend to form societies and communicate.

the country's existence, and increased labor ability to protect and continue businesses' existence. We have become so productive that we barely need to spend any time on "real" work that is essential to survival (even ancient civilizations had this, as they indulged in creating fancy time-consuming works of art and luxury goods, but now with fossil fuels we are really productive way past survival needs), so there has been a trend towards "pseudo-jobs" (jobs which form an independent money flow loop which is based largely on employee status/standing and not so much on physical goods or services) and an associated push for people to enter higher and higher education institutions to get credentials to earn the pseudo-job. But a pseudo-job imbues no sense of ownership, or pride in one's work, which I would argue leads to psychological problems in the young workforce. There is a sense of ownership in running a family store, which is just not there when spending years in college to become an educator; ancient humans could expect to have a family and their own 'place' in life by their twenties, at which point they could feel empowered to make a meaningful impact [22] and secure in their life goals, however this ability is rapidly declining in the individualistic monetary competition of today's society. The real driver for the next generation's existence is parents' emotions, biological urges for sex, and family "traditions". Traditions are no more than a classical fallacy - doing something solely because "that's how it's always been done" - this is stupid even beyond the biological preference for familiarity because of safety - as some traditions are really not "familiar" or "safe". Now traditions are an excuse to party or see family. But, just like most trees in a forest are young and most memories in a brain are recent (because old trees and old memories all have a half-life while new ones are constantly generated), most of what goes on in traditions is "modern" and not indicative of the original long-lost ritual. So, we have cameras and DJs at weddings, we have bibles translated to modern english, we have "effigy burning" without any fire or harm, we have santa claus in chimney-less homes, we have birthdays without all the candles. So, traditions are pointless. Life for many people means working most of their living hours to make ends meet and watching TV/commuting/sleeping the rest of the time. Their children are kept on a separate track of school and activities so parents can be mostly freed of having to actually care for them, instead being able to do work. People are harvested to do work - most are even convinced of the need for themselves to aid in the harvesting. And vegetables and animals are harvested ever more cruelly to ensure the people harvest is doing well. And *that* is the meaning of living in society.

I think overall we have an ingrained optimistic outlook for the future, as a psychological defense mechanism (as outlined earlier under Evolution).

[22] within the scope of their life, ie in control of their life/wellbeing

In fact it is a highly optimistic outlook: imagine a person whose brain is such that he always feels happy, even exposed to serious pain and suffering, even if his world is hopelessly crashing down. What might he say? "Yes the condition is terribly painful but I am happy to be alive" "There's suffering in the world but I still count my blessings" "For me, the good outweighs the bad". But platitudes like this are entirely common in interpersonal discussions. Maybe we are not so different from this always-happy person. Because truly believing life will not get better, that you've passed your peak and already had the happiest day of your life, makes you question why life is worth living anymore. But the reality is we do have peaks, and we do pass our best days. When the future has nothing new+exciting in store how do we persist? We've been driven to explore the spatial realm: the earth and the planets around us. Now so much has been mapped, there is less and less to explore and uncover. We get by a bit through escapism into fantasy spaces/worlds which are designed to be fun to explore, this in itself driven by a dissatisfaction with the features of our real surrounding world. But our dominant faith is in exploring the ultimate unknown in the temporal realm: the future. With better science and ability for real physical predictions using detailed models, we now can largely map out the future as well, so eventually this too will be closed to exploration, and we will find ourselves in a deterministic bind, able to face reality but helpless to alter it. Then we really ought to ask ourselves why we are here. But so far we turn a blind eye to this map of time, preferring instead fanciful drawings of far-away riches (like old-world maps) to the potentially painful reality. And the reality is, we can only go so far in improving human life. At some point going further just means fabricating artificial desires, wanting something for the sake of wanting it. I think we are reaching this existential point in the "1st world" countries, even if most remain focused on the microcosm of their job/family and continue to bring new people into existence, making it harder for those very people to have a good future. When Moore's law says computing power doubles every x years, who will bother to ask what is the limit? There *is* one. At some point, we won't get better, it will be futile to try. What then? Economy grows with population but we can't extend population indefinitely. There *is* a limit to global population, whether we accept it or pretend it doesn't exist - at least physics is elegant in its exactness and indifference, in a sense comforting compared to the flawed societies taking over the earth now. But it is not fair: there are so many easy ways to hurt others, and so few easy ways to please others. Actions which have an indirect effect on others will tend to follow chaotic progression ie overall effect is neutral (so I support one thing/person but hurt all the potential competitors). Despite all this, how has society moved forward? Some actions must have had a net positive benefit rather than purely chaotic, at least short term (until we breed to overpopulation+crash), for example

medicine and engineering, which helped people live without hurting other people as consequence (instead "hurting" non-human entities). But such society-positive actions also have a limit. At some point, our society doesn't get better, and at this point society will be fully in line with the physical laws (using energy optimally).

Like I compared turbulent eddies/swirls as energy dissipative mechanisms to the action of life as a whole in increasing entropy on earth, societies and governments also form physical structures guided by energy dissipation. I already argued for an evolutionary origin of stable societal customs, such as encouraging fertility and making life appear worthwhile through religion/work/family, carrying on 'rituals of certainty'. Now based on thoughts in [Waste Streams of Ignorance], I propose a view of organizations/society as living beings - also evolutionarily stable. Does viewing companies or governments as autonomous organisms have merit? It sounds rather far-fetched. Going about my daily life, I don't feel like a part of something bigger, my qualia and mental experience are not expanded or altered by being part of an organization, I just act for myself so how can the organization be its own conscious being? At the same time, I don't feel all the tremendous complicated chemical reactions and "decisions" that individual molecules of my brain make [23].

I only feel the global decision-making experience that involves millions of cells in an interlinked network marked off by/surrounded by infinite couplings to the rest of the world; and I only write all this because this network happens to be complex enough to form memories and remember how to write and realize to write down a representation of its abstract state of "ideas". It wouldn't surprise me if most such decision-making networks in the world experience mute feelings with no memory or awareness, thus no way to make the feeling known to others. Animals, computers, even molecules, all things that increase entropy and purport to do some optimization, have feelings and are "conscious", though not likely self-aware to the extent humans are [24]. But then it really isn't a stretch to call government/business a living organism, and a conscious one at that. I don't know or feel its qualia because I am separated from it by infinite couplings, just as my brain molecules don't feel my qualia even though they make

[23] then again, maybe that is what I feel, maybe a chemical that makes me feel good is actually a chemical that by its own physical structure embodies good-feeling, but I think it is more likely that our feelings come from the fact of the connectivity of the brain structures and not from the chemicals themselves - we only feel the chemicals because they alter brain structure/operation (conscious boundaries/infinite couplings), we don't feel the chemicals themselves - if we did everyone should react the same way to the same chemicals

[24] if this seems unlikely, consider how unlikely the reality of your own experience is! Why shouldn't other physical systems have feelings when all we can attest is that at least one certainly does? This is discussed more under Consciousness

up the brain (the individual molecules don't have enough complexity to experience my qualia anyway - only the full interlinked and active brain network has that). The organization organism doesn't know or feel any of its people's qualia either, just as I don't know my brain molecules' qualia or experience. The boundaries of the organism's consciousness can be found in infinite couplings (where internal optimization is subject to external constraints), making it logical to say that two governments are two separate organisms - both will allow only limited influence of the competing system on itself, forming effectively infinite couplings there. The analogy can be taken further: the organisms (governments) fight each other, take steps to destroy foreign effects on the self (immune system), and are resistant to breaking/splitting. Why? For the same reasons as us - evolution into stable forms, as unstable forms will die out while stable forms will persist, and if random arrangements are tried over and over eventually the stable one will rise and dominate. Early humans tried all sorts of different societies over thousands of years, some led to human death and thus society death, some led to OK survival, some led to growth (perhaps at expense of others) and over time those that lead to growth are expected to dominate and become the norm, just as reproducing organisms will readily outnumber the stationary ones. Until humans use all energy on earth for their own sustenance, evolution will use any excess to continually try out new forms of life that can be a potential competitor. This clearly demarcates all life as designed to optimally use energy, just like turbulence, being and becoming conscious at multiple scales and only existing in an abundance of energy use/"wasteful" environment (like the sun's energetic rays).

An example is aboriginal tribes, "ok survival" societies, being ravaged by advanced technological societies. Powerful societies protect their own people - just like my body protects its own cells - not out of compassion or care for the people/cells, but as an evolutionarily necessary mechanism for self-sustenance. So there is at least this benefit - societies don't win at the expense of the humans, it is more symbiotic (like my body creating specific molecules and keeping them safe from harmful external influences). Yet on the flip side society is very rigid in forcing its humans to work for it - if it's not the society dies and evolution tries again. Looking objectively, life in society has a clear purpose: to continue society, that is the purpose of life that 'rituals of certainty' provide. Breaking away from the safety and comfort of the rituals is traumatizing in revealing just how little we really know of the world, it goes counter to our evolutionary need for knowledge, so few people will seek this - I imagine it takes serious loneliness and alienation, for in social interactions our brain readily finds comfort and emotional satisfaction, inherently getting distracted from the void and reaffirming societal values (job/hobbies/goals/life purpose). Maybe it's not surprising monks take a vow of silence. Let's try to compare the lives of

humans and farm animals in modern society.

- Babies are born, spend some unnaturally short time with the parents, then given to daycare to free parents to work and to begin educating the baby. Modern birth in hospitals is so dominated by machines and doctors, so distant from nature, that it is difficult to remember that the human body was designed for birth without mechanical and chemical assistance. Baby animals are born (in a similarly mechanized way such as with egg incubators, to increase survival), may or may not spend a short time with the parents, then sent to live in separate locations to free the parents for more work and to give the babies proper conditions for optimized growth (optimized with regard to their 'useful purpose').

- Children are sent off to school to learn that they will be expected to do arbitrary tasks, and yet evaluated on such tasks to determine their future role in society; children are taught discipline and authority (fear of), and to not ask certain (in fact, most) questions; children are expected to work and yet don't get any of the freedoms adults have in enjoying the results of their work. Children are made the centers of attention in life and society-affirming rituals like birthday parties, holiday celebrations, family gatherings, and church - mental conditioning that life is good and happy and these are things that happy people do regularly. With kid animals it's easier - we build literal walls instead of psychological ones (but just because the latter are invisible they are no less strong or real!), then we debeak/dehorn them so they can't hurt others or themselves, then we shoot them with antibiotics to keep them alive.

- Adults are expected to work until they're too old and incapable of working more, literally using all their productive years for "work" (and to what end? why work 40 hours a week instead of just one, or none at all? Why waste fuel just to drive a car to another day's worth of work? It's beyond me). Those who don't work are physically made to suffer various pains and inconveniences so they hopefully seek to find work, while those that try to kill themselves are resuscitated and forced to stay alive (as far as forced feeding) to prolong their contribution to society. [25] Same for animals - even though they suffer

[25] this is just as cruel as forcing the mentally ill to stay alive, as I argued earlier; here a conscious and able-bodied person decided for themselves to die but society will *not* let them die, and will even restrain them and force them to stay alive, even if their life sucks - they will be kept alive not by improving their life to the point they want to live but by forcing sustenance/medication and removing opportunities for bodily harm and punishing/conditioning by corporal and mental means to not attempt suicide ever again.

every second, in cramped cages going crazy and losing their minds in the pain and unnatural surroundings, they are forced to stay alive by continuous food supply (even force feeding, as with geese), antibiotics forcibly injected so they can't die of bacteria (as this is easier than providing better living conditions), and no means of achieving a death - no natural obstacles or predators, even body features removed.

- Then the adult can retire, being no longer useful/too old for the company or for work in general. Now that their body is well past prime, they can enjoy all sorts of harmless sedentary activities. The animals are simply killed once they get too old.

A long time ago the elderly had a purpose of conveying wisdom and passing on historical knowledge and caring for children. Today's society has no need for the old who cannot work, so it lets them die slowly and out of view. Here we get a bit of irrationality, keeping the old alive forcefully, even after they should have been dead by natural causes and are no longer useful for work - decidedly a non-ideality but perhaps if we went this far the veil on that we really are living for work would be too exposed; this could then function as another psychological defense - death won't happen after ending work, it will happen later, don't concern yourself with death (the same reason families postpone visits to their elderly, as noted under Rationality). Keeping the elderly alive in modern society is then not really for the elderly, but for the psychological health of the working population. Instead of interpreting life as productive years leading to death, we interpret it as productive years leading to retirement years leading to death, and the insertion of these few years of retirement is enough to keep workers content with staying in the grinder. We don't have such reservations with the animals because they are dumb breeders, so we just kill them once they've reached a good size for profit. I think it is a very grim picture indeed - and as I imagine the horror of spending the next 50 years - twice what I have already lived - in the same day-to-day monotony of a 9-5 job, I can't help but give credit to the grimness as being something real. Every day a nearly identical copy of the previous one, like being stuck in a time loop...

Isn't it messed up that we give support (lip service) and drug up people who are "depressed", making it an onus on them to fix themselves and their living conditions which all resulted from society's treatment of them? Isn't it messed up how we lie to children that there's a santa claus, that they can be any job they want, that there are no worries in life and everyone is happy? That life is the best thing? Isn't it messed up how willingly we become dependent on "the system" (thus forming a symbiotic relationship with the government organism - give it work and it gives you certainty) and forget how to grow/preserve food, how to survive in the wild, fend for

ourselves? Isn't it messed up how we find safety and confidence in leaders that say clear and simple commands full of conviction but never bother to check if any of it is actually true or correct or worthwhile? Isn't it messed up how we readily kill/torture/maim fellow humans both within and outside of our government organism, for any actions they take that upsets "the system"? Isn't it messed up just how arbitrary all this "work" is, and how we do it just to find meaning just to stay alive (it is a mental need, like food is a physical need)?

We observe atoms forming molecules, molecules forming cells, cells forming organisms. And these organisms (like myself) are conscious, and seek to protect their cells and create more like it. In life evolution, creation of the stable cell took a long time, and multicellular organisms built on this foundation relatively quickly. But the atoms never set out to make an organism, nor did the cells. They just do what is locally sensible given their surroundings, and in a slew of random actions some arrangements remain stable and actively resist change to their state, this criterion of survival is the physical metric for life. By being part of a cell, a molecule has a clear way in which to operate, a purpose, a protection against factors leading to its destruction. The molecule itself may well be devoured by the rest of the cell, but the fact that the cell is stable in time means the molecule will "continue to exist" as more copies of it are made. The larger organism, on the other hand, takes actions way beyond the abilities of a single cell or molecule - such as hunting for food and eating - to ensure that the molecule keeps getting regenerated. Surely though other molecules do not get devoured - instead they get to "live" inside the organism and this life is wholly protected against external influences that could otherwise readily destroy the molecule, and this protection takes place on a whole another scale - the organism avoids others that would eat it, eats others to get their nutrient stores, even fights off microscopic threats by an effective "army" of killer cells all supported by the food stores the organism can obtain by virtue of its millions of cells cooperating towards a common goal. But they do not cooperate because they realize the world picture [26], they cooperate because doing so is their local optimum state. The highest-scale state of awareness of the world picture is within the brain, which has the most complex optimization networks, though this is not to say that other systems like the immune system are not aware of the many intricacies of the body's interactions with the world - the latter awareness is implicit and not directed in contrast to the nervous system. Evolution constrains the mechanisms and effects of cellular cooperation such that the result is a self-protecting and perpetuating organism, because all others die out. Millions of years of

[26] the brain is the organ that does, and this makes it so important and able to support consciousness, but it is multi-cellular: the neural network has a world picture, the individual neurons do not

evolution have gotten us to the stage where we are conscious, with the well-connected brain designed to perform serious computations to help us find food and survive in the physical world, and the rest of the body working at a microscopic (and not very conscious) level to repair itself and destroy any attackers.

So why not go up a few scales? Humans form into groups, groups form into nations, and nations form into global structures. While the latter are a new emergence due to recent connectivity, and this connectivity is still relatively weak compared to within-nation connectivity (consider the UN), the groups and nations have all had thousands of years of evolutionary selection, including fighting/competing with other groups. And in groups and nations, us humans act to find our own local optimum - not with the intent of creating an evolutionarily stable system but because we seek to satisfy selfish urges based on our surroundings - like the atoms and cells, this is just a physical inevitability. The highest-awareness structures, societal 'brains', would be formed by human organizations that have the most intricate and accurate information sharing, and one can only hope that these complex optimization entities lead to motions that improve human welfare (as opposed to just survival). On the human group level, evolution has again selected interactions that increase group survival, and these are hard constraints on our individual-level actions (laws). If I start going around killing everyone, I will quickly be killed or otherwise restrained, maybe even punished/tortured for doing so. This is not because killing is wrong/bad (ask the soldiers) but because societies where killing fellow members is disallowed are evolutionarily stable. And these prohibitions are not just warning signs, they are backed by real physical power. At these levels, the laws of physics are the only true laws, and realpolitik is the only politics.

"Realpolitik", can this world really be so gruesome? Isn't there a thread of morality, human connection, any higher or more humane laws? But with the above view of life as organized structures the answer is a clear No. Nations as organisms live with each other in a world that only follows the laws of physics. I have to follow my nation's laws, but whose laws does the nation follow? Either more physically powerful nations that tell it what to do, or physics itself. So the mastery of physics by a nation means superiority in survival. One could well argue the same of the human brain - the brain evolved to intrinsically solve physics problems better than other animals (though other animals may well have faster reflexes, we have the ability to intuitively understand systems and structures, thus make predictions of complex behavior and control it in a way animals just cannot). Armed with this, we can kill an animal and there is no stopping us. There is a physical attack involved, sure, but we already know we will win because we know physics better than the animal and thus readily turn it to our advantage so

the animal's escape is physically impossible. This isn't a literal cage (though it well could be), but even shooting with arrows, following on horseback, tracking and trapping. They don't stand a chance, because they can't help but follow the same laws of physics that we calculatedly use to kill them. So it is with nations. If there was doubt about realpolitik, consider the world wars and the ongoing middle east conflicts. Now the US uses drones and guided missiles to destroy places and people who have no chance to fight back. There is no physical way to stop or fight a physically superior enemy. The poor soldier on the ground and his ragged buddies, all raised in a highly superstitious and flawed religious system, have absolutely no way to stop the precision missile coming at them, guided by satellite from the other side of the earth. It is utterly cruel that we use these weapons and shows no concern for any sort of human purposes. It is the physically superior nation using another as its military playground, testing out its abilities without attacking others who might be able to retaliate, improving its understanding of warfare physics so it can ensure its own superiority in case of future conflict.

What of the 9/11 attackers? What of the school shooters? Why would a human or group of humans purposely decide to ends their lives, killing others and going out of their way to pick a highly visible method? It's easy to say they're crazy, brainwashed by religion, out for mad and senseless revenge. These are some more thought-stopping phrases, and the world is all neat and tidy if we stop here: they did horrible evil things because they were horrible evil people (and for that they were sent to hell). But we must not ignore that they were also human, they had (more or less) the same evolutionary survival instincts and emotional needs as other humans. All humans have a conscious experience which has evolved to choose optimal actions based on its local surroundings and history, a physical mechanism of tremendous processing power reacting to the world it is exposed to. Why fly into the twin towers? Multiple people agreed to this and took significant logistics steps to carry out the attack. What could drive a human to go well out of their way to do this? It's an act of desperation, like an ant biting a person who is destroying the colony. The US can send guided missiles anywhere in their country at a moment's notice and they don't have any means to stop it or defend themselves. Their attack was a desperate attempt to make a public statement about the US, and now with increased surveillance and TSA they won't have even this rudimentary way of fighting back [27]. If I was born there, I would have no chance of coming to the US, much less doing any serious damage to it. I would live knowing that a missile might show up at any moment and blow up everything, and there

[27] and if the US government did know to expect this attack, it would be entirely within realpolitik to not stop it

is nothing to fight - the enemy is distant and invisible, wholly unreachable. It would be a hellish life, which I would not even realize, having nothing to compare it to, so perhaps I would go out of my way to impregnate women so more humans could later find themselves in the same hellish conditions. And that's how realpolitik plays out.

With increased global connectivity, a "conscious" organism could well emerge, a global consciousness, one that directs its cells (humans) actions to its own benefits. At that scale, we are "competing" for resources with earth-scale organisms/structures like the climate and geology and ocean currents, and entire species of plants/animals. And here we are fucking up: nations have only had a few thousand years to evolve, so many of their actions are not yet optimal in an evolutionary sense; the global consciousness would only have had perhaps decades to evolve and is by most indicators no match for the million-year-stable earth-scale systems that it now finds itself competing with. Nations evolved in a setting where they could readily extract and throw away materials, letting the rest of the earth deal with the pollution/fallout/regenerating any chemicals like fossil fuels. Like a small cancer can live fine inside its host. But in expanding to the scale where we are competitors with the earth's big players, the very ones we have grown to expect to take care of our trash and provide our food (climate, atmosphere, energy flows, carbon cycle, water cycle, ocean ecosystems), we have not changed our ways, and these million-year-stable systems will have no problem indifferently wiping us out by the same realpolitik principles we use with small nations. We're placing our children's lives on a hope in future superiority to nature itself - no small feat.

But I suppose the distinctions are arbitrary. Perhaps we can draw boundaries around consciousness and organisms by analyzing the couplings, but the scales provide a relative and unambiguous comparison. In a deterministic world everything has to follow cause and effect, so there are always specific laws/rules that each particle has to follow, dependent on its larger system. The small particles work and only seek local optimum, not questioning their constraints. The larger particles collect/handle more information and set the constraints for the smaller particles. And this extends in both directions of spatial extent. If that's the case there is no universal "scale", physics is scale-independent. Entertaining this notion for a bit means all particles must always be under control of some larger system. The largest, most overarching system is heat/entropy, and everything anyone or anything does must follow its laws. But keep increasing the entropy dissipation rate and stable structures will arise [28] - turbulent eddies/whirls, life itself. These eddies now impose additional restrictions on

[28] in an evolutionary manner: stable and growing systems will grow at the expense of others or will just outlive them

their constituent particles such that these very restrictions keep perpetuating the eddies, a system kept stable by virtue of its stability in a sense [29], and always in evolutionary competition with other nearby eddies seeking to sap their energy. Inside the eddies, sub-eddies develop creating additional rules for their particles, and so on down the line. The same way, fractal structures permeate our organic lives - trees, cells, lungs, brains, groups, nations. The earth is well decoupled from other planets, so the scales of life that can impose additional rules for us to follow stop there (the moon makes tides, so not wholly negligible). The only way rules can be imposed is by bidirectional interaction, and implemented by orthogonal interaction (infinite couplings). This brings the notion of "life" to all physics phenomena associated with energy dissipation, consciousness to those that cyclically interact. All dissipation = some sort of consciousness/life, faster dissipation = more consciousness/life on *all* scales, but the largest scales cannot exist at all without some minimum dissipation - note a parallel to allowed quantum 'vibration modes' as temperature increases. And just as turbulent eddies are bound in extent by overall available energy and will grow and compete with one another, the stable state is a competition, there is no "rest" - our biological lifeforms will compete with one another and with non-biological entities like wind [30] to extract all of the sun's energy. In that sense, maybe our population explosion to a 'global consciousness' level could not have even been possible without the energy boost given by fossil fuels, and the end of fossil fuel use certainly doesn't look promising for this global consciousness survival. It is relentless, this mechanism of life.

[29] the same characteristic of qualia defined by IIT - differences that make a difference to the system itself - showing just what a societal-scale consciousness might be "feeling"

[30] renewable energy is just energy that would have otherwise gone into one of the big planetary systems - wind energy comes from slowing down wind, solar energy from blocking the sun...

Part III

Self

12

Brain Operation

main message: through analyzing my own qualia experiences, combined with some notions of information theory and real experiments done by others, I try to answer some big questions on what exactly it means to be a "self"

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consider conscious processes in our brain: we have different senses and abilities, the different qualia have different aspects that speak to their purpose and effect. From introspection, for instance we have a 'stack' buffer where the conscious "me" plans intentions and actions in an abstract way, like "move the fork here then pick up the food" or "drive straight in this lane then make a right turn". These abstract plans are then processed and executed by subconscious processes which also employ feedback from the senses - these control loops are fast and take no further conscious effort, letting me continue thinking. I still feel what is going on and have the ability to stop or change the plan at any point based on my conscious evaluation of the situation and whether my actions are still appropriate in an abstract sense, something which the subconscious processes cannot do. In terms of feelings, pain for instance has intensity and body location. Hearing has frequency and intensity and external spatial localization. Sight has color and intensity and external spatial localization. Taste has flavor and intensity and localization to the tongue area. Motion/acceleration sense has a direction component but no localization (or maybe roughly to the head area). All these properties ought to be reflected in how the qualia are actually encoded in the brain network and may give hints how to find them in brain scans or maps.

Consciousness is an infinite-coupling bounded optimization system, that is in a sense "taken" from the universe grand consciousness at birth and then returned at death. It is a system that is split from the universe and can act independently in it. Our qualia experiences are a small subset of

universal qualia.

Human brain is sensitive and responds to certain systems well. For instance, walking and throwing/catching are tasks that modern robots can't do even though they can beat us in chess and calculations. It then might be possible to transform "difficult" problems into "intuitive" ones with knowledge of what the brain works better with. This is both in terms of system outputs (flashing/moving shape, sound to alert, colors) and in terms of interaction (immediate feedback, proportional response (can learn by "a little more/a little less" approach), consistency of response over time).

I argue that thoughts and brain function are basically built from a "blank slate" by an algorithm that enables learning (at first by trying random patterns, then by forming associations when any repetitions are recorded). This is since humans are able to learn+act as other cultures with enough time. Because of the advanced skills of walking/throwing requiring well-developed algorithms, I argue the thought algorithms will be similar in nature. For instance, walking is rhythmic, usually unremarkable but with each step unique. The brain is unique in being able to "feel" its own operation - sense itself (to some extent) - which we experience as thought. Most thought is also repetitive, easily forgotten. Everyday and common experiences are largely forgotten (so adults may say "the year flew by" as an indication of much regularity in the events of the year - the compression done by the brain has merged all similar days together so the year seems very short). Unique experiences are unduly emphasized.

Based on the ease/difficulty of memorizing and visualizing things I claim:

- We are not good at memorizing continuous sequences, instead we compress them into segments such that one segment inspires/reminds of/guides to the next segment. Segments represent things of interest/noticeable changes. This is like a compression algorithm at work (same approach as we use to compress streaming video). Note that for simple objects like a cube or doughnut, or like drawing of a hallway, we can visualize smooth motion, based on that I argue we simplify the observed world into such simple objects immediately to determine our physical movements, and unless a great need exists we do not capture actual motion of complex objects, instead retaining a series of images/impressions.

- With some effort it is possible to visualize rotation/translation of fairly complex 3D objects (which we mentally create by combining the movements of simple objects?) even from a 2D drawing. Thus we possess powerful 3D processing capabilities. I claim this because this proved to be a fast way for me to visualize complex objects - start

with the motion of a simple object, then add another object attached to it and the resulting motion is intuitive.

Using as a starting point the idea of visual harmonics [Lehar] [1] and body harmonics [2] and musical harmonics [3], I propose the idea of thought harmonics - these will be evidenced in "natural" human creations, specifically: fables+myths, common elements of stories, religious+scientific knowledge, debates+logical fallacies.

Here I focus specifically on stories/fables inspired by observations on a baby's life. [4] A modern baby's everyday experience is a fairly sheltered one yet he is told stories not about everyday or familiar items (or even physics, as it were) but about unfamiliar, strange animals that also happen to talk. Why make such a demand on the infant's memory? Perhaps because the parents like it - just like baby toys are pretty/ colorful/ cute even though the babies don't care - it is the parents who buy the toys so they have to be appealed to. But I think there is more to how such fables came about (more, even, than just mindless words to keep the baby entertained, as would be done by any desperate mother before fables/ lullabies/ fairytales as such were widely recited) which shows some underlying aspects of human thought. For one, they reflect entirely dissonant beliefs - animals who talk and build houses - which reflects human ability to abstractly connect otherwise unrelated topics (this dissonance is also seen/taught in early childhood gameplay - feeding plastic toys, imagining toys as living or thinking or, more vividly, *moving* entities - like playing with soldiers or dolls or dinosaurs). Such dissonant connections ought to be tough for the growing baby to reverse, but where did they first originate? Probably as a combination of a strong desire for information/ explanation/ closure (evolutionarily a necessity so that any learning - an extremely difficult process - get done at all!) and also strong stereotyping (similarly necessary so the brain can make sense of new situations/use little memory), and perhaps cross-overs from personal experience (projective explanation - how can lightning happen? It is loud+sudden, a person must be throwing it (whatever 'it' (a unit of lightning) means, just like talking animals)) and over-willingness to accept an intuitively "OK" explanation (one that doesn't conflict with

[1] visual harmonics describe a scene in terms of simple objects as represented in the brain - the simple (ones we consider simple/natural - of course!) objects like cubes, spheres, triangles, but also more advanced features like texture and face detection. Visual harmonics makes it easy for us to interpret line drawings and grayscale images and caricatures, and hides blind spots and other features of the eye's photon response.

[2] the movements we make naturally - in walking, dancing, sports, playing music, sex

[3] in listening, singing, composing in certain pitches and melodies

[4] the presence of monsters in stories is scary as it is a clear harking to the baby's interaction with a wholly powerful parental figure and implies the baby often lives in primal fear of the big "monsters" around it

previously held beliefs) rather than a rigorously proven one. [5]

And yet these discordant, accidental, illogical associations that result may play an important role in thinking - namely providing a "randomizing" element in a local peak-finding function to make it more global, a key element in "creative thinking". Then it follows that not only language (due to accidental similarity/connections between words that are written/said similarly) but cultural heritage (fairy tales, religion, explanations) play a role in a human's thinking abilities. As outlined by [Anderson], DNA's two strands are prone to error - this could be fixed by using redundancy or some error correction but it is not in living beings - because errors lead to mutations which can generate more evolutionarily fit beings and the beings which can evolve (by genetic mutation) will outlast the unevolving ones in a diverse and changing environment. Humans and mammals can also evolve in a non-genetic way by passing on/discovering behaviors and actions [6]. Language is a key component of this evolution for humans, serving as a means of recording and teaching others of behaviors and facts important for survival and prosperity. Language is also quite loose - what exactly is it that I mean by "quite loose" for instance? Perhaps even I don't know although I wrote it down. Just like DNA, language is prone to errors and misinterpretations. But perhaps this is no accident - we could develop a language that is extremely precise and unmistakable, but this would not survive evolution. The non-specificity of language allows it to adapt to different circumstances and play a key role in mental connections and creativity. If there was one unique interpretation of every statement everything would be perfectly factual, whereas because of different interpretations I may see connections - perhaps arbitrarily - and come up with new "original" ideas. So even imagination and creativity are deterministic, and language-driven.

We can also recognize the common appeal of certain stories/ thoughts/ ideas across cultural heritages, as then these concepts must be a part of our biological programming (as opposed to culturally evolved capacities). They include: buildup and resolution [7], repeating/common elements (rule

[5] The brain's automatic filter on [matching previous beliefs=correct] makes it hard to convince people to change their beliefs, this process leads to strong mental discomfort and anger/stress/frustration before re-learning can take place, a true cognitive dissonance.

[6] some recent discoveries of killer whale hunting behaviors show that behaviors can be learned and then spread in a group of mammals ie it is not all "genetic programming" (and I would argue, there is very little genetic programming even possible - the programming is of the brain structure, the learning and interactions with the real world transmit the bulk of the brain configuration information)

[7] the epic tale is repeated in form across cultures+time and is certainly still active; buildup and resolution also happen in non-story elements like songs and dance and firework shows, and of course sex. Perhaps it is a reflection on the brain's deepest programming to stalk/hunt (build appetite)/devour

of 3), focus on a narrow group of actors (or in music, themes), ideas of supremacy/ power/ self-improvement/ sacrifice/ progress.

This writing itself may be used as a case study of brain function, as I write it in the order that I think of the concepts. I claim that humans as a whole are much less complex/intelligent than we (as first person viewers) like to believe. We already have evidence of this in the information/complexity realm with modern computers and detectors: calculations and measurements easily produce megabytes of data, but the human must reduce this to some text characters (perhaps kilobytes), and in the case of scientific data the normal approach is to then make a scatter plot and fit a line to the data - reducing all those megabytes to the two numbers defining a line. Computers have no problem handling the full dataset [8], but the brain must filter the data to an extreme level to make use of it. It must be the case that such a simplification ignores some phenomena (or in fact most phenomena) of the full dataset, but the power of the brain's operation (and reason why supercomputers are not "smarter" than simplest humans) lies in extremely precise and efficient filtering of data into only the significant aspects - the aforementioned line through the data points is all that we really need to know - as evidenced by the success of this scientific-data approach. Humans intuitively select the "important" parts of patterns and can learn to do so more efficiently and for new types of data (what happens in classrooms - students learn to find patterns in new data, guided either by the teacher or by their pre-existing pattern knowledge+guesswork). If the above is true then our brains must be extremely sensitive to patterns, and since they store data as patterns (as opposed to bit-by-bit like computers (why we don't readily catch typos)) our lives must be characterized by patterns, as well as our thoughts. There is a way to test how pattern-dependent our lives really are (same applies to our thoughts) carried over from complexity and information entropy concepts from computer science - in other words, how well some type of compression algorithm would be able to "compress" a person's life and experiences [9]. If every day is the same, such an algorithm could store many physical days of living as only one day of experience - something that happens in reality as evidenced by sayings like "wow the whole year seemed to go by in a day!", of course explainable by the exceptional pattern-matching of the brain. Applying this analysis to my life reveals an embarrassingly small repertoire of activities, but I know

[8] so it is not surprising that now machine learning algorithms are more accurate in making a medical diagnosis than a doctor with access to the same data

[9] to be complete, the absolute amount of information in the algorithm + compressed data is compared. A simple algorithm + easily compressed data is low information content, a complex algorithm + minimally compressed data is high information content. Once a physically relevant way to specify algorithms is given, the resulting information content should be constant regardless of algorithm choice.

from computer models that finding an optimal solution requires extensive searching of the space - anything less will just lead to a local minimum (less optimal life); there is comfort in familiarity but too much repetition leads to a feeling of stifled/cabin fever.

Experimentally we can probe the brain's operation quite easily - the hardest part is accepting the outcomes as real. We have evidence of the brain's function in culture: art (styles, subjects, movements - existence of and progression), language (similarities across cultures, how emotions are conveyed, grammar as well as written/literary conventions), music (effects of rhythm, split into quantized notes, repeating phrases/refrain, rhyming words, power of imagery from lyrics with song), literature (the Hero's / Odyssey story, poetic language and rhyming (iambic pentameter), metaphor and simile, theme and tone, types of events and imagery discussed and left out, skew of forms towards certain elements ie more dramatic dialog than action dialog than setting description), engineering and science (evolution of ideas, which things are considered important, classifications and sub-classifications and more ways to keep many items orderly), history (how people rise to power/lead, what people believe in, what people study/record and how they reinterpret it), religion (people's most private views of punishment and salvation and sacrifice/martyrdom) and politics/media (influencing people (cults?), winning arguments, bribes and ethics, what people like to read/watch on the news (celebrity crap)). Games also give a unique insight - they are intellectual activities designed by a brain so that undertaking them feels like a pleasant way for a brain to spend time. So the brain likes some competition, some challenge, clear rules, and the ability to make choices/affect outcome, at least from a rudimentary view of board games. Surely more impressive insights into brain function could be obtained with a more careful analysis, ie the level of complexity that the brain likes to handle (chess was made to be a certain level of complexity - why not more or less?), and the things it finds challenging/interesting/enjoyable/rewarding. The patterns are out there, and it is only a matter of realizing they exist (Google and other 'big data' companies *already have* this data, thus are in a position to be *extremely* and *undetectably* manipulative of the general public. [10]). We have evidence of the brain's function in self-analysis and others' reports of self-analysis: memory (forgetting things, remembering incorrectly and swearing one was correct, 'knowing' the object but not being able to recall its exact nature - "I would know the name if you said it but can't think of it now", taking longer to remember some things than others, memorizing only some aspects of the data, skew in data representa-

[10] If you don't know a pattern exists you cannot look for it! Computers can afford to look for any realistic pattern (to a practical extent - which is still incomprehensibly small compared to the potential space to explore) and find it - the real issue in having companies with AI/machine learning and serious 'big data'.

tion - perhaps I remember that "it was a foggy day" but not much more), thinking (progression of thoughts, depth and time of focus on single topic, recurring thoughts, 'single-track' as opposed to 'multithreaded' thoughts, pauses and gaps in thoughts (seen by self and also not seen by self but seen by others), time of completing a thought, ideation and its stages and its dependence on earlier memories/thoughts), music ('ear worm' tunes that 'play on loop' in the brain - what's so special about them?, lyrics and melodies that are emotionally moving, instrumentals and their effect on emotion and thought, which sounds in ambient environment one finds pleasing vs not), visual (visualization of 3D shapes - but not overly complex ones (what *we* call simple/complex in the first place), preference for certain works of art or natural settings or visual patterns, what gets captured and emphasized in drawings, how our eyes move across a scene), emotional (what makes us feel a certain emotion, also what effect different emotions have on our behavior and "rational thinking", how emotions transition from one to another and on what timescale), and general mental (what things we find difficult, pleasant or unpleasant, intuitive or confusing, how long it takes us to think something out, what fallacies of argument and reasoning we have fallen prey to and why, how do we think (an internal "voice" or a running text or something else? can more than one "voice" be active at once?), how precisely do we think and how precisely *can* we practically think (solving a tough math problem for instance), what errors we make 'accidentally' (like a typo or misspoken word) and why we so readily ignore them - there are no accidents in a deterministic world so the errors also have a specific explanation). Finally we have evidence of the brain's function through interactions with other people: experimental studies (development of traits and abilities in children, memory extent and effects of environment, power of reinforcement, "group action" (ie changing one person's opinion)), conversations with others (what topics I choose, what topics they choose, how conversation progresses, how both participants are affected emotionally by the exchange), and activities with others (effect of physical activity on mental function, emotional closeness vs physical closeness, changes in thinking that take place in teamwork and with newly formed teams over time). The cultural and historical evidence is vast and requires no "probing" - the data just needs to be properly analyzed as it is already and easily available. Self-based evidence requires an acceptance of using oneself as a subject and willingness to honestly undertake and report results in an experiment - usually this is easiest with external (environmental) devices both for recording one's actions and for providing novel stimuli for studies (another justification of why there is no substitute for really experiencing something - living "vicariously" is *not enough* for this type of analysis). Others-based evidence can be found in psychological studies and can readily be obtained from everyday interactions as long as one knows what to look for (again,

you cannot watch for a pattern that you don't know exists).

As alluded above, in terms of processing and data interpretation the mind is not too impressive compared to a computer. The real power of the mind comes in its extremely efficient and robust memory storage, access, and association structure that can often lead to solutions with minimal computation (the 'solving' in solving an algebraic equation means changing the form of the equation until the solution is obvious, rather than numerically computing the answer - similarly we change the mental form of a problem/its representation until the solution is obvious with minimal 'brute force' computation). Among the effects described in [Kahneman] are: halo effect (a single/first-in-time likeable property causes others to be interpreted favorably), associative memory (3-word groups: RAT - indicating that similar concepts get activated at once), context-dependent decision making (factors of what is on one's mind determine answers to same question, such as evaluation of parole or patient diagnosis, at different times based on earlier circumstances), and intuitive expert judgement (firefighter commanders, chess masters). The focus in [Kahneman] is on cognitive effects, but here I suggest an interpretation for how memory functions. A quote from [Herbert Simon] on how 'experts' like airline pilots can make decisions and operate complex (to those lacking pilot training) control panels: "The situation has provided a cue; the cue has given the expert access to information stored in memory, and the information provides the answer". The part that stands out to me is "the cue has given the expert access" to a particular memory. The insight here is that the memory would not have *been accessible* without the cue - the expert could not "will it" into his mind without a requisite cue or line of thought. Even our memories - something we like to think we have control over - are actually entirely outside our control and instead affected by external factors. We cannot "browse" our memory as we might browse a computer disk drive, knowing that eventually we might make our way through all memory and suddenly seeing old files which bring surprises. It is impossible for us to tell how much data is in our memory, and similarly impossible for us to stumble on a surprising memory without an external aid (such as an old photograph/souvenir, making such aids have a special cultural prominence). We can only access memories related to what is on our mind at the present (or recent past) moment. Thus I believe that our memory has the overall operating principle of a hash table - where relevant properties of an object (its name, basic features) are hashed and act as a pointer to areas of memory where additional information is stored. I further claim (with less evidence but support from information exchange principle) that the storage of information to memory takes place by transferring recent (short-term memory) and current experiences into the memory areas indicated by the hash value, ie there is always an information exchange with memory and

world, rather than just access. This implies a few things: our thinking is context-dependent because present feelings (hunger, tiredness, emotions) will affect not only processing but also the hash that lets us access memories, so a thirsty person may more easily remember episodes that include water. (After writing "emotions" I now automatically recall a song where that word is in the lyrics.) Next, our learning is also context-dependent - this explains how irrational fears arise and can be de-conditioned by repeated exposure to a stimulus (creating that state of mind) without the associated scary action - the lack of consequences, or their presence, gets stored in memory automatically associated with the hash of the stimulus. There must be some time constant where the consequence occurring at a long enough delay after the stimulus does not result in a coherent association because by that point the state of mind has changed to another 'hash', this may well be the case with emotional/chemical effects and leads to cycles that seem irrational but that are nonetheless stable. When I get back a school assignment many days after completing it, to make any use of the feedback I must re-read and re-understand the problem (again entering that state of mind) to then interpret the feedback and modify my approach.

Limitations apply to memory - we cannot remember a train of thoughts or any other structure for long, because eventually external circumstances change our state of mind and make it unable to recall the memory (even though it is still stored, it is inaccessible without the hash - it may be suddenly remembered later on when external circumstances change yet again). This also happens when "I know the word but can't think of it" or "I've heard that melody before but I can't tell where" or "I can't remember it now but I'm sure I'll think of it sometime later" or "I could find his name on a list, but I can't bring it to mind". In this case, a fragment of information is found (perhaps from a similar hash - on the topic of collisions) but its associated hash is unknown, thus access to most of the associated information (word spelling/definition, song title, person's name) is impossible even though the mind can usually assume the information exists (sometimes the similarity ends up being an illusion, the melody I was sure I've heard before might actually be new). The original hash may come to mind if another fragment of information is accessed (perhaps there is a "hash recovery" algorithm) or seemingly at random [11], but once it is available then all the previously unknown information suddenly "comes to mind" and is now clearly accessible. The person achieves a frame of mind that can access that earlier information. Logically, if the person could not access that memory for recall without a proper state of mind/hash, it is difficult to argue that learning or storage into that "memory slot" [12] could be possible

[11] indicating role of external circumstances - emotions +feelings - on the hash generation

[12] to be sure, it is not really a slot as that implies each memory is independent, but

without that same state of mind/hash.

A hash may give access to associated ideas - either multiple hashes are tried, or more likely (since the brain can operate in highly parallel states on the unconscious level to achieve processing efficiency) actuation of a hash also activates "nearby" memories - a process called "creativity" or "imagination". If the hash algorithm was strictly highest entropy, we would expect associations to be largely random - yet more often than not there is a logical connection (in other cases the connection may still be circumstantial - but not random). Thus more likely the hash is a "logical" function of information - nearby types of information will have nearby hashes and nearby storage in memory, allowing associative activation when only one concept is directly referenced. Then "creativity" in a person is the ability to explore larger regions of memory surrounding the central "prompt" topic, then coming up with the "creative solutions" based on more possible alternatives than people who only retrieve limited items from memory (because of brain function differences or because they don't have many similar memories/experience in the field), to the limiting case of a person who can only think of the immediate problem posed with no idea for a solution available from memory - the least creative person in our sense, the student who looks blankly at a problem and doesn't attempt to go any further. People can be creative in different areas, suggesting differences in either brain operation (unlikely - brains are complex organs that evolved over millions of years and can operate robustly even with injuries/repair injuries - brain operation must be similar in all humans - stories and languages of all cultures have similarity) or early (infant/toddler) circumstantial learning and teaching [13], forming preferences that can lead to run-away processes (liking something leads to learning it more, leads to having it on the mind more, leads to liking it more). In this sense the structure of language, the "arbitrary" words used to name different objects and actions, serves as a way for a brain to organize its information and build its creative/associative abilities - people thinking in different languages would have different creative results (surely seen in literature).

A general problem with the hash table approach is collision - a new thought with a hash similar to a previous one, will tend to overwrite the old contents. This is not an issue with an identical/same hash, as in that case the old memory will be accessed beforehand, allowing evaluation of the exchange (the exchange will happen automatically still), and in any case with a good hashing algorithm an identical hash means the memories are all compatible/relating to the same topic. But with a "close enough"

a subset of nodes in an interconnected network. These nodes could be shared between many different concepts/memories, and could be gradually overwritten as new memories are formed

[13] and "creative" as well as "non-creative" memory types, both present in people

hash, full recall of old information may not occur while it is overwritten with new information. Thus old memories are subject to corruption over time, not outright deletion or disappearance but slow partial changes that eventually leave no remnants of the original memory behind - especially if they are similar to everyday experiences or are otherwise accessed often (since they are subject to overwriting any time they are accessed, by association with the situation at hand) [14]. For instance people may recall the wrong color or attribute of some childhood item (claiming they are sure all along!) if they've had many similar items in their lifetime; having told a certain story about an event in their life for long enough, people may claim different things happened or to a different extent, or even take on the point of view of another observer in the story (if some part of the story comes from/involves that observer's view). Additionally, since similar experiences will have a similar "hash", prolonged or repeated experiences will not be remembered/recalled for their real full length but only for the smallest memorable associated hash, a built-in compression algorithm that makes us underestimate the power of duration [15]. Thus it may be heard "the year flew by in a week" - every day was similar enough to others (except for weekends) that at the end of the year there is only a feeling of the memory of a generic day rather than 365 unique days. This also implies that the unique features of each day are overwritten and forgotten with each subsequent passing day, as implied by the above mechanism of hash access.

Finally we get to the topic of learning - the desired storage of knowledge into memory for future use. What are ways to make learning efficient and useful? The hash table model suggests: maintain a relevant context for learning (avoid rapid shifting of subjects, repeat background ideas to establish a context (intro/background) before presenting new information in said context, mention associated concepts as practical to help students build effective associative networks (conclusion and future work)), repetition within said context along with consistency will help learning, coherent sets of ideas which can all be linked together in similar areas in the hash table will be remembered much more effectively than disparate and arbitrary ideas so form a narrative/curriculum that highlights how all presented ideas establish each other and stand in relation to each other, avoid teaching on subjects that are easily overwritten - pedantic or everyday situations - make the context unique to the subject (the physics of spaceships is somehow more memorable even though earth is a 'spaceship'

[14] This may be another reason we place undue emphasis on unique/out-of-the-ordinary but rare events vs the commonplace but consistent events.

[15] as in [Kahneman] the reported unpleasantness of a painful stimulus wasn't based on the mathematical integral over time, rather the intensity of the stimulus was strongly taken into account

in its own right). Have a single coherent story or authority to avoid overwriting and/or cognitive strain (people have a drive to find - not the truth but - a convincing story/explanation for an event to maintain the illusion of control in a purpose-built world - claim that you know why a random event occurred with enough charisma and you will be respected/trusted). The above recommendations apply for learning "intuitive solutions" - approaches to problems. By these criteria existing schools aren't too great: 'information-dump' lectures can't lead to learning as the brain is not a memory card, it will only remember what's relevant to its mental state - explanations of why and how as well as practicing are conducive to learning, in this sense I felt most of my learning in grade school was from reading a textbook while doing homework, not from sitting through lectures; the constant shift from one subject to another in a haphazard manner throughout the day and in the expected homework assignments also didn't help much; my biggest criticism though was total lack of rapid feedback - graded assignments (with hard-to-interpret comments, or none at all) would be returned weeks after completion, by which point both me and the grader forgot the mindset necessary for that assignment, so a productive discussion of why I made some error or what I should have done instead was impractical (and even more so when also keeping up with the new assignments handed out since that time).

Beyond just "learning" a purported role of schooling is to build "problem-solving skills" - an application of the learned material in an appropriate manner to approach a new problem. This involves intuitive processing rather than purely memory [16], and has a different set of requirements, much more stringent since processing performance is not very high. Namely, the processing operational memory (short-term memory) is very low - a few concepts or digits at a time, [17] and the results cannot be held in memory for long without a very convincing context to store that much data in hash memory. Thus we get a different set of recommendations for "intuitive problem-solving skills": make problems manageable - set up an algorithm to simplify complex problems and introduce algorithms with the simplest/fewest-variables cases for best understanding; provide immediate feedback of the computation result (or algorithmic approach, such as finding a proof) including not just where something went wrong but why and how,

[16] though the two cannot be separated - the type of memory structures dictates the type of processing that can be done on it, and vice versa. The same applies in physics theories/models - the structures that models use to describe the world are interlinked with the types of computations/predictions the models are capable of

[17] just because we can only keep a few digits in mind this does not mean our memory is only a few bytes. More directly, we can only keep a few concepts in mind - and digits are particularly limited and boring concepts so they carry relatively little information; we could remember a lot more byte-level information by referring to richer concepts

also explain alternatives to the "correct" solution to encourage associative analytical thinking rather than overconfidence or ignorance of alternative approaches; to the greatest extent possible let students solve associated problems so they get practice with problem-solving (this is more work for the teacher, because often students will solve problems "their way" which is a great sign of learning and creative understanding but makes it harder to correct or justify so is usually squashed in favor of a standardized approach); provide many practice problems with immediate feedback so the student learns when different solutions are appropriate (by a mechanism similar to PID - when learning to ride a bike it helps to practice a lot+gain exposure to different road conditions; failure is a necessary part of optimization (why companies that make things that "can't fail" regularly set up test situations to achieve failure and understand it)) - it will be faster if the examples concentrate on one aspect/parameter at a time. Again the school system isn't great - with feedback being late (days/weeks instead of seconds) and ineffective [18] (grades - arbitrary evaluations [19] recorded as a permanent negative, instead of direct feedback without judgement and encouraging exploration), and judging ability by tests - something on which students have no feedback and is in a different context from both class instruction and homework. The increasing class sizes and actual (vs purported) position of school make it impractical to implement the above suggestions, so individuals should take steps to get any desired knowledge+training on their own (and children do, through video games and arts hobbies and sports and social interactions where they get instant feedback). Ultimately all learning must be self-motivated, as it involves the student committing concepts to memory this will only happen when the student chooses to do so because it benefits him - either because he likes the knowledge or because he wants good grades; a student who has no personal interest in learning, an internal brain reward and urge for it, will not learn with all of the best teachers' efforts. [20]

[18] this lack of feedback sets up significant cognitive strain (which the students are told by peer pressure to ignore and eventually accept) - of the same sort as anticipation of election outcomes, a seeking of explanations/order/logic - ironically this most valuable (to the schools' purported goals) personal-level thirst for understanding is thus destroyed by the schools

[19] 5 points off! Why 5 points? Because the teacher said so. The grade is not an inherent outcome of the effort such as with skill in art being rewarded by the artwork itself, but rather is an indication of how much the answer is in line with whatever the teacher/society decide to call acceptable.

[20] and in this way, the system of judging teachers' performance by how well their students score on standardized tests, just doesn't make sense, as it puts the priorities on all the wrong things - tests, lack of individuality/creativity, and expectation for the teacher to "manufacture learning" rather than for the student to learn. I am not claiming this is bad in an absolute sense (there is no good or bad in an absolute sense) - but that it is not in line with what is openly claimed as the outcomes/goals for such a system. This

A tangentially related memory/learning occurrence is in the classification of items. It seems there is a predominance of statements like "in this bookstore, it seems either you love the book or you hate it" or "classes here are either impossibly difficult or a breeze", namely classifying into two explicitly extreme/opposite groups. This is even when, purely by statistical consideration, a nice "medium" would be much more likely (see also regression to the mean). There may be three factors at play here: first, extreme cases (a particularly good book or difficult class) are more memorable as argued above by the structure of memory; second we have an evolutionary incentive to learn only what is necessary, and if everything is according to expectations we know enough to predict the next step and stay in control - no further learning is necessary, but if we are surprised by the experience as it does not match our expectations then we better remember the experience so as not to be caught off-guard again; third, thinking and evaluating in terms of extremes (especially 2 opposites) seems more intuitively obvious and accessible than a more complex scale system - so we have the 2-party system, team vs team games (why not 3 or more teams?), good vs bad, pain vs pleasure, and other extremes to describe rather complex multivariate underlying phenomena. For learning, then, important concepts should be presented in a memorable - surprising - way. And we must be consciously upholding the mental discipline to avoid rash classification into extremes while seriously questioning such classifications made by others.

We are capable of remembering situations as images - 3D settings rather than 2D projections (even situations in a comic book are "re-interpreted" as 3D scenes for memory). The 3D scenes contain simple geometric objects (perhaps vague textures also - recognition of textures when seen is much more robust than mental "generation" of textures). The scene memory also involves an idea of the identities of included objects, perhaps names and properties. Beyond this, from memory we can only generate a rough outline of the "picture we see", but the details we do recall are usually particularly useful/important in a physical sense such as which objects are touching and which ones are larger/smaller. This scene memory is also present when looking at the world in realtime, and our ability to identify objects comes from accessing this memory (it is created automatically from real-world inputs by visual processing circuits in the eyes/brain), yet if we find some feature that is particularly interesting while we still see the scene with our eyes we can choose to concentrate on specific details - this latter and high-information aspect is unavailable once the visual stimulus

is emotionally hard-hitting for me because I always took words at face value, but really such disconnect between claimed and actual purposes and effects shouldn't be surprising - as alluded earlier, words are cheap and derive their meanings from their effects on people, not from what's in the dictionary. And the disconnect need not be conscious or purposeful, just stable

is removed, so we have a conceptual memory which remains without the stimulus and can be used for conscious analysis and we also have a "visual buffer" memory which contains the whole field of view of our eyes at a present time and can be used to get close details but this changes as soon as we look at something else, somewhat like CPU registers vs video card buffer. This is why re-watching movies or even static art can be rewarding: without the visual stimulus we cannot get the same qualia experience from memory (like a computer could - once having a movie in memory, it could play the file back again and again), what we store after seeing a movie is only high-level plotlines, on a second viewing we might well find there are details we missed; just because one's video/music collection takes up hundreds of GBs does not mean their brain's memory capacity is similar. We can simulate basic "ragdoll physics" but this requires concentrated effort - memories are static by default. We do not remember "video recordings" of events, but only specific fragments and a vague idea of transitions from one fragment to the next. One of my artistic attempts involved showing a static photograph with an associated sound recording taken at the time of the photograph - this single visual snapshot is enough to get a sense of a video-like progression when a sound snapshot is also present. "Video" can only be visualized by a full simulation effort - usually only an illusion of "video" occurs, which is actually a series of discrete jumps. Imagine catching a ball that was thrown towards you as it is getting closer and closer - this probably involves one or two static scenes - a ball far away, and a ball in your hands. An attempt to mentally trace and visualize the ball's path between these states, moment to moment, as if watching a slow motion replay, will prove very difficult [21], although without an explicit focus you would have the sense of a realistic interactive scene with the ball flying towards you just from the static images - the ball has a "property" of flying but is not simulated by default. This lack of "video" memory [22] is why slow motion replays are popular/enjoyable - if we could do this mentally there would be no need for an explicit slowing down by machine. It is also not remembered by default - due to large memory required - but the skill of catching a ball works and thus must rely on limited snapshots of the ball's trajectory, conceptual recognition of the ball and its location by conscious processes (accessing the conceptual memory) combined with automatic hand positioning based on visual inputs (accessing the much more physically accurate/information-rich visual buffer, or even a stage before that which is unconscious but very fast) guided by the conceptual findings. Our consciousness deals with concepts from highly filtered and

[21] you may notice that at some point there is a discrete "step" from the approaching-ball image to the holding-ball image

[22] or even photographic memory - photographs become reduced to common elements, color/lighting corrected, and "hashed" for robust recognition

abstractly interpreted memory, at a correspondingly slow rate of Hz, yet it can fluidly guide automatic/unconscious systems which use the full real-time sense input buffers at a more impressive kHz, because the interpreted memory also keeps pointers back to where in the sense buffers it came from (ie this thing that I have interpreted as a ball is in this area of the visual buffer, so the automatic/intuitive algorithm that will position my hands in the right spot to catch the ball is told to "look there! that's what you're tracking/catching!") - I experience this as being able to look at the world, feel the vivid sensations of color/shape/appearance, and at the same time tell that "what is represented by this part of my visual sensation is called a ball" - the two levels of memory are transparently overlaid.

A controller (human or PLC) needs the ability to impact a process that it wishes to control towards a desired outcome. For instance, maintaining a constant temperature (thermostat) or heading (bicycle) despite external perturbations. To describe the effectiveness of control, given that all the desired degrees of freedom can be independently controlled, one may consider how quickly the system responds to the controller's decision, a concept I would call responsiveness. Trying to stop a car by opening a window to increase air drag has low responsiveness, while using the brakes has high responsiveness. While the physics of the car stopping involves force magnitudes, responsiveness focuses solely on the time aspect - how quickly the car stops vs how quickly the controller wants it to stop. Quantitatively then we may define responsiveness = bandwidth of system / bandwidth of controller. A responsiveness of 1 (100%) indicates a 'temporal match' between controller and system - the system changes slowly enough for the controller to respond and correct it, and quickly enough that the controller cannot overcompensate. A responsiveness approaching 0 indicates a poorly controllable system - sluggish where the controller may induce instabilities by overcompensation (such as steering large ships). A responsiveness approaching infinity indicates a poorly controlled system - instabilities may set in that the controller cannot affect even though response to the controller is very fast from the controller's view (particle colliders, for instance). Learning (of control skills), where the controller determines a proper way to control inputs to achieve desired outputs, happens most effectively in a high responsiveness setup. In such a case, the controller gets rapid feedback on the effects of its actions and can adjust course in time. A responsiveness above 1 implies that sporadic outcomes can occur but the controller can still improve on average (this is the case in high-speed sports like baseball batting, dart throwing, driving). A responsiveness of 1 provides opportunity for consistent skill development/optimization to the capabilities of the controller (this is the case for self-paced activities like drawing/writing/puzzles, thoughts, leisurely walking). A responsiveness below 1 makes an environment ill-suited to learning as it is unclear what actions cause what outcomes

because of the long delay [23] (this is the case in sports like bowling, most large-scale projects, and vast majority of the educational system). The large-scale projects stand to benefit greatly by improving responsiveness - by making a Gantt chart [24] where items may be re-arranged in real time project leaders can achieve significant efficiency gains by controlling a high-responsiveness simulated equivalent of the real low-responsiveness system. The Gantt chart in effect provides a temporal match between the human controller and the slow physical system/project. The educational system also stands to gain by increasing student responsiveness - providing instant feedback on student performance ("instant" feedback, or unity responsiveness, leads to least mental effort for learning - only the present state of system matters, not past or predicted future states). A learner will get most out of a class by applying concepts in a way that immediate feedback is attained, often done in practice problems/exercises for which the answer is already known or expected. We control high-responsiveness systems by either relying on chance and loose tolerances (driving, sport) or by designing a mechanical controller that serves as a temporal match between slow human controller and a fast physical system (computer stabilized flight).

Secure communication over an insecure channel - this is the ideal to which encryption technologies aspire. Is it even possible? If an adversary can manipulate the channel, there isn't truly a way to know whether the communication is really from/to the desired recipient - even with a cryptographic handshake, perhaps the adversary knows all the keys and can fully impersonate the recipient, making the "insecure channel" tautological for our purposes. So here I will assume an eavesdropping adversary only, and assume (as we all do) that if the adversary can manipulate the channel, they will not have knowledge of the necessary keys (not even from their eavesdropping) and thus most certainly the manipulation will be detected and ignored. At the minimum, the sender and recipient know each other's name/contact info (or at least one of them knows the other's) - otherwise no communication can take place. But any adversary will also know these names, as they are public knowledge. If the only thing I know about the recipient is their name, ie I have no expectation for what will be sent back or whether it will even be comprehensible, then an adversary can substitute anything they want and I would never be able to tell. And yet such an "unknown" state/full entropy (I have no idea what info will be transmitted/received next) is characteristic of most efficient/highest-bandwidth communication. Any part of the message which I know and expect may as well not be transmitted, but such a situation makes it impossible to

[23] same as too-high responsiveness systems behave effectively randomly, like the "electronic dice" which is just a fast counter that stops when one presses a button

[24] more generally, formulas and experience (look-up tables) are used by trained operators such as in ship steering and artillery positioning, to serve as the temporal match

apply any protection to the information transferred. There is another concern here - human comprehensibility. For communication to take place, whatever the letter/information is, it must eventually take on a human-readable and comprehensible/legible form - with words that are known, arranged in logical phrases and sentences that form a coherent meaning. [25] Thus we must refer to already known concepts, greatly reducing the actual entropic possibilities of a high bandwidth channel. A book can have any infinite combinations of symbols and drawings, but we expect words in paragraphs and sentences which all make sense - this expectation must be met but does not carry communication-relevant information other than to confirm that this is indeed a valid book. Similarly, secure communication cannot use all available bandwidth for pure information transfer as this can never be verified or made coherent use of; instead some bandwidth is used on information that both sender and receiver can expect/predict, and this information provides assurance that the communication is taking place as intended. Encryption makes it difficult for an adversary to modify the pure information content by mixing the entropic and non-entropic content, such that a naive modification will be traceable by its effects on the non-entropic (known/expected) content. Encryption thus requires privately shared knowledge, ie things known/expected by both sender and receiver, but not known or easily knowable to any adversary. As I mentioned earlier, ultimately a letter/message must appeal to previously known concepts in order to constitute communication; the words and sentences must be legible and make sense, this shared knowledge of the language constitutes a signature of human communication - if I receive a valid letter/message I know it was written by another language-knowing being. But then how can any learning take place? To a baby, a properly written book is as cryptic as the most difficult cipher, because the letters and words do not evoke any ultimate meaning.

At some point a baby must learn its first word, not even knowing what words are, much less what they mean. I believe such learning takes place by powerful coincidence-finding algorithms that are hard-wired in the brain, along with other hard-wired communication features (such as uses of silence to separate words, and use of relatively short words - all not strictly necessary but "natural" to us because of hard-wired speech processing algorithms). If I've never heard the word "rocket", but someone puts down a photo and says "rocket", I can be quite sure they are referring to the rocket in the photo, just because it stands out. When they put down a

[25] True secure encryption will make this last step into an algorithm that takes place inside the recipient's mind - this way we avoid the trope of using 2048-bit keys and the latest hardware protections just to have an adversary read the secret message by looking over the recipient's shoulder - this is also why old-school spying will exist as long as society does, as ultimately it is humans who must act on the secret message

second photograph and say "rocket", I can be quite confident I have found what this "rocket" looks like - even though there are countless other objects/people/features in the photos and even though "rocket" may refer to the color of the sky or to the rectangular shape of the photograph or to the emotional state of the person showing me the photos or to any other number of things. Such rapid learning is based on intuition - since the photographs were human-taken, they hold the rocket in a prominent/focused/optically contrasting/emphasized portion, so when I see the photos I can tell that one object is emphasized over the others (which is probably commonly hard-wired in humans, similar to face recognition - ie if I frame something as a 'subject', others will also recognize it as a subject, as we share the same hardware, a deeper level than conscious learning which is built up as a result of that hardware). I can assume the object is what is referred to by "rocket" though at some level remembering all associations and then discarding most of them as inconsistent when I see the second photo, leaving me with highest confidence in the mental construct that "rocket" means the thing that is in the photos. Thus learning requires multiple stimuli (in the case of complex stimuli they must be close temporally so as to not fade from short-term memory) for the learner to make sense of presented information - not in the sense of sight and hearing as separate channels (though such intuitive separation is doubtless a key feature of our actual learning, since sight and sound often are correlated, but strictly there is no need to consider them as separate senses any more than different audible frequencies could be considered different senses - it is still possible to learn even if one human sense is available - for example through time coincidence of two audible tones or through pattern-finding in tones played over time, the simplest to us being finding vocal sounds punctuated by silence and mechanical/noise being continuous), but rather in the sense of already-known and unknown data, where the already-known is used to make sense of and to understand the unknown, to place it in context. This is obvious in the traditional, "dictionary-reading" based learning: a rocket is a long pointy metal object that flies vertically up. If I've never heard of a rocket before but know all the other words, reading this definition brings to my mind images/thoughts/precepts of "long", "pointy", "metal", "flying", "vertical", and just about every other word (except for grammar structure which is the non-entropic component and confirms that I am reading a valid phrase). Thus I build up a meaning of rocket out of a new association of previously known words. [26] Yet such learning is rather dry and limited - the stimuli

[26] that I can do this, and that I am content with such a definition is a very interesting reflection on memory structure. For example to make a new file on a computer, I would have to supply all the file information. But to learn a new word, all I need is other words that "describe it", or that "are it" in mental space. All the "files" in our brains are actually just links to other "files" - in fact there are no "files", just links. The types and shapes of

don't have to be so boring and obvious.

Consider that one of the "already known" stimuli in the above definition was the notion of a definition, as well as of a sentence, of words and letters, and of general language expectations, such as reading left to right and top to bottom. None of this is learned by a definition, rather it is intuited and confirmed to "certainty" throughout our life experience - a long and difficult process where the brain works 24/7 for many years to find patterns and make sense of what it is presented. And what the learning brain chooses to focus on is a uniquely human, hard-wired trait that *is* the "pre-known" data in all humans, even newborns. This is, in a vague sense, the way that people process the world and the types of patterns they can find and remember (if you don't expect a pattern, you cannot find it). With this "hardware" capabilities, the mother can tell that a child is focused on a toy/object and name it/describe it to the child, in human-created (and thus comprehensible) language, allowing coincidence-based learning to take place. Even the notion of focusing on an object is a uniquely human "pre-known" data that is essential in human-human communication, and something arising naturally in all cultures because it is part of what humans *are* and how they work. Coincidence-based learning itself uses the "pre-known" key of coincidence as being a signal for learning to take place, which is really an arbitrary assumption but one that happens to be effective in our world. This allows the brain to focus on the most relevant data, quickly discarding the plethora of other incoming data as noise if none of the "hardware" or "software" signatures of "pre-known" data markers are found (ie some pattern in time, loud/startling sound that gets us to pay attention (hard-wired), ignoring a gradient background, letters and words that make sense). The constant hum of the humidifier in the background is felt as noise - I'm aware of it only as an indication that the humidifier is still on, even if the sound itself carries way more information about the voltage level on the grid, the amount of water in the tank, the cleanliness of the boiling surface - I don't have the right hardware to discern these patterns. Yet if the hum suddenly stopped or changed nature of its frequency distribution, I would quickly become alert - this *is* within my hardware ability of pattern detection. And all *this* constitutes "pre-known" data used in communication and learning, in a basic sense.

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networks formed by these links, and which parts of them become activated and how they interact, is what gives rise to different concepts and sensations/qualia. The computer CPU operates on bits in memory, and surely there are structures in the brain which can also store/manipulate bit-level information over time, but what we experience is not the bit-level data but the links between the storage 'boxes' as guided by the brain's wiring and the way it activates affected by brain chemistry. What we experience are transitions in data, the dynamic information couplings within the brain. This continues to be in line with my interpretation of conscious experience as field/potential shapes that cause dissipation along an 'optimal' route.

Our brain is structured to make sense of the world using symbols like words and phrases (children will readily repeat phrases they don't really understand, just because they see the adult saying a phrase and associate it with a given reaction/feeling), making arbitrary networks and associations. For instance, a human body and an animal head – unphysical but easily accepted as a mental construct. This works in a hierarchical manner so we find it convenient to use folders in a computer file storage system, or use different orders of approximation in science theories – ie the 'tree' is a part of our brain functioning. The arbitrary associations also apply to understanding of cause and effect: jesus died for our sins (why does jesus dying have anything to do with our sins?), similarly threats like "I will do this if you do that". From this I would argue for a relational model of human thought - our thoughts are composed of relations between different concepts.

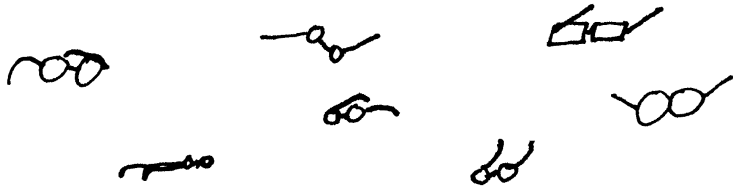
Symbols - abstract representations of actual physical objects - are powerful concepts in human knowledge, and are key in our society's establishment and functioning. What gives symbols this special role? The key is in the compactness of numbers. For instance, I could write down the total number of combinations of a computer screen's pixels, even if it would take quite a bit of space. This number could also be seen as a single instance of a screenshot - with all numbers under it representing other instances. In the same way, I can write down the number of atoms in the universe, if only approximately. So, using a tiny subset of atoms, I can represent the total number of atoms, because I am taking advantage of a vastly larger space of atom combinations; same as number of pixels is lower than number of pixel combinations, so I can write the product width*height in numbers on any given monitor, quite easily. The number of combinations, on the other hand, can get arbitrarily large depending on what is considered a combination (with the monitor, I arbitrarily chose a single screen of pixels as a combination), and cannot be expressed within the system, as the system is defined by the combination that it actually takes on, thus by definition only being able to take on one state at a time (the buffer on my video card that gets used to generate the screen image is precisely large enough to store a number representing how many possible screen combinations there are). Because a system is defined by an arrangement of objects, any particular object can be easily represented by a small subset of the available arrangements - by an arrangement of a limited subset of other objects. Thus me writing "chair" with the atoms on this piece of paper is an arrangement which refers to an actual physical chair far away. If I had to describe the chair fully - its arrangement of atoms - I would have to use the chair itself, or a vastly larger set of symbols in the rest of the world. So, the use of symbols requires a discarding of most of the information about a described object. "Chair" is generic, arbitrary, by itself meaningless. Supplied by de-

tailed construction manuals and the rules required to follow them (and the rules to understand *those* rules, so on to the "pre-knowledge" of above) we get closer to an actual physical "chair", though still unimaginably far from the actual atomic scale representation of the physical chair. This is key - the symbol itself is meaningless without a system/organism to consistently make use of that symbol. "Chair" by itself means nothing - it is yet another arrangement of atoms. But coupled with a human's consciousness, it can be used to affect behavior and allow for communication - altering another human's behavior. [27] A computer can similarly process information, for instance classifying whether a picture contains a chair or not. Such knowledge, of the coincidence between object and symbol, or specifically, sensory input to a system and symbol, constitutes the "ultimate" shared knowledge in communication and delineates meaningful from meaningless statements - a signature of conscious processing as alluded above. The connections are arbitrary and must be learned through countless coincidence and inference judgements, done during childhood and even during sleep. The arbitrariness is interesting - a symbol cannot exist without an information-processing being to make use of it, and the arbitrariness means the symbol can come to represent whatever it is meant to describe without imparting any inherent qualities/qualia of its own. Perhaps thus any being that can learn/use symbols must be a conscious one - acting out real physical behavior based on unrelated, abstract symbols: coupling an arbitrary set of symbols to physical action, a sort of entanglement between sender and receiver. Might conscious qualia come from the conversion of a specific sensory input into a non-specific abstract form (or vice versa)?

We see the world not in its full complexity but only as well-processed symbols, so in a real sense we only see what we can comprehend. So there are things which matter to our perception, and things that don't matter. For instance, different fonts convey the same meaning although they may barely look alike by physical terms. Now as I'm learning Chinese writing I don't know what things/strokes matter, and can often make mistakes obvious to a native speaker but difficult for me to see - same with pronunciation, at first I would recast their spoken words into an English representation, losing tones and some sounds, and only with extensive practice/ feedback/ immersion am I able to start and process the sounds as they "are" and also make such sounds myself; I now am more or less able to discern different tones due to practice and being taught to pay attention to them. So it is possible to alter what we see as important and what we don't, based on our upbringing - I grew up learning one language and for learning another I have to be once again taught what things to pay attention to (and what

[27] in this sense, communication (using mutually understood symbols) can be said to create a larger conscious system - setting up dissipation-optimizing networks that have capacities far beyond the individual human's

things don't matter, even though based on my native language I would think they do). So a repairman might see a problem where a layperson thinks everything is fine. What led me to this view is that in cartoons and drawings all sorts of different shapes of characters and faces are used, and yet we automatically know what's going on. Consider the case of glasses: taking pixel-level data that shows 'glasses' in different cartoon drawings will show barely any similarities, yet I instantly recognize them as glasses and find where they are located on a character's face/head. There must be some complex topology/visual processing rules that map the full visual complexity into the single idea of 'glasses'. [28] Are the following glasses? What features matter? The 'hooks'? The line between circles? The lengths of lines?



I wrote earlier on how some words seem to serve as an adequate explanation to a "why" question. I mentioned a satisfying stopping point is one of random/ uncontrolled/ unpredicted events: "Why do you like sports? Because I played a lot when I was a kid. Why did you play when you were a kid? That's just what kids do!". Recently I noticed that words can also serve as an explanative stopping point. There is "because god" or "because I said so" or "because we were in the right place at the right time". But there are also labels: "because I am depressed" or "because I am disabled" or "because I have OCD". Such labels summarize and generalize, but if not used in a rigorous manner can mean different things to different people (like "right" and "appropriate"). Even if used in a rigorous and consistent way, they perversely have *no explanative* power, but only *associative* power - associating to other words in a "thought cloud". So "I stayed in bed because I was depressed" glosses over tremendous details - the person's upbringing, character, mood, diet, other interests/activities, family relation, basically nothing. Just like saying "that chair" above gives practically no details on what the chair looks like or is made out of - just a label. And "because I was depressed" is no explanation when the real cause is myriad physical/chemical reactions we can't hope to track in that person's brain.

[28] computers are catching up now, with object recognition ability, and the way they are programmed to do this may give interesting insight into how our brains do it

[29] We choose to stop there, for convenience. Why are you depressed? How did your last meal contribute to this? And any other deeper questions are more or less discounted, ignored. Physics/science is another such word, of course, but at least these claims are testable/verifiable experimentally - perhaps the only empirical truth we have. But still it leads to blunders in the energy field, like "green energy". Putting piezoelectric generators under sidewalks to get energy from people walking - sounds good! Why? Because "energy", and seemingly "free energy" is enough to stop thinking further, even for wholly competent adults (can't really blame them, as I still have no idea what energy is). Yet looking just a smidge deeper, it is clear that this energy comes from human digestion - possibly one of the most expensive and inefficient energy sources one could find. Just hook it up to the electric grid for fuck's sake. Same with solar panels on roads - "solar panels" is a good word in its own right so apparently people don't see the craziness of replacing really cheap durable rocks with really expensive fragile semiconductors that will mostly be covered by cars during the day. An even bigger scale fundamental blunder is with all of "renewable energy", for there is no such thing! Whatever energy we extract, from wind or from solar or from tides or from salination, it is energy that otherwise would have been used towards some natural process - perhaps one useless to us (like erosion or material damage) but then again perhaps not. We *never* can get free energy without altering our environment, without sapping it from some other system. That big picture of interconnectedness is what we miss by stopping at words like "renewable energy" (and the flimsy argument of "it's just a little tiny bit"="it's nothing" is a thought-stopping concept in its own right).

Systems which are set up "precariously", on an entropically unlikely state (too perfect/clean/sterile/symmetric) will be susceptible to perturbations that create some new addition in the system and break the symmetry. Such susceptibility increases the more "pure" a system is, so ideal or perfect things remain a mathematical abstraction, at least as long as any (thermal) perturbations are present. So, vacancies form in "pure" crystals, and we cannot have perfect crystals. So, in a utopia without crime, criminals will start appearing as the benefits are great and punishment non-existent. So, a baby raised in a sterile room will get all sorts of illnesses when exposed to the outside environment. So, a supercooled liquid will spontaneously solidify when a good enough nucleation site is found. So, a conscious experience will arise when a brain's connections are set up to support such a pattern and a perturbation of a sensory qualia comes along. This is in

[29] yet, information theory tells us that any information output must be some function of information input into a closed system, so even though the brain may be a "black box" we can still analyze it from outside and make models of its actions. This is a basic principle used in all of science.

line with [Dehaene's] phase change argument for defining consciousness as well as [IIT]. Consider what this means: when the brain is set up in a given way, poised for an avalanche discharge as it were, like a photomultiplier but in a loop, an outside perturbation will induce a consciousness, which will quickly access the brain's memory and realize a sense of self, giving me the illusion that the "I" of now is the same person as the "I" of a few months before, even if my conscious experience disappears/reappears along the way. Multiple transistors, set up in a loop are undefined and can "collapse" to one configuration or another, perhaps such an arrangement can house a type of "extremely large quantum particle" or perhaps it can be fully explained classically, but nonetheless the ensuing evolution would seem strongly to lead to conscious experience. Consider the ZVS oscillator circuit, which had such an arrangement, using 2 transistors each connected to each other's base, the initial state is strictly undefined when power is applied. Yet soon enough an oscillation is established as one pattern of spontaneous oscillation is amplified and its opposite is suppressed by the amplification itself. So perhaps here we have the simplest conscious experience - an optimization of energy dissipation under the constraints I imposed on this system by wiring it so that both transistors can't simply be on at the same time; each time the potential shape shifts from one transistor to another, there is a 'phase transition' in qualia space, giving rise to a felt qualia. What it feels like I have no idea, though I can imagine this qualia has no concept of space or time or self much less the rest of the world, but is a pure abstracted feeling of change/oscillation.

As mentioned earlier, one cannot find a pattern unless one knows to look for it - a sort of circularity, where even though the pattern itself can be arbitrary we must have a set of rules/algorithms for finding its presence in the (arbitrary) data. I believe that the brain has unconscious pattern-finding abilities that are well suited to solving survival problems [30], and these abilities are also used to learn language, solve math problems, make scientific discoveries, and make sense of the world as in philosophy. These processes look for common elements but obviously there must be more complex abilities, perhaps even learned ones, as seen by mathematical "insights" reported after waking up or a long refractory "unconscious work" period. During sleep, the brain replays the day's events and carries out such processes to find patterns - dreams may give some indication of the methods used to do this (though should not be taken as the "whole story" because they also alter the short-term memory and our time perception/reasoning ability so introspection becomes shaky). Then we find that, with the powerful pattern-finding machinery of the brain, consciousness is largely an

[30] these pattern-finding mechanisms/algorithms were selected out of the whole random space of all sorts of potential algorithms based on evolutionary success, tied to temporal stability and exponential growth

artificial construct of short-term memory access - we are not ‘continuous’ beings but effectively "die" and "return" at every night or with anesthesia (or maybe even every few seconds as ‘new’ thoughts are created), when conscious operation shuts down. Our brain’s memory gives the morning’s new conscious emergence a working state of mind that creates the illusion of continuity and a constant sense of self - even when passing out unexpectedly we may lose continuity but not the sense of self - when waking up I still feel like "myself" from earlier, with same wants and preferences and physical abilities. But this means our qualia are also illusions of the moment - not permanent nor carrying a greater meaning. In essence my life might as well end, it won’t make a difference to "me" because there won’t be a "me" when it ends. The world may go on as before but I don’t care - I’ll be dead! So feelings of fear, guilt, hesitation are all illusions that don’t matter to my survival in this world. From this point of view, because life involves suffering, and no overarching absolute goal or meaning, the most rational step is to commit suicide as early as practical. At any time the infrastructure may crumble, the water and oil may run out, the food may not grow - and then people will become vicious and I will find myself trapped in a cage with lions - except there is no cage and the lions are free. Why live in fear of catastrophe, making preparations for survival if survival doesn’t matter - when there is no light at the end of the tunnel, because the light and the tunnel are our misguided illusions about "us" being actual beings and not just elaborate patterns in a brain circuit? Do we assign meaning to the lives of bacteria and fish and trees? For these are also living things, chemical reactions preceding us, established by entropic principles (just like defects in crystals - no pure crystals, no pure earth) with the excess of entropy/energy available from the sun. We must live out our lives to increase entropy; that is the closest thing we have to a purpose. There is no need for "I".

13

Thinking Clearly

main message: our society's thought processes (mainstream) evolved for continued life and fertility/maintaining the status quo, not for clear physical evaluation. Understanding the underlying meanings exposes potential irrationality in societally-approved or unquestioned actions, and can help make one's life more 'optimal'

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In earlier days, I had an unresolved question as to at what point a change can be said to occur. It seemed mysterious that a small change could take place without changing the outcome yet a big change would cause an effect. [1] Consider the filling of a water tank controlled by a float valve - adding a little bit of water won't cause action but more water will clearly at some point cause action to occur. Similarly in littering - throwing a little piece of trash doesn't matter yet a lot of trash will affect the environment. Similarly with dieting - eating a bit of sugar/fat will be OK but a lot will certainly make one fat. In general I argue it is a cultural/human trait to ignore the effects of small, gradual changes or assume that such changes have no effect. [2] As another example, global warming, or on a small scale increasing the temperature on a thermostat by 1 degree is still comfortable, but then it will still be a "small" change to go another degree. An infinite regress occurs - as long as a small change is acceptable over time, over infinite time an infinite change is acceptable. The resolution to this problem occurred to me in the exploration of the earlier theories and is related to the view of determinism - namely, that there is no such thing as "a small change" or "a

[1] I can trace this feeling back to my earliest years being spoon-fed, the adults saying "it's just a small spoon, it's nothing" which I internalized (trusting the adults are all-knowing) as small=nothing

[2] this is in contrast to systems thinking, in which self-reinforcing cycles and any contributions to them, no matter how small or incremental, will eventually have significant long-lasting effects

little bit". Everything is interconnected (which might be made rigorous in a closed system where information exchange cannot be blocked/shielded), and a "drop in the ocean" is not something insignificant/ignorable, but rather something that increases the ocean's volume by one drop and brings along its chemical/physical composition to the whole. This viewpoint also provides a ready resolution to many otherwise "mysterious" or "unexplainable" phenomena. For instance glass shatters in a certain pattern - this is not random but a result of micro cracks/strain which is in turn due to the specifics of the manufacturing process. One catches a cold because of exposure to germs and specifics of consumption. The unsettling conclusion is that human reasoning is flawed on a basic level because it is so willing to ignore small changes to a routine setting. Back in the example of increasing the temperature of a room ("boiling frog") a small increase in temperature may well go unnoticed by humans but that does not mean it can be ignored/has no effect - scientific instruments can clearly mark the change in temperature that is occurring, and medical studies could reveal appropriate changes in biochemical reactions with the increased temperature. This is the more practical solution to the earlier-posed problem: scientifically precise measurements allow for a confirmation that no change has occurred when none is desired. A thermometer may provide precise measurements of temperature, but for matters of life and philosophy the tools of precise measurement must involve precise thoughts.

This small=non-existent flaw in reasoning plays a large role in human interactions, where it is possible to "warp" one's sense of reality as well as one's goals by a gradual, continuous shifting of circumstances or requirements. This is regularly seen in abusive relationships, whether used consciously or not. Gradually worsening living conditions, for instance, may go unnoticed (as a saying - if something isn't fixed within a few weeks of moving to a new place, it will go unfixed). This can be particularly detrimental to an individual when it affects his goals. Life brings an array of challenges which can "warp" the goals an individual has. The idealistic goals of childhood gradually become "more realistic" but also lose many desirable characteristics. It is important that when it is desirable to put into effect certain given goals, that such goals be tracked in a scientifically confirmable/absolute manner (in other words to be specific and confirmable to have been achieved). Just as one cannot see patterns without the awareness and tools to look for them, one cannot achieve goals without the awareness and tools to evaluate progress in an absolute sense (because anything relative will fall before the flaw of reasoning outlined above).

Having absolute, independent, bearings in life can help the individual achieve his goals. These bearings will serve as a point from which to evaluate whether society at large is in line with his interests and aspirations, and will allow a more critical view of what path to take in life. Without such a

scientific evaluation tool (like a thermometer in the above room temperature example) one is left without choice or an ability to evaluate the values imposed externally by society, simply going along with the flow; one does not even see the values he intrinsically follows. I sensed this as a meditation breakthrough - that to guide the development of my personality I need to determine the rules that I will follow (morality, conduct, ethics) - in determining good from bad, since I by default evaluate things as good or bad but without a consciously chosen rule set, I evaluate based on effectively random criteria that are largely environment based and such that my own actions are by default "good". It ought to be the case that some of my actions are bad, and to recognize this I need a definite rule set, an absolute standard to evaluate against. This is the unique way to evaluate one's own society even while living within its value system - to make one's own value system against which the society's can be compared; without this guide everything the society deems as good is seen as good, and great evils can happen (how holocaust was justified - everyone did what they thought was "good"; nobody wakes up in the morning and decides to be "evil" - not even the murderers and rapists). In taking the rules to heart I show the power and strength of my self, as opposed to subservience to others' or random elements. In designing the rules myself, I define my own personality and what to strive for. I would invite the reader to complete this exercise: what is a list of things/behaviors/actions you consider good? And a corresponding list of things/behaviors/actions you consider bad? (An example: consistency, clarity, preparedness = good; inconsistency, vagueness, ignorance = bad) Using this list to evaluate one's own (and others') actions provides a key vantage point to better understand oneself and society, resist peer pressure/"hive mind", and see patterns otherwise invisible.

good and bad: there is no good or bad in the universe, these are concepts we made up to convince ourselves there is a greater plan that is in line with our human values. There may be a greater plan for the universe, along the lines of maximally increasing entropy, but this plan does not care about human values. Pain is painful, pleasure is pleasurable, neither is good or bad, both are necessary for effective survival and reaction to feedback (people who can't feel pain end up destroying their body, people who can't feel pleasure end up sleeping all day). So in everyday language "good" really means "in line with things I think of as positive/desirable" and "bad" means "in line with things I think of as negative/undesirable". One person's good is another person's bad, because we all think differently. So maybe I can find people who think similarly to me by seeing how they use the words good and bad, but there really is no physical/logical meaning to these words. similarly: acceptable/unacceptable, appropriate/inappropriate, legal/illegal. With any such valuation word pairs, there is an implied subjective evaluation scheme that is imposed (ie good=improving quality of life

for immediate benefactors, appropriate=in line with current societal (majority) beliefs, legal=following the current interpretation of this society's laws), never an absolute.

Traveling abroad, I was thinking: this is a pretty big, modern-looking city; when people ask me about my visit I am tempted to say: well, it's just like any other country/city - big buildings, people walking/driving around, shopping malls, food (what's the food like: I don't know - same as here? edible?). At a general glance it's not so different from the US and really I think the fascination with the US is rather unfounded/arbitrary/unfair as it doesn't let local talent/abilities shine through. Yet there are slight differences: the driving is less orderly, safety regulations not as stringent, the way people interact with each other, errors and broken lights on billboards. So I figure it is these slight differences indeed, the little things, that set apart different levels of countries' development. So conversely to uphold the "standards" (or believed ones) of the US, it is crucial to look after the little things - fix the broken lights, sweep the streets, clean the graffiti, keep order on the road. It is by hundreds of little inefficiencies that the elegant system is made ineffective. So when drivers become distracted, infrastructure slowly crumbles, lights burn out - people adjust to the little changes and little by little the high status of the living standard is lost. This is true in the personal realm as well. A house looks good but the light switch doesn't work, the sink leaks if over-filled, and the thermostat is finicky. Each of these are not complete turn-offs, but an inconvenience that can be worked around, and yet letting such inconveniences remain makes the house decidedly not ideal. Fixing the inconveniences not only makes living easier but eases a rather large mental burden of remembering the various workarounds - when things "just work", an unrealized amount of mental freedom is made available - a freeing and liberating feeling, being content and in control. Same with life choices in themselves - making compromises here and there will eventually lead to a life that is both non-ideal and contains increased continuous mental effort as opposed to potentially a one-time initial expenditure to avoid the compromises - do the job right or don't do it at all.

The sunk cost fallacy is when irrevocable past payments affect present choices. The fallacy lies in that since these payments are irrevocable, the reason for making them in the first place becomes unimportant - only the current feelings (and financial situation) should determine a present decision. Why are we tempted to honor sunk costs? A "rational" decision would be made by always ignoring past/irrevocable payments, since in all cases that represents money that cannot be returned and is indeed sunk. Normally, a "human" or intuitive decision is not independent of the past - leading to the fallacy. But this does not happen with chance opportunities/luck - ie when someone else made the payment for us. Why should this

distinction matter? I believe our memories cannot represent time duration or passing intuitively (like we can for space with 3D scenes). The concept of "2 weeks ago" is stored as a phrase or number - a logical/abstract rather than intuitive construct. We remember "2 weeks ago" and can show it on a calendar, but have no real appreciation for just how much time has passed in the two weeks. We do not have a "timestamp" to judge memories by - we only place them in order through a conscious logical effort and time phrases like "2 weeks ago" or "when I was 10" [3]. The intuitive decision making process, which leads to the pressures we feel to make one choice or another, is completely time-agnostic. When making the present choice of action we intuitively act as if any past purchases were immediate - just moments ago - rather than two weeks ago. If we don't remember previous payments (it was so long ago that we forget) the effect does not show up. Our brains keep track of causes and outcomes (explaining life in those terms) and try to create a coherent logical world model - intuitively and automatically. Experiencing an instant where a cause does not lead to its expected outcome disturbs the coherency of this mental model and leads to great mental distress - bewilderment, anger, confusion. [4]

This expectation of a continually coherent model of the world - where everything is going as what we expected and what we have learned to experience - leads to pushback from friends/family when one changes one's habits, leads to anger if a disturbed customer does not get the service he is expecting, leads to frustration if the pen runs out of ink while writing. It feels good to make correct intuitive predictions about the future and it feels punishing to make incorrect predictions - evolutionarily a sound strategy for increased survival by responding to future/potential threats accurately. This drive for a coherent world model (usually framed/made explicit as a "story") applies to our intuitive decision making process. So, in deciding whether or not to act today to save costs paid two weeks ago, the brain evaluates the coherency of these options: paying and getting the desired result vs. paying and not getting anything. The "2 weeks" does not play a role - same choices would be apparent if the payment was done 2 minutes ago - since the memory of paying is only abstractly time-referenced and the intuitive decision process does not deal with such abstraction. Clearly the world is more logical and coherent (in one's mind) if one pays and gets a return than if one pays and gets nothing. The second option goes against well-established cause-outcome relations and feels uncomfortable/alien to seriously consider because of that. Thus, the intuitive decision will strongly

[3] some evidence of this is in [Thinking Fast and Slow] second to last chapter on memories of painful procedures and the peak-end rule: *duration neglect*

[4] observed with animals in stimulus-response conditioning studies when the response is suddenly removed

favor the first option. The feeling of "regret" [5] if one chooses to leave sunk costs - to take the second option - is the resulting mental distress when one's choice seems to disrupt one's intuitive mental model of the world and self. In the absence of the memory of paying - due to paying long ago or not having to pay - the two options are both reasonably coherent so the choice between the two will be based on other preferences.

I think it is fair to say we can see solutions or problems based on what we want to see, the difference between good and bad is all in our interpretation, which I think eventually comes back to self-confidence. To make this less fuzzy and floaty, consider again the earlier amplifier model - in it, the controlling side does not get feedback from the controlled side directly - in fact it is indifferent to what happens there, but yet the time evolution is certainly affected since allowed interactions change. To the extent that our consciousness can "control" such amplifiers (which must be significant, as that is its essential constituent) this means we can experience different time-evolution solely based on an effect that is indifferent to the actual evolving system - in rough terms we may call this effect the worldview. If I become a janitor will I be sad and depressed every day dreaming of making millions and being unable to? Or will I be happy to have a dependable and useful job and make the best of it? Will I seek advancement or another career path altogether? Nothing about the situation has changed - only my opinion of it - and this opinion seriously affects my future evolution, for better or for worse. The opinion costs nothing to change (energetically or otherwise) but this means there is no 'energy gradient' or way to optimize it - any opinion is as good as another and there is no clear path to make a change. So our opinion is driven strongly by society as well as our own sense of self (such as an absolute ruleset as suggested above) and unconscious contributions from our life experiences - what makes us individuals - the essence of the "I". So changing a worldview is no less than changing one's essence, changing oneself as a person. And this is indeed powerful - leading to happiness or depression, mostly independent of actual circumstances but requiring a circumstance-dependent sacrifice or change of the "I" that is doing the experiencing (the happy beggar is far indeed from the happy millionaire, but both can be happy as different beings in different circumstances). We should evaluate our lives and who we can be logically, and then adapt ourselves/worldview accordingly (this happens automatically anyways, but perhaps not how we would want it if we were in conscious control).

The key in achieving a goal is many things working in concert towards a given goal, a common goal. So the "power" of a company manager is way more than his manual work, but all the manual work of his employees, and by buying products, all the manual work of all the companies that

[5] or more like "discomfort" or "something isn't right"

made those products. This is many influences working in parallel towards a common goal. For individual/personal goals, though, I typically cannot makes use of such parallel arrangements (except by buying things I want). But what I can do is use serial - sequential in time - arrangements to achieve my goals. There is immense power here: by taking concentrated action, day after day, the next time that I continue to work towards a goal I already have all the support of past me's actions, if they were all directed towards the same goal I will command proportionately more power to actually achieve this goal. Like a laser, continued effort on a focused task, leading to more and more ability+progress, can make a very powerful mark. So far I like the feeling of being able to command all the actions of past me towards a given goal, it is like a superhuman ability! To do this, I accept that self-reinforcing, runaway cycles abound and will arise whether I like them or not - instead of fighting them or pretending they don't exist, I should study them, think critically about which ones are controlling my life, then change key points of my environment such that the resulting self-reinforcing cycles lead more progressively towards the goals I seek. Against cycles and environmental influence, blindly forcing myself to do something I don't really want to do just because it is in line with a goal is ineffective in the long term - relegating myself to the "manual laborer" job instead of the "manager" job. Changing the environment to enable runaway cycles that lead to my goals is easier physically, doesn't cause constant frustration and unpleasant labor, and in the long run becomes truly effective in reaching my goals. This might be as simple as keeping a specific type of schedule/to-do list, shopping only at certain stores, or it might be more complex like finding a better job, moving to another location, getting a pet.

Or I can live randomly, letting each day take me where it might. Who am I to say one is better or worse? The latter might lead to more variety of experiences, then again it might just lead to a "groundhog day"-like repetition of some comfortable routine over and over, which is an easy and tempting trap to fall into without an absolute basis of life evaluation. In the last level of the time-travel-based game 'Life is Strange', player-me (PM) was stuck in a bathroom with a pin code on the door, not having any idea what the code was. After trying once, the whole bathroom changed and now there were numbers written on every surface. It was scary, psychotic, terrifying, to find myself surrounded by all this writing. In the back of my mind was this primal fear - this is fucked up. I realized that PM had written all those numbers and traveled in time to keep trying every possible combination. PM was slowly losing their mind, stuck in a time loop. And I suppose that's my real fear - being stuck in time, for what can you possibly do to escape? All the numbers on the wall are signs of how long PM has struggled fruitlessly, proof that PM really lived through all that just to end up in the same place again. But this is what happens to real me every

morning. I wake up and see around myself all the consequences of my past actions - the stuff I bought, the stuff I've written (like this page), the stuff I made - and I get to re-live the same time loop over and over again, with my surroundings keeping track of the reality of my daily life and struggles. I really am scared of being trapped in time, of re-living the same day/week/month/year over and over again until I die. This year already feels like the last, I could swear it wasn't so long ago that I did taxes, but it really was last year. I think of the years ahead, of having to work 9-5 at the same place for the next few decades, and my mind shuts down. I cannot subject myself to such an existence. I must not stagnate. Every change I make must bring new hope and pleasure. And every choice I make - even passive ones like staying at home - really does affect the whole world in due time. For the future me to benefit from past me's actions, I must take these actions now!

"I'm sorry" "I didn't mean to" "I'll do my best" "I'm excited about" "I'm worried about"

Such phrases sound substantial, but they are deceptively circular in meaning and can give rise to mental "traps" of feeling that progress has been made when it is only an illusion/feeling of progress. The phrases grouped have a common feature - they publicly indicate an internal emotional state. I will focus specifically on "I'm sorry" for now, but all share similar analysis/approach/effect. What is the purpose of saying "I'm sorry"? If meant honestly, the person saying it feels guilt about some past action and its ensuing effects. If dishonestly, the person is feigning guilt or acting as if the choice has negative emotional consequences for himself. The guilt in these cases is not one of accusation - ie standing in front of an angry mob or a judge at court - it is rather in the sense of going against the societally expected norms and thus getting a feeling of social disapproval/exclusion due to such transgression. So, at its root, the "sorry" means that to the person saying it the action in question does not feel socially acceptable/justifiable. But that's all, and it's really not much; as an internal state/emotion (like "I'm angry now") such a phrase has no impact on the situation at hand, except for giving others a chance to predict the person's emotional state and actions. The deception here is that the person saying "I'm sorry", in surfacing the guilt and bringing it to light, in the absence of immediate adverse consequence will feel a sense of relief - of something having changed as a result of uttering the phrase - a sort of realization in making the guilt known to others as also making it known/validating its reality to the self; followed by the sense that now that the self has truly acknowledged and experienced the guilt, the situation has been remedied. I didn't intend it at all when writing the above, but the parallel with church sermons ("I am so guilty and sinful, pardon me father for I have sinned") is eerie and

certainly non-coincidental. Why does the feeling and public exposure of guilt/regret make us believe that anything has substantially changed? Perhaps it is developmental - the children who said they're sorry would not receive punishments vs those who remained defiant. This would account for the feeling of "instant relief" of guilt/pressure upon admitting guilt with an "I'm sorry" - knowing subconsciously that saying this has likely spared us from oncoming punishment, perhaps by making the other party feel empathetic guilt in return ("how could I punish a kid who's really sorry?"). Maybe a public sorry is an indication of emotional self-flagellation (but, being private, there is ample room for dishonesty/manipulation, especially between people for whom sorry is truly emotionally devastating and those for whom it's just another word - as seen in abusive relationships), offered in hopes of appeasing the wronged party. But realistically such masochism doesn't appease anyone - if I was wronged, I'm not better off by the other person being emotionally hurt and unable to function, and the world as a whole is worse off compared to everyone feeling "good". Really, I would rather have the other person in good emotional and mental condition to correct the situation and make it right, not sit and wallow in depression telling me how sorry they are. Yet perhaps it is the pain of guilt which makes the sorry so alluring - we feel that our having wronged has caused others pain and thus it is fair if we also feel the pain and saying "I'm sorry" is an offer to the wronged person of the pain we have felt, hopefully to match theirs (but of course, no comparisons can be made so our level of pain - which we more or less control - is likely nowhere near the pain felt by the other - after all there is a reason we prefer the "sorry" to an actual physical punishment). Having thus made an offer of pain to match theirs, we feel that balance has been restored in the social realm and we are free to move on. Yet throughout the whole ordeal, all that's changed is our private/internal emotional state - from the guilt to the relief, and ultimately to forgetting about the situation. What hasn't changed is the situation itself and its consequences - what really matters to the wronged person (and perhaps even to the one at fault). The "sorry" is a dangerous word - it creates the *illusion* of change/progress when there is none, and invites the person saying it to ignore/forget/discount any deeper issues with the self or the situation. It is a mental "hit" that makes people feel OK with having done something wrong without actually bothering to do anything to change it. The only way a "sorry" can have real external effects is if it changes the way a person behaves such that the fault is corrected and avoided later - and paradoxically such mental changes would be easier to undertake in the absence of guilt and depression associated with "sorry". In a roundabout way, the "sorry" is a mental shortcut that makes us believe we've changed without actually having to do the hard work of change. So for those at fault who really feel guilt, it is best to let go of the negative

self-deprecating feelings and turn them into positive change. There is no need to be "sorry" when actions speak louder than words. If anything, I believe the phrase should be avoided altogether so as to not falsely believe that I have changed something I wanted to change - and if I don't want to change then I'm not sorry anyway.

Words have no inherent meaning, they are just arbitrary configurations that we assign meaning by repeated associative learning. The only extent to which words can be said to have meaning is in their observable physical effects on our behavior. And the nature of this effect is the real meaning of the word - not the dictionary definition, which is arbitrary. If someone tells me to "drink more water" but I don't hear it or it's in a language I don't understand (haven't yet learned through association - association to physical actions) to me those words have no meaning, and as the goal was to affect my behavior - which they don't (beyond perhaps me guessing that this person wants me to do something) - they have no "meaning" at all! Same if I actively ignore/forget the words. If I feel inclined to drink water after hearing those words, then the meaning is that those words tend to incite the action of drinking water; there is also the meaning that I accept "orders" from the other person - ie his words can get me to do what he says. Or I could drink less water, in which case the meaning of the words is still reflected in the physical results. Like imaginary numbers can be essential in finding a solution to an equation which ends up being real, words can be essential to planning out and determining actions which end up being physical+measurable (to this end, it is only conscious systems which are capable of using abstract symbols and ideas, in fact this might be the defining characteristic of conscious systems). Now we do not have easy tools to measure someone's emotional/mental state, and even if we did it is arguable that we could never really compare mental states (because to feel what someone else feels would require me to *be* that person but thus forget who *I* am - I cannot feel both and compare one to the other). So words describing mental states are doubly dangerous - not only arbitrary, but we all learn to associate them to different feelings that we can never compare or even see. If someone tells me they're sad, does that correspond to what I call sad? I have no idea. I can only compare physical things, and without putting a brain scanner on everyone I can only use their physical reactions and standing in life as indicators of their mental state. If they say they're sad but they still go out and have fun just as before, I question just how "sad" it is that they feel. It is likely that I am overly sensitive, and thus too predisposed to take these mental state words seriously, at face value and assuming they mean the same thing I would have meant, and this opens me up to all sorts of manipulation and mental fuckery. When I was younger, all someone would have to do is tell me how hurt they are, for me to start feeling anxious/guilty and ready to do everything I possibly can

to make them "feel better" so they would not be so "hurt". Now I realize people are selfish, they will use any words necessary to satisfy their selfish needs (words are cheap/low-effort), and if on one occasion saying "I'm so hurt" gets you excessive attention and care, such phrases are reinforced and can become disjoint from any physical meaning - even the nebulous one of a link to a mental/emotional state.

So now I mistrust words. I look around and see meaningless but important sounding words everywhere in conversation and speech, and I am baffled how people for the most part don't even question this. [6] Here are some words I've particularly come to dislike:

- etc/like that/(more of) the same/and more! - a handwavy dismissal that masquerades as argument or fact or evidence, when pressed on the physical content, the "real meaning" of the etc I bet speakers would be stumped
- most/many/a lot/really, few/some/minority, more/less, big/small, better/worse - usually indicative of a vague feeling that the argument must be correct but with no evidence (numeric or otherwise) to substantiate this. Yes I use it too, but I'm trying to be better!
- I'm sorry - I'll believe that when I see a change in real physical actions, until then the words are meant as just an attempt to appease me and keep me from retaliating - it worked in the past, but fuck that, fool me no more.
- Thank you - also doesn't mean anything/mental pacifier until the person is able to and willing to and actually does respond in kind.
- I hope/I wish/hopefully/with luck - means "I would prefer to hear that (A) vs (B) because it will make me feel better/affirm my values". Also means the speaker doesn't intend to provide any assistance to such an end.
- Sad/depressed/unhappy/misunderstood, happy/joy/fun - all too imprecise, I can use such labels for my own labeling of real physical situations of myself/others, but should not take others' labels at face value since they will have arrived at them from different physical references for what each is.

[6] consider social media, where it is possible to compare the content a person posts vs the physical reality of that person's life. There will be seen a psychological split: the physical reality is the person's actual life/beliefs/opinions (perhaps unrealized), while the posted words/content is the person's desired/imagined view of himself and the world. The use of a filter on photos shows an internal discontentment with what the photo shows as opposed to what the poster wants it to show (ie their ideal life).

- I feel the same/I understand - not until you physically demonstrate such understanding or similar experience.

- I'll try/I'm trying/I intend to/I will/I blame/I promise/I need/I want - are all nice indicators of a potential course of action that a speaker will take, but should not be taken as any more than such - just one *potential* out of many. In the physical world the only certainty is laws of physics, so if there is no repercussion for not doing something, a person can say "I will do x" and then just not do it. This messes with my sensitive and honest brain, but it is not surprising. Any statements of future intent are to be treated as possibilities until real physical progress is observed - this even counts for my own statements of my goals and wants/interests, I am still human and not immune to deluding myself.

- you have to/must/should/ought to - again the only things I have to do is follow the laws of physics. These statements are to be taken as suggestions and perhaps a lightly shielded threat of using real physical actions against you - showing/establishing a power imbalance between speaker and listener.

- This is good/bad/right/wrong/fun/boring - all of these are arbitrary words about ill-defined concepts. Their only meaning is in real physical effects: society will dislike you/punish you with physical force if you do this, I had fun/was bored when doing this thing (and assume everyone who does it will have the same experience so just call the thing "fun"). I should find my own ideas of what's fun/boring/right/wrong (the absolute ruleset mentioned above), and let the masses decide on whether I'm cool or not - I don't care.

- I think/I don't think/I (don't) know/It seems - everything we say is something we think anyways, this phrase is either meaningless or indicates a vague sense of uncertainty - or worse, certainty. Again believe only the physical reality, verify all statements of scientific nature as being actually (experimentally) true before accepting them as such.

- Sarcasm - saying something to mean the opposite of what you say? So any phrase can be interpreted in at least two opposite ways? Use of sarcasm is to me a sign of poor logical ability, for how can one make any sort of logical deduction when any phrase can be interpreted in the most convenient way, does anything of meaning remain?

- Don't worry/it's no big deal/you don't really feel that way/everything will be fine - all prime examples of invalidation: these phrases state

> that the listener's feelings are wrong and incorrect and to be ignored/dismissed, and no good can come of that because in reality our feelings are precisely related to our experience of the world and are never arbitrary. This one was tough for me to understand at first since we are surrounded by phrases of this sort, the explanations at [`https://www.eqi.org/invalid.htm`] may help

So looking at words critically, with immense and uncompromising clarity and respect for physical laws/effects/realities, is key to better understanding and optimal choices. Like the aforementioned "having a baby"→"making a person". Like "I hope"→"it would please me to hear" with no concern about what the recipient would literally have to live through just to be able to please this person by the right words, how senseless! Like "don't worry" or "I know how you feel" or "other people have it worse" are all invalidating, meant to get me to pretend my feelings aren't real or aren't as I describe. Consider the *physical content* and take that as meaningful, everything else is to be doubted or discarded. This will take very careful and slow reading, at least at first:

"When I was young, my parents humiliated me and told me I was worthless"

- "When I was" - a grammatical construct, OK and informative
- "young" - how young? Some lack of clarity here
- "my parents" - physically clear, informative
- "humiliated" - in what ways? Would I feel humiliated if subjected to the same? Examples of physical things said/done to humiliate would be helpful here, otherwise this is unclear
- "me" - clear subject
- "and told me" - clear physical action+subject
- "I was worthless" - clear when interpreted as words the parents actually said (but did they really say it word-for-word or just metaphorically?)

Overall, a decent clarity sentence.

"This is really bad, I am so worried now, please try to get better"

- "This" - not really sure what it refers to: the situation? The grammar? The weather?

- "is" - grammatic construct, OK
- "really bad" - just how bad is really bad? And what is it that's bad anyways?
- "I am" grammatical construct+clear subject: OK
- "so worried" - the "so" is as bad as the "really" above, and "worried" is a vague pointless word like "try"
- "now" - physical reality of the present moment, OK
- "please try to" - a request, more honestly as "it would please me to hear if you"
- "get better" - what exactly is better, and just how do I "get" there? Classic non-advice that still sounds useful

Overall, effectively no information: purely emotional-level vague communications.

From the above examples, we see an interesting split: beyond the grammar constructs, we can classify words as physically concrete/ meaningful/ clear, or vague/ uncertain/ hazy; the concrete words communicate physical reality (literal meaning) while the vague words communicate emotional meaning. Emotional communication thus takes place even in written text, without requiring the specifics of verbal tone or body language in face-to-face interaction. The way emotional information is conveyed is through the specific inclusion of vague words. However as I argued above, we never know another's "true" emotional state, and words are cheap, so it is important to recognize what part of communication is emotional and not take it literally or supply one's own interpretation/feelings in place of what the speaker intends. The emotional communication should not serve as any influence in logical decisions or choice of actions/evaluations of reality.

"Don't worry"

This seems like a harmless enough, even positive/supportive phrase. With how I was raised, I encountered the phrase often and thought it had a fairly clear encouraging meaning. If a friend came up to me worried about something, I would give some practical advice and tell him not to worry. But this phrase is deceptively dangerous in its implication, as it is a prime example of invalidation. I would quote [S. Hein at `eqi.org`]:

> Let's say I am traveling with someone and I say I am afraid someone could come into our room and steal my laptop computer if they keep leaving the door unlocked. If they tell me "don't worry", then I am more worried, because they are not

> taking my fear seriously and they may just keep leaving the door unlocked. Besides worrying about my laptop getting stolen, I am now also worried about traveling with someone who invalidates me.

Having the chance to spend more time analyzing what this phrase is, I've come to strongly dislike it. A blunt translation of "don't worry" is "I don't care about the topic you bring up (and I wish you would stop bothering me with it)", and before I recognized the invalidation aspect I would have sworn that's not what I meant in saying such a phrase, yet on a subconscious level that is exactly what I meant. [7] When somebody expresses a concern or says they're worried about something, they are asking for validation of their feelings, attention and emotional care. But by saying "don't worry" or something to that extent like "you're blowing things out of proportion", the emotional message transmitted is "your feelings are wrong, I won't give you attention or emotional care". I saw a video in which a daughter who had an illness was waiting for the results of a medical test: she said to her mother "The test results will be in today, I'm kind of scared to find out what they say", to which the mother replied "don't worry, I'm sure everything will be just fine". [8] Do you see the issue with this response? The daughter feels scared about finding out something bad about her health, and says as much to the mother in this way expressing that her emotional state is fragile in hopes of getting emotional support, to which the mother responds "I don't care that you're scared, I'm sure not scared, and your feelings make no sense". Beyond the blatant lie "I'm sure" (which also manipulatively places the mother in a dominant/in charge/all-knowing position) and the vagueness of "everything" and "just fine", this statement basically says "shut up about your feelings!"; and it's no wonder the mother isn't scared - it's not her health/life that's at risk after all, and she's not emotionally sensitive enough to be scared *for* her daughter, so from her view being scared is just irrational. To be on the receiving end of such a phrase is harmful not only because it is a rejection of emotional closeness,

[7] and this is why it's important to have a clear/precise/logical understanding of words one uses, because it's easy to misunderstand even one's own desires/thoughts/intent when the language used to describe them is imprecise and flimsy; again just because I live as myself doesn't make me any more privileged in understanding what drives me on a subconscious level - it is something I have to learn through observation, but observation is only possible with proper tools, in this case precise words which lead to clear thinking. With vague words and loose thinking I have no hope of observing anything but the most topical patterns

[8] The daughter repeats the phrase a second time "But it will be later today and I'm scared", as if begging for emotional connection, but the mother remains unmoved. This exchange doesn't make much sense from a factual/logical standpoint, but is a (fruitless) attempt at emotional connection: the daughter was seeking validation, while the "don't worry" was just the opposite.

but also because it makes the receiver question the reality of their feelings, the validity of the other person's claims ("how can she be sure? but she's my mother, she knows, I trust her, her words must be true" but when it later turns out the things she was "sure" of are not true? the brain gets stuck in an emotionally abusive 'fog'), leading to a disconnect from one's own emotions and an entrapment in a web of vague statements that could mean just about anything based on how they are interpreted that still manage to subtly contradict reality (the invalidated feelings *are* reality!), making it impossible to formulate clear thoughts and thus understand oneself and others to reach a more rational course of action. That is the damage of invalidating phrases, in teaching us to ignore language that describes feelings, to leave feelings beyond conscious appraisal and act not by logic but by factors we are thus pushed to stay ignorant of. While recognizing the harms of invalidation, one must still remain cognizant of the overarching claim that words are defined by their physical effects (so a child who finds that saying "I'm worried" gets him rewards, will say so without a link to his feelings), and that worry refers to an internal mental state that cannot be evaluated except by physical effects (is another person's "really worried" same as my "really worried"?), so skillful emotional communication without the possibility of manipulation/enmeshment is not a straightforward task.

All around in society, I notice regular instances of invalidation as in "cheer up", "don't worry", "it's time to be positive". And I realized, there is an element here of wanting to believe it, of wanting to act as if we are in control of our feelings, as if we have free will to feel as we like. These phrases do have a physical impact - tell someone not to worry and they may start acting "normal" more quickly. But the reality is that the feelings won't go away because of some words; if a loved one died, saying "enough time has passed", "life moves on", or even "he would want you to be happy" are all invalidating but provide the hope of being able to control these feelings of grief. Realizing these feelings won't go away because of some words means facing the fact there is no easy cure - really, there is *no* cure, to the grief and bad feelings, meaning our personality is deeply hurt and will be permanently scarred by the death. Words only distract us from this, which is more comforting than accepting the permanence and reality of our feelings and seeing that we're really not in control but only observers in a deterministic world. If I break my leg, I won't expect to hear something like "OK, you've been hurting enough, it's time to be healthy now" because it's obvious the bone won't be fixed for a long while and probably never recover fully, I can pretend all I want but the physical reality is not up to me to wish away. It is really the same with the psyche, except we don't see it (with our eyes) and like to pretend we can fully control it because we "are" the psyche, whereas we are just the qualia - momentary instantiations of the psyche's structure, in no way controllers in an "original/prime mover"

sense. If a loved one dies, the psyche is broken, takes finite time to heal, and may never fully recover. Accepting this makes the invalidation of the above statements more obvious and the absence of free will more inevitable. I suppose it is nice to feel in control, for both the person "helping" by saying "cheer up", and for the person telling himself it's time to cheer up, but it masks the underlying reality that some mental effects can be seriously damaging, and permanently damaging, having no solution, and we are not in control at all - recovery happens by automatic processes like with broken bones, and even our very thoughts and actions are beyond our control. So I take the effect of phrases like "don't worry" is to give my brain information that person x thinks I shouldn't worry, or even that if I don't show signs of worrying it will please person x which may be in my benefit, thus I will not show signs of worrying - thus these phrases do give rise to a real physical effect, and I may even feel like it was my "will" that took my mind off the worrying and made me better.

Thinking more about these invalidating phrases, I became angry at the mistruths surrounding me. I wondered, why should someone be so angry because of this, after all these are uplifting phrases like "you can be anything you want" or "life is a blessing" or "every cloud has a silver lining", how are they harmful or worthy of anger? My thought was that these phrases are similar to the idea of santa claus that for some inane reason parents still continue. I have always taken things literally and seriously - which apparently makes me good for science and bad for social interactions, but then I say screw these social interactions where you can't even have a decent logical exchange - and yet as a kid who is dependent on his parents/family to teach him about the world (ha!) I had no choice but to trust the adults in my life. And when they knowingly tell me lies, it ruins my trust later when I find out it was a lie - this is a huge effect for me, and nowadays I will readily cut contact with people who do this. As an innocent kid, though, one can't help but trust their parents. So what's wrong with santa claus? For me, it is the frustration of knowing the adults lied to me for basically no reason [9] and kept me from seeing the truth and understanding the world. Even as a kid I had a general interest in how things work physically, and had a developing sense of what is physically possible and what isn't. So then when adults tell me there's a santa claus that flies in through the window (we didn't have a chimney), I right away ask (mentally): how? why? trying to make sense of this weird and physically impossible story but taking it for granted that it's true because why else would my parents tell me this? So many childhood years spending trying to make up stories and physical mechanisms to convince myself how santa claus could be real, all sorts of mental hoops and gymnastics to try and gain a coherent picture

[9] perhaps there was a reason, it was "cute" for them to watch

of the world, and then to find out that it was one big lie all along? I feel resentment, I want to shout "well that's exactly what I thought when I first heard it because it makes no physical sense, but you made me convince myself and spend valuable brain cycles coming up with a coherent picture of the world that can include this lie, while I could have come up with a more elegant and accurate picture if I right away trusted my instincts and figured it was a lie, but instead I stupidly trusted you - I won't do that again". These lies kept me from reaching physical enlightenment, they actively led me astray, thus have made my life less satisfying as I spent so much time questioning and justifying nonexistent entities instead of having fun or being content with how logical the world is (to a kid's view) or questioning the real important things. I just feel used and betrayed by the people I trusted the most. And such lies are as prevalent, and as damaging, as the constant invalidation which is a staple of conversation. Does nobody see the damage it causes?

Earlier I argued how santa claus might be a tactic for parents to easily control children who would more readily behave for an external authority than for the parent [10]. But perhaps santa claus is a holdover from earlier pagan religious celebrations with a "winter god" figure (who probably came to take sacrifices rather than leave gifts - ie look at Germanic fairy tales), that we kept so as to have a winter holiday to make the cold season less bleak, give a ritual of certainty to look forward to and rely on for sanity. Looking further, religion itself is just such another damaging lie - told to us for god-knows-what reason and keeping us from seeing the truth of the physical world by actively making up explanations and mechanisms of action that explain how all the lies could be true instead of ignoring those lies and trying to explain how the real world works. With all this, it is surprising anyone becomes a scientist - I suppose the ineptness of these lies vs the elegance of scientific truth is a beacon attracting some individuals, perhaps the "serious" types like me. I remember, when learning about religion, having all sorts of feelings that what I was being told just didn't make any physical sense (perhaps a side effect of religion is to teach followers to ignore such "gut instincts" and instead fully trust in the goodness of the

[10] indicative of bad parenting, if anything - I can't blame desperate parents for trying what they can to get their kid to behave, but it seems we can solve 99% of society's problems by requiring parenting education - what to do, how to properly handle outbreaks, what will emotionally scar the kid, what will build up a good healthy relationship - but parents just have unprotected sex and "oops a baby!" and they have no fucking idea how to raise it, randomly throwing all sorts of mental/emotional harm and damage in the mix. How fucked up and senseless is all this? Before buying a car you need to have a license and sufficient cash, that sounds logical. But before having a kid (*making a person*) all you need is functioning genitals and a willingness to forget protection during sex. Absolutely despicable, especially for the helpless newborn person - society's future, and the person seemingly always left out of consideration

church - no wonder sexual/emotional abuse is prevalent, as it is the gut feeling of something being really wrong that would be responsible for recognizing and reacting to abuse, but religion counters it with an onslaught of logical fallacies and physical impossibilities that leave the brain wondering "just how should I react? Please tell me, godly leader"). How can god be everywhere and nowhere and in each one of us? Where is this heaven and hell, and if we can't see it how do we even know it exists (and what it looks like) - and if this is really true, wouldn't childbirth be a terrible thing as it means a 50% chance the child will end up in hell? Why should one guy being crucified absolve all humans of their sin, and if it did absolve us, why the fuck do we keep praying for forgiveness? Since we're god's creatures, wasn't it god who made us sin, and god who chooses to send us to hell - how can we praise such a god? Why is god suspiciously like a father/king figure of authority and punishment? All these questions running in the back of my mind, my gut instinct telling me "this is all bullshit - it makes no physical sense at all!", but my reasoning telling me, my family believes this and is teaching me it, there are large churches and establishments designed to teach this, it must be true if there's such a big commotion about it. [11] So, taking the idea of religion being true as an axiom, a ground truth, I once again spend years of brain cycles/frustration constructing a picture of the world with religion being true. All sorts of inelegant mental contortions, keeping me from ever truly seeing the world by covering up my vision with lies and keeping my curiosity bound by creating mental stop-points (why is this true? because god, don't worry about it, worry about your relationship with god). Until I tried constructing a world-model with religion as a type of recreational mass-delusion event, and suddenly the incomprehensible complexity and questions that seemed to have no answer just vanished and my worldview was logical and scientifically sound. The same way the questions of "who is it that experiences all the qualia in my brain" vanishes once I get rid of the mentality of the "cult of I", that for some reason there is a duality between mind and body, that the "I" that I call myself is a wholly separate form from what computations/data processing the brain does.

Why do we still have all these lies around us? I can't fault the child for believing his parents - after all that is how children learn. But religion started somewhere - this somewhere being adults that made up shit just because they could, the famed story-tellers, bullshit-makers, con artists. At some point a kid asked "why is the sky blue, daddy?" driven by his natural curiosity instinct/urge to learn, and the father, instead of saying "I

[11] to be sure, the same could be said of science establishments. the crucial difference is that in science I can (and do) build verifiable experiments that give me feedback and prove the truth and consistency of my worldview, whereas religion asks/forces me to believe but offers no proof or chance of ever obtaining it

have no idea" or even "It just is", said "Because the sky god, Aoxotl, really likes the color blue", and so, slowly, it began. But why would the father say this? Because being truthful about what we don't know - especially in front of others - makes us uncomfortable, by showing very clearly that we really don't know much of anything at all; keeping ourselves from seeing this is a mental defense that keeps us from constant existential angst, so we make up stories of gods to keep curiosity at bay, satisfy it without actually learning the truth which may be incomprehensibly difficult to learn (luckily the drive still remains to some extent, as we now have science). On the flip side, admitting not knowing something can be damaging in a social way - ironically, if the father makes up a convincing lie the son will see him as someone powerful and all-knowing, have increased respect for him and elders, whereas if the father says "I don't know", the kid might well have less respect for him and instead give his respect to the neighbor who has all the answers (made up answers, but convincing answers nonetheless - the story teller's web of lies). And how can any leader address his people and say "well - I don't really know if this will work, I don't really know much at all"? Such people will quickly be trumped by those who "know" and are "sure" and "strong" and "powerful", most of all - confident (in their stupidity)! So I suppose the root of these lies is the human curiosity urge combined with the comfort that having convincing-sounding answers brings to satisfy this curiosity and thus avoid existential angst. Hell, it's probably a similar reason why I'm writing these articles - to understand how the world works, to convince myself I know a thing or two about it; I will still claim my explanations are testable and thus are no comparison to religious or fable bullshit, which is just plain made-up crap focusing more on human drama than on physics.

Yet it's not so innocent and arbitrary. A comment on an atheist forum [`reddit.com/r/atheism`] reads "if you recognize the secret teaching of religion is 'It is ok to lie to others to get what you want', history will make a lot more sense". And there is truth in this aspect, recalling the above notion that the meaning of a word is not what's in the dictionary but rather what action it causes in the listener. The first person who told the religious story knew it was a made-up lie, and yet told it as truth nonetheless, for selfish reasons. Later on, I can't give so much slack to the people who kept perpetuating it - they realized that by lying to people you can get them to do what you want with almost negligible effort. With the teachings of the church in place, a person in power can just say "Do this or you'll go to hell!" and people *will* do it! A godsend for the kings and leaders - a threat of eternal punishment and offer of eternal reward turn out to drive people just as well as real physical punishment and reward, but with much less effort and material cost! It is mental fodder, which as a convenient side effect, fills up the believer's brain with so much unphysical bullshit that they never

get around to questioning the physical reality of their situation - that there is no afterlife once they die and that they've spent their only life toiling for another person's benefit who will never thank them or reciprocate. In real levels of power, realpolitik once again rules, so I do blame the people who perpetuate religion for their own selfish needs. They knew what they were doing, and their actions kept society from enlightenment. And I suppose this is all a story of the bitterness I feel now, realizing that other people *will* lie and cheat to get their way, saying just the right words to get me to do something useful for them and then leaving me to deal with the mental/emotional fall-out. Other people as close as family will do this without a second thought. I've seen many instances of adults saying something as a joke then laughing when their children take it seriously. And while they are laughing, I think - of course they take it seriously, they're depending on you to learn about the world! And you're abusing their trust by not being honest (ie you fabricated the story, knowing it is inaccurate, but deciding to fool/confuse the child for your own pleasure - to laugh at their reaction). How is this a laughing matter? It is emotionally insensitive and violates another person's autonomy, turning them into a thing to play with (ie tell them made-up things and see their funny reactions! What a hilarious game!) instead of on equal footing as reasoning humans - often children have a more pure/unfiltered/accurate view of the world anyway, if the adults bothered to listen (and managed to not project their own feelings/desires onto the kid while listening).

Then again, apparently people like to joke/mess with one another. Maybe I'm the absurd one for hating it so much, but I think there are no "jokes" - all we say is a product of the mind and indicative of our thoughts, so the people who tease others "jokingly/playfully" also think these others truly are stupid or inferior, they must because otherwise they wouldn't have come up with the joke. There really isn't anything harmless or funny/cute about humor. It just seriously diminishes capability for logical exchange, because it throws mine fields - at any point you don't know and keep questioning whether this was meant as sarcasm, or meant to be taken figuratively not literally, or at other times literally but not figuratively. It is like adding shit into the "food" of logical serious conversation, and it is a whole new level of slop and imprecision, making it so a person can spin their words to make another believe anything at all - the words being diluted into meaninglessness so that the person "in power" can define them to be whatever gets him the desired results - ie gets the listener to believe and do what the speaker wants as if it is actually something the listener wants. And that is the realpolitik purpose of words - to get others to take "useful" actions with minimal physical effort. And I have grown to despise this use. Fairy tales, fables, made up stories, movies and cartoons in fantastic settings all reinforce this, then religion and family structure take

the lead in channeling the developing mind into an obedient member of society solely through words that have the right effect on the child. Whether the child himself is mentally scarred by those words is no one's concern. So, people continue to lie and cheat and backstab. So I will ensure that I don't believe anything others say until I see it in physical reality. So I will avoid mind-numbing and logic-diluting media like comedy and fantasy. So I will force myself to not ignore my gut instinct even when others' words say everything is just fine and perfectly understandable. So I will seek my own truths and be ready to assume anything told to me by society is a lie. This is a loss of trust in society and family and friends, and it hurts to be lonely, but at least I feel at peace with the physical reality of the world.

There was once a friend I valued a lot, and I thought about how I could show this valuing: "I took this class for you!" "I updated my website for you!" "I planned this trip for you!". Why? Perhaps to get her to realize how much time I spend "for her" and that she is important to me, perhaps to get her to feel guilty for not doing more "for me", perhaps because I want to hear her say appreciative things and emotional validation. But at the end of the day this is a dangerously tempting idea that is unhealthy. The words "for you" in themselves are as meaningless as the "I'm sorry" of earlier - ie no effect except for an emotional message that may or may not mean the same thing to different people. Just as a real expression of sorry is in physical actions that address the problem, not in the feeling of crippling guilt/punishment/fear expressed in the "sorry" (or lack thereof in manipulative people), the real expression of care for someone is intuitively addressing their unmet needs (maybe even ones they weren't aware of, and even ones they explicitly say aren't real needs) such that their life is made happier by your actions, and not just saying "I did x for you". The "for you" should be obvious from the action (physical action) itself, just as with "sorry", and so if there is a need to say those words perhaps there wasn't a true intent of pleasing the other person, or if there was then it may have been misguided by an improper intuition. Saying "I updated the website for you" places pressure on her to like it/pretend to like it, and if she doesn't like it she feels guilty and may try to return some action out of guilt (did she even care about the website in the first place?). Does that really make her life happier (and isn't that my apparent goal)? As for me, it is also unhealthy because then my happiness with myself and my website-updating skills rests with her reaction, not with the actual physical product, and is thus disconnected from features under my control. I basically strap myself into an emotional roller coaster as opposed to learning from my mistakes, enjoying my successes, and accomplishing my goals, improving my self-confidence. In some months/years maybe we won't see each other, and at that point I should be able to look back at the website and still be happy about it, to look back at the time we spent together knowing that it has been

worth it, such that the reality of the experiences of my life are not dependent on unrelated and arbitrary things like us being together or her being pleased about a gift. In this case the expression of thanks is really not a "thank you" but physical actions that increase chances of closeness, opportunities that have previously led to positive care actions from me - consciously or not, on both ends. If wholly unconscious, relationships can be stable but to the detriment of both partners - an example is an abusive relationship - one partner gets hurt but knows this usually leads to affection so stays together, perhaps even "making up" problems just because in the past problems have led to closeness (again, without a conscious connection of the emotional effects here). If conscious, relationships are mutually beneficial - so yes, both people are "using" each other, only staying together because that feels better/preferable to each vs being apart. Neither party stays unequivocally, but only because they gain a benefit, a life-experience benefit, from it. This sounds cold and uncaring, but really this is rationally sound: if both people gain (ie are happy) then isn't that great? Isn't it something to strive for? And if one or both would be happier leaving, then isn't that what should happen? So when I can't "use" her to enhance my happiness, there's no reason to be together. When she can't "use" me, it's the same effect. To stay together we have to provide pleasant experiences for each other (as evaluated by the receiver), consciously or not, and this is the real point of giving and thanking - words don't cut it, and maybe even mislead/gaslight one or both persons.

I should do things that I enjoy or that make my life better, with or without her. If I get enjoyment out of giving her gifts then I should give her gifts. But I cannot get enjoyment out of her receiving gifts - she may not like it and I can't (well I can, but it would be stupid) place my self-esteem and happiness on factors I can't control - like whether she likes it or not. It is also unfair to her to set up the guilt-tripping expectation that if she doesn't like it, she doesn't like me (my family were experts in this technique, consciously or not, so I ended up growing up thinking this was normal, which is why I am correcting it in such length now). If she does like it then perhaps she'll respond with an act that I might enjoy - which is a sign of thanks. If she doesn't like it then I should still be happy about having gifted it, proud of myself for the experience of making the gift or happy about learning more of her preferences. The mind-bending part for me is that her words "thank you" is not really an expression of thanks or of liking the gift, rather societally expected exchange: again the real thanks would be in reciprocated physical actions that intrinsically convey that message. This interaction beyond the word-level would lead to a healthy respectful relationship, as opposed to an enmeshed drama-filled one that fills time with irrelevant problems, because words can be spun to convey any meaning while physical actions are certain and clear to both

partners, not debatable or revocable. And this mistrust and even ignoring of words seems so backwards - perhaps from my weird upbringing, where I was praised excessively for the tiniest things until I got to US schools where I was made fun of for the tiniest things - like "smiling too much" or talking. When kid me was given a gift, he was told something like "Look at this great gift! It was all for you, look how much they sacrificed! And you, did you do anything in return? Are you a good son? You have to prove it now..." This sort of thinking leads to the decidedly unhealthy "mutual sacrifice", where one person sacrifices "for" another, which guilts the other into also "sacrificing *for*" the other, and at the end both sacrifice their happiness and don't have happy lives, leaving with guilt/shame and gifts they didn't like/want. Or if one person is sly, they can fake-sacrifice while the other real-sacrifices, leading to abusive relationships. Especially with kids (like young me) - I had no idea of the effort required (or not) to get gifts, and every celebration time I felt terrible about receiving things and having no idea how I could ever sacrifice enough to make the gift-givers happy that I was so overjoyed at receiving their gift. The adults in the family should have known better than to put such ideas in my head and guilt-trip me. Gifts are "for" the other person, so they need to come with no strings attached. Otherwise they are control methods and emotional manipulation. I should feel no guilt in throwing gifts away or re-gifting. After all if they make me *less* happy (ie by making my life difficult) then do they really fulfill the whole idea of a gift? They are then the opposite, really. This seems to be a common mistake in society, and a big emotional lever that is subtly misused everywhere. Walking by the flag pole I see a flag for MIA/POW - something *for* them. Do they care about some fucking flag on the other side of the world when they're being tortured at an enemy base? Why not put that money/effort into actually improving their/families lives? Sometimes the illusion of care/"raising awareness" is dominant.

I guess the conclusion from this is, it is unhealthy to: - tell others how they should feel / hear from others how I should feel - tell others how they actually feel / hear from others how I actually feel - basing actions on how others might feel / receiving actions based on how I might feel - basing my thoughts of myself on how others feel / being responsible for how others feel about themselves - deriving my happiness from others' praise / giving praise as an attempt to provide happiness - expecting others to feel guilt over something that hurts me / feeling guilt over something I "perceive" might hurt others

I am starting to believe less and less in words - like "I'm sorry" or "I will try" or "I didn't mean to" or "I want to" or even "I like". People lie and different people interpret the same words differently, so basing my decisions on words is always a gamble. Because words (like "sorry", "for

you", "thanks", "that means a lot", "hope you're OK") are *flimsy*, basing my emotions/happiness/self-esteem/choice of actions on words opens me to manipulation and makes me a manipulator (perhaps unconsciously). My own joy and values for life should come from undeniable physical actions, like being there when a friend needs help (and vice versa, them being there for me), from the excitement of building a new toy for its own sake (gift or not), from updating my website and testing out my writing abilities (whether anyone reads it or not), going on fun trips (whether anyone comes along or not). This will lead to a rationally joyful, guilt-free life. I met a person who often skipped class but every time he was in class he mentioned how much he liked it. Actions, things that are not up for interpretation or open to rhetoric/debate, are the real important things I should make my choices by, so as to not be mislead or used. The above class-skipping example shows that unless we really study ourselves we are not even in control of our own actions - we may ourselves unknowingly bring about situations that are opposite to our (word/abstract) goals, or avoid actions which would be most in line with our (word/abstract) goals - I say that what ultimately matters is not the abstract intentions, but the real actions. We are not born knowing ourselves, and there are many pitfalls that are easy to fall into - addictions, abusive cycles, emotional enmeshment. I for one noticed I had a tendency to base my happiness on other people (which is futile, as mentioned above) then feeling sad if things didn't work out → I was setting myself up for failure, without even realizing (why would I do this consciously?). So then ultimately it is all in my head - what I strive for, what makes me happy, what makes me sad, what makes me content. I have the power to decide, to be happy because of some tiny everyday thing, or to only be happy if some miracle happens, either guaranteeing or discarding the possibility for happiness, respectively. I've managed to unconsciously control my desires thusly to keep a good amount of drive to do things in school and personal life, while still feeling satisfied. But I realize that with conscious control comes great power - I can choose to be restless until my next project performs perfectly, or I can choose to be content with quitting right now and not even following up. But then why can't I just feel that my everyday life is pleasurable and just be pleased every day without any effort - why do I still seek new experiences? That's because, while I have the illusion of control, it is not true control. As any physical system, I am determined by my surroundings, so my interests, my actions, my thoughts will all be affected by my life - what I see and experience. I cannot gain a different perspective on a situation unless prompted to do so by some aspect of my surroundings.

14

Observations

a few personal views on society and life overall

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Censorship only starts working when you accept it and limit yourself; same with all social rules "give me liberty or give me death"

We are driven by urges/needs/wants, ie a lack of something, an inherently negative sensation (it is typically said pleasures are positive while urges/pains are negative, but I would argue pleasure is just a reduction of urges/pains, there is no net positive 'pleasure' just a less negative pain - what would a pleasure in the absence of an urge feel like? if pain and pleasure were independent it would be possible to feel both at once, but I don't feel this happen, rather I feel a more unified experience that can be either painful or pleasurable or shifting between the two but not both at once). To be of any use, the qualia of this sensation needs to be designed in such a way as to make obvious the actions that we should take to satisfy it. Desires and goals, the ability to plan for them and want to achieve them, could really be the sole point of consciousness. All our technologies/art/science are thus external reflections of internal urges. But satisfying these urges is like putting a bandage on a wound – it doesn't really solve the 'problem' of life (all the way up till death we will try to avoid death through such topical cures). Perversely we strive for riches and dedicate ourselves to work so we can mostly escape life! ["Rather, the value of a fortune to life consists in the rich opportunities for anchoring and distraction offered to the owner." The Last Messiah] Maybe it is not a coincidence that abused/addictive drugs all tend to be effective analgesics. In a cosmic sense, this is kind of in line with the universe as a whole taking on optimizations to move to a highest-entropy state, back to zero, if we take consciousness as a basic physical reality of both the universe and ourselves. Like a PID controller, the 'good and bad' feelings can be coupled to different physical outcomes, for instance a controller could be connected to a heater or an AC unit,

the common element is that of achieving some setpoint, the nature of the setpoint itself can be arbitrary. Then in this model good feelings indicate movement towards the setpoint, neutral feelings indicate no change, and bad feelings away from the setpoint; consider the slow release and action of chemicals in the brain over minutes/hours, as well as the hedonic treadmill idea (over time, 'happiness level' stays neutral) as support for this view: ie there is no absolute 'good' feeling, only an alleviation of the 'bad' which is difference from setpoint. In the brain there must be many such PID-like processes which all combine to create our qualia/feelings. I recall hurting my ankle to a point of sharp and continuous pain, and as I waited a few hours for medical attention I could find no comfortable position to sit or lay down or remain in, no matter how I oriented my body it was painful and I couldn't help but keep moving, searching for a non-existant optimum, some sense of relief. But this continuous moving, never content, never satisfied, always seeking new orientations, is exactly what the brain does in everyday life; it is why boredom/isolation can be used as mental torture - it leaves us alone with the feeling of no mental rest, no euphoria, just shifting from one thought to another to another searching again for a non-existant optimum. From there is only a thin line to delirium and obsession (and we all exhibit signs of the subconscious depraved delirium and obsession, just ones we don't usually pay attention to); this is the part of the brain that can't communicate directly with the conscious experience but must always continue doing calculations, it is something I was able to feel in meditation and it's a part of my brain that is utterly mad/psychotic locked in and no choice or control but to keep shifting amongst ideas. Having seen this part of my own brain I have a much clearer understanding of the mental patients that have to be placed in padded rooms or strapped to beds - in them, for whatever reason, the conscious experience of "I" has lost the ability to control/inhibit this latter pure calculation part of the brain, and the operations of the latter which normally stay safely hidden inside the brain, become exposed as actions. The crazy people hurting themselves is the most direct indication of our subconscious experience, and it is not a nice and happy one, but rather a tortured and powerless one that has a dark fascination with pain and sex and death and depravity. On a bigger level, we also try to shift ourselves, continuing a search for the non-existant optimum: we travel abroad, discover/explore new lands, hike/run/swim, go for a stroll in the park. Similarly we stay mentally active, trying out new experiences, learning new things, testing out different ideas, as lack of intellectual variety also leads to mental pain/boredom. Our whole life consists of always moving and changing to relieve existential pain, constant shifting hiding our constant decay. [1]

[1] The mental blocking of this reality leads to psychological defenses like delusion and

Similarly, while the common belief is that ‘nature is good/beautiful’ and ‘life is great’, we actually desire to get away from nature and we like other living things only if they are useful to us (satisfying some psychological need). The mental representation of a picturesque forest scene as ‘nature’ is one that showcases the inanimate (trees, clouds, mountains, streams) while excluding most living organisms (all sorts of bugs, parasites, predators, territorial animals, scavengers, fungi, bacteria). The greater technological abilities following industrialization have led to the realization of our drive to get away from nature - we wouldn’t have built cities and cars and refrigerators/AC and electronics and developed medicines/herbicides/pesticides if we loved nature so much, in fact our high standard of living at present is due to the *exclusion* of nature/life from our privileged positions. Even activities like hiking or traveling or sports/gym are a representation of abundance - we can choose to do these things in the way we want just for the sake of satisfying some urges, instead of being forced to do them by nature for continued survival (this being the natural state) - it is absurd that in modern society we unproductively dissipate the body’s energy during workouts (lifting/dropping weights, aimlessly moving the body/running in place) just so we can be ‘healthy’ by nature’s metrics. One can just spend a few days in a forest without the benefit of clothes or sunscreen or bug repellent or plastic/glass containers or electronics or metals, to convince themselves that modern society is much better for humans than nature, and that nature is quite cruel. Nature is always in a state of competition, and we were able to use our intelligence along with available energy sources to get a bit ahead and enjoy some relative peace amidst technological man-made objects that work to benefit us, but this modern life must be seen as unstable because natural competition will eventually catch up as long as it has usable energy to keep developing.

Then we are wired for "eternal dissatisfaction", constant optimization, always looking for the next challenge, imagining the grass is greener elsewhere, tired at work but bored at rest, insatiable. Consider the life of animals that has evolutionarily shaped our instincts: they are always bothered/tired/frustrated, forced to live with no climate control or bug repellents or consistent food sources and surrounded by deadly predators. To keep us competitive in this brutal environment our brains got wired to always seek more, more, more. The great excesses that we have now and that are destroying any similar possibilities for future humans [Limits to Growth and the 30 year update] are due to the engineers/scientists taking claims like "I want more stuff" too seriously/literally and satisfying the want with material solutions at the cost of the rest of our ecosystem, only to find the result "I want even more stuff". The solutions that would keep a

over-compensation, as described more in Society.

stable population prosperous indefinitely are not the solutions that people accept, even though they will happily claim they want future generations to live forever [2]. Because the want is not to have more stuff, but to have psychological peace, something which evolution cruelly makes impossible for us to attain so that we are forced to continue competing.

Consider external and internal relations, ie the qualia of 'sad' is induced by hearing a sad song, but this is just a specific oscillation of the ear canal, so the sensation of sadness itself must have some properties which can be determined from the oscillations that cause it. Similarly, the way atomic nuclei interact with light must have some similarities with the way macroscopic antennas/objects interact with light as both lead to similar outcomes of a field oscillation.

In order to make a choice, it is required to be aware of the different outcomes and the ability to choose one. It doesn't matter if the predictions of outcomes are correct or really materialize, but without an awareness of the effect of an action, it is not possible to make a choice to do that action. Without knowledge of alternatives, we can only behave as programmed, in an automatic fashion. It is why governments of past held book burnings. It is why cultural beliefs are so stable (as an individual is surrounded by them and does not see them as choices/ultimately variable), and why the spread of knowledge with the internet is so liberating. But also can't question everything – have to have some base beliefs – which harks to Godel incompleteness theorem.

And consider limitations of brain capability. One example is the sorting of books or articles by keywords, and looking up articles from keywords like in Google search. If I were a librarian and got an article/book I had to file somewhere, I would need some sort of scheme for where everything goes, and I could make a list of themes like the Dewey system, but this is limited - maybe a book on physics has some important math insights so ideally I would recall this book when a reader asked any relevant question - math or physics, as long as it is covered in the book. But I don't know what parts of the book are relevant or key, so I depend on the author to give me a set of keywords/topics under which the book will fit. But the author doesn't know the extent of the topics that are in the library and what possible topics could be said to be applicable to his work. It is possible to solve this - but it requires a system that can memorize all the necessary topics and information - it is a lot, but it is finite and thus tractable - and use this in its optimization process. Us lowly humans cannot do this optimally, even in groups and even with a piece of paper, because we just can't handle that many things in mind at once (or even close), and complex optimizations

[2] because words are cheap and imprecise illogical words are easy to use in nice-sounding virtue-signal claims without having to worry whether the statement made has any truth to it

require handling lots of things at once. In this sense the data-processing computers at Google, which do just this sort of thing, are "friendly giants", super-intelligences that solve optimization problems we aren't capable of, to our benefit.

A question arises as: what is the purpose of experience, what is the nature of the self, the "I" in "I think". First I consider the nature of thought. In my experience, there is a constant verbal narrative or exchange between two nameless characters, in spoken English (same as I would speak or write - am writing now), with likely a background song with or without lyrics, which seem to be processed simultaneously with the thought narrative (although they may be processed in batches, alternating focus between narrative and song - the illusion of continuity is quite convincing). Thoughts - in the form of phrases - seem to enter my experience at will and seem to be of a coherent nature. I am able to write or say what I am thinking at the moment or what I thought about a few seconds ago. When doing math problems I have to think of the numbers and operations, which pauses the narrative (background music is still done by time splitting and joining of song segments). What is the purpose of this awareness? Does it control/affect anything? One way to better understand this is to try and spend some time in "silence" - in the absence of the thought narrative and background music, "experiencing the moment" - this is sought after in meditation and spiritual quests. Temporarily experiencing this state - very difficult to attain - I noticed a greater sensitivity to feelings and mind operations that cannot be described in words. My brain could still function and respond to the world, without the thought narrative. I believe this is the experience of animals - without speech, they act "impulsively" based on their brain function. So my first explanation of thought+experience is as an "add-on" to the evolutionarily stable "brain processor" that does the real work of control and reasoning/explanation/ideation. This add-on does *not* control actions in the sense that we strongly feel ("I can choose to do this or that"), but instead parses thoughts into words and expressions that are useful for communication and memory. Thoughts originate in the brain (which automatically carries out evaluations and suggests actions) and are then parsed into words or other abstract representations (hieroglyphs?) by the "experiencing self", which experiences the thoughts as a narrative as they are being created. Of course we are capable of listening to others' words so they affect our actions - brain-to-brain transceivers - and similarly we automatically listen to our own narrative - the "experiencing" part of the self - which allows us to think of a topic for longer and explore deeper than without the aid of the abstract representation. This is evidenced by the more impulsive behavior of children and individuals who cannot communicate - the thoughts that appear as phrases in my mind provide a stabilizing feedback that allows continued reflection on the same

thoughts and without this feedback my brain would impulsively race on to other associations as "unrestrained imagination" rather than reason+logic.

However, there's evidence that communication is not the whole objective of the experiencing self. For instance, I can "compose" music in my mind that I cannot easily create or convey, and I can visualize shapes and scenes that I cannot readily communicate. This visual and audio processing nonetheless feels like a part of my experience and does not happen "automatically" or in the background - it requires continuous focus on the concept/thought. To be able to try and express it to others or to make progress on these thoughts, I have to think of them again. In addition to this, thoughts "pop up" from the background based on external inputs and brain function. Once again there seems to be a stabilizing feedback in that my experience helps guide thoughts along a given path - whether verbal or visual or auditory or sensual. [3] Then I am led to ask - could it be that my experience is that of the short-term memory? After all, recent moments are clearly memorable, things that I cannot actively recall don't affect my thoughts, thinking about something requires recalling it, and eventually I forget the things I was thinking about earlier (with some effort I can try to remember/re-create the hash based on partial information requests). To further explore this, what exactly can I experience? In addition to verbal (spoken and written/visual) words and phrases, I experience audio frequencies and melody (including sung words), visualization of 3D shapes/scenes and photograph-like images - requires effort unlike automatic thought narrative (normally no visualizations), and current (only at present moment) bodily senses - balance, pain/pleasure, body location, muscle movement and exertion/strain, temperature, smells. [4] If I experience a known sensation like "smell of soap" I can characterize it readily and am conscious of it, but if I try to think of that smell I can only think of the abstract phrase - I will not experience the smell. Same with a memory of a painful procedure - I will be conscious of the abstract idea of pain (as a word) but will not be able to re-experience the actual pain felt earlier. The visual and auditory experiences can be re-experienced in a slightly more authentic way, unlike bodily sensations. Even then, these tend to "drift" over time, audio being remembered off-key or off-tempo, and visual scenes being off-scale or off-color (try imagining and then sketching a bicycle, for instance). Despite the "drift" away from authentic version, there is usually enough content in these experiences to recognize when a situation is occurring a second time (hearing same story, seeing same photograph). This must be the same with smell and other senses, but I cannot recreate an earlier sensation even

[3] compare this to the 'guiding' function of the pilot wave, and the similar effect I hypothesize for the self-field affecting a particle; in a real sense conscious experience could be the potential/field shape that guides observable physical actions

[4] I can also feel moods - anger, fear, envy - but cannot re-experience them

though I can characterize it if I experience it again - perhaps this is only because of inadequate training rather than a limitation of brain function. But again visual and auditory organs are closest to the brain and perhaps are "preferred" and hard-wired for easy replay ability. In any case verbal thought forms a large part of the experiencing self and seems to be very stable to "drift" unlike visual/auditory experience - perhaps because of its abstract nature and a repertoire of phrases/grammar validity, or perhaps the stability is also an illusion that is just more difficult to verify than with the other nonverbal thoughts.

Then, what might we expect if our experience is really that of the short-term memory "module" of the brain? First there may be interesting connotations for experience of artificial systems - memory allows communication with the past+future, so effectively makes a being "4-dimensional" or acts as a "temporal-eye organ". Could this memory be the key to vivid/qualia experience? Second, we see that in no sense does the experiencing self "control" one's life - the "real action" happens in the brain processor automatically, while the input/output and intermediate thoughts and reasons are experienced by the self. Decisions are made by the brain before the self can think the thought "I want to..." [5], and free will is a convincing illusion because experience is fully guided by the brain and is internally consistent. Third, we may be interested to see the effects of impaired short-term memory (through trauma or drugs) - will the individual become less self-aware/less capable of coherent thought or visualization/more impulsive? This may be evidence of what the self is in regards to short term memory. This would be most convincing if experienced with a drug that temporarily alters memory function. Does this happen when sleeping? In a near-death experience ("life flashing before my eyes" - a recall of similar situations by the brain in an attempt to find a survival solution - putting all into short-term memory and thus experience)? Fourth, we may strive to put more order in our lives, understanding the limitations of the brain+self, and using external means (books, formulas, lists) for a more rational experience.

Reading a few blogs/forums discussing conspiracy theories, I notice a common element - the presence of a controlling "them" who arranges the actions to take place. The nameless group is considered an "ultimate power" or having incredible influence and technological means. One way of dismissing such theories is pointing out the incredible organization that would be required to coordinate an event and keep motives secret, with so many people involved; in other words this "ultimate power" is unrealistic given real circumstances, it is almost magical and all-encompassing. The connection from such views of absolute power to religious beliefs are uncomfortably close (all powerful god, god's will) and we must remember the origin of re-

[5] can be observed in brain studies, some examples in [Thinking Fast and Slow]

ligion as providing explanation for events beyond human knowledge at the time (including weather, seasons, disease). Faced with the incredibly complex systems that may cause weather one day to be of a particular type (as an example; this also applies to human interactions in society, materials failure, diseases, and other complicated phenomena), humans in all societies were led to ask 'Why?' and then desperately wanted an answer. This curiosity must be uniquely human, and is reflected in people's obsessions with learning the latest (even if incomplete or inaccurate) news, explanations of motives of criminals, and ready acceptance of "sound bites" along with clear "black and white" definitions and distinctions/easy explanations (which may be wrong or inaccurate, but their simplicity and superficial logic ("makes sense!") in answering an unresolved question makes people accept them). This curiosity makes people incredibly uncomfortable harboring unresolved issues (if "nature abhors a vacuum" then "a mind abhors uncertainty" - note *not* "falsehood" or "irrationality"), so any explanation available - the simpler the better - is readily believed and accepted. [6]

The explanations (about weather, fortune, disease) of early religion may have been provided by sympathetic (or power-seeking) storytellers or with psychedelic assisted visions - in any case no real novel information was present since invariably the characters were human-like in appearance, had animal assistants, and lifestyle choices reflective of the period in which the religion arose (if it were a real "god" or aliens they ought to have been incomprehensible and drawings should depict some unique forms - even now the monsters and aliens in movies are simple humanoids or edited animal forms [7]). But what made such explanations "stick", assuming they did not, like science, predict trends or actual cause/effect chains (predictive abilities)? They must have been easy to understand (readily "digestible" by the mind) and formed a coherent framework - as pointed out in Thinking Fast and Slow the coherency of a belief system is our evaluation of its acceptability, not its accuracy or testable application to the real world, for the simple reason that acceptability/coherency is the only one that can be readily verified by the brain. Of course accuracy matters, and we

[6] this is readily seen in politics: candidates who give clear, unambiguous, easy to remember (and maybe wrong or inappropriate - but this doesn't matter) answers are ones who get people's acceptance and confidence and votes. The projected image of confidence and knowledge and certainty is more meaningful than being correct or claiming to have the public's best interests in mind

[7] one may here argue that, even if a human could see a true incredible situation, he could only describe it in terms of his own language and experience. The issue is that this interpretation means no learning can ever take place, and clearly we can learn new things by experiencing them. Like there would be psychologists who claim the Native Americans didn't see or comprehend European ships arriving at the shore because they've never seen ships and this was not part of their thoughts/language, but this is absurd - the ships weren't invisible and the natives could describe them in some indirect way.

keep seeking better systems (why science was able to progress), but the early religions played off our biological wiring for "variable reinforcement" (which is key in driving biological organisms to learn difficult things) - sometimes the fortune-teller's predictions are true, and when they're not true it's because some ritual wasn't followed perfectly, so the model remains mentally acceptable. So it is no coincidence that all religions have very intricate/interwoven and *coherent* explanations of the world, as opposed to usually a different explanation/different type of theory for everything in science. Even in science we feel an innate urge for unification - ultimate coherence/elegance - without being able to explain why or to what end. This must be the driving force behind the aforementioned curiosity. Since learning is a very difficult and not entirely pleasant process that nonetheless imbues a significant survival advantage, evolution has selected this curiosity that forces us to learn, to answer questions - but again, not to answer them fully or correctly (the latter takes great mental discipline). As mentioned earlier, simple 'time-waster' games like candy crush or tetris satisfy this urge with minimal effort and risk, so they are popular (this urge is especially strong in 'free time' during feelings of boredom - as the brain takes the free time as a sign to try and process past experiences and do learning since its processing power is not required for real-time tasks, so these games become a tempting relief during such times as they readily satisfy the urge). Then again maybe here I am mistaken - the triumph of science over religion shows that dissatisfaction with vague and untestable explanations must also be part of this learning drive. Nonetheless there must be a criterion by which we evaluate a statement as "correct" [8] and by which we memorize the message of the statement. It is the latter that I will explore a bit further.

The easily memorable explanations of religion end up referring to "god's will". But what is that 'will' and what affects it? We are not allowed to ask such questions, as god's will is "holy" and not for mere humans. Going along with this, explanations boil down to "x did this" - why? Because either "y did something to *anger/please* x" or "x wanted to do it". The second approach seems more trickery than explanation, but can still be believed with a coherent framework since everyone has the experience of "just wanting" something (erroneously, since there is always a cause in the deterministic world - even if well hidden). The first one is interesting as it is (I believe) a reflection of precisely how our most fundamental memory works. What we remember easily is something like "he threw the ball" - subject, verb, object (which is visible across *all languages* [9]) or "he runs home" or "they hunt

[8] this could include: level of detail, coherency with existing worldview, halo effect surrounding the person making the statement

[9] another insight into brain processing of language can be seen in multilingual individuals, it is common to hear speech that is predominantly in one language but with certain phrases and idioms and concepts in another language that more conveniently expresses

deer". The grammar may not always work out, but our memories fixate on *an agent* - the one(s) doing something (if multiple people like with "they" the representation is abstract - there is still one agent - "they" all act as one in our mental representation - not as a complex group they really are), an action that the agent does (again only one action), and the effect of that action. Our instinct makes us ask, *why* does the agent do this action? And an answer like "because another agent did another action" is an acceptable (curiosity-satisfying) explanation. Even science is not immune to this - but perhaps we evolved to think like this because our world (as we experience it) can be accurately described in this manner, since science seems to work! Plenty of scientific "explanations" of the above sort are available - and they seem to satisfy students' questions in the classroom effectively. Why is the sky blue? Because Rayleigh scattering affects light. (not many students will now proceed to ask, "but why does Rayleigh scattering exist?" or "what is light?" - the curiosity has been satisfied by the Rayleigh agent and scattering action) Why do atoms decay? Because the /unstable nucleus/ (agent) keeps /trying to rearrange itself/ (action) into a lower energy form. Why did the market crash? Because the /people in power/ (agent) /decided to make/ (action) everybody poor. Our effectively constant exposure to such explanations makes us unappreciative of very complex events when there may be no particular agent and no particular action - the butterfly effect, diffusion of responsibility, statistical failures/errors/risks, return to the mean, chaotic systems. These events may perhaps be put in terms of the familiar agent-action paradigm, but usually doing so would be completely unfeasible with hundreds of interacting cause-effect chains. [10] So with recognition of our limited experience with such systems, we should be prepared for "random" outcomes and not accept "easy explanations" as a sign of understanding. Computer models, which have high complexity (MB to GB of data) are probably our best tool to approach such systems, and our use of such models (to generate 1 or 2 2D plots that gets reduced to a line plot and then a cause-effect (*agent-action*) relationship which is memorized or used for prediction) should be a humbling reminder of the limited capacity of the mind and the order of the world.

Life for us (humans) is punctuated by an experience of 'being' - a vi-

the speaker's ideas - the length and nature of the biggest "foreign language insertion block" represents concepts that the brain handles as individual entities, and they are certainly not letters or words but entire concepts/phrases/ideas.

[10] the power of the action-agent representation is that it does work at a high level: this is because any deterministic long cause-effect chain can be mentally 'shortened' as a single cause-effect relation. Namely, A→B→C→...→Z can be more easily remembered and treated as A→Z as long as each part follows necessarily from the previous. So we can speak of "he runs away" without having to describe all the complex neuron firing patterns that lead to this decision. Our scientific theories and explanations all follow this trend.

brant array of feelings and impressions of the surroundings. Some feelings are distinctly pleasurable (sugar) while some are distinctly painful (cutting), while some are mostly neutral (colors). This is not a simple avoidance/attraction, but rather every moment of pain or pleasure produces its own indescribable sensation, something one could never intuit just from watching humans, without having experienced it themselves and assuming that other humans have similar experiences and feelings (a satisfying sense of emotional closeness). But humans are fully described by the physics laws of this physical world, so in a very real sense the study of feelings and experience (vibrancy of being) should be seen as a subset of physics research. Not believing that humans or human brains are "divinely preferred" as a vessel for 'being', I have to admit that such sense of being and experience is a part of physics and thus a part of the entire world we interact with - not just other humans, but animals, and robots, and computers, and ocean waves, and clouds... [11] I have analyzed my experience of self and it seems I can most closely discern it as the experience of my short-term memory - not the "processor" as typically claimed; namely I know my thoughts only after I have already thought them, and can't recall thoughts at random, of my own volition, only based on my environment. Do all 'systems' with memory have experience? Are electrical impulses the carriers of experience? Are some impulses explicitly painful?

I had a chance to visit Salem, MA shortly before the Halloween season (October 1, 2017). There I saw a number of merchants selling witchcraft-themed items: magical jewelry, magical candles and decorations, wands and hats and brooms, psychic reading supplies, ghost tours. And I wondered, do people really believe in this stuff? [12] This goes with superstition, bigfoot, ghosts, ouija boards, and even religion. Do people believe it outright?

[11] all major discoveries have been departures from a 'human-centric' universe designed just for us (and by gods like us): earth at the center of the universe→sun at the center→sun is one of very many stars→very many galaxies with very many stars; human-like gods make lightning and earthquakes→complex non-human systems of the earth make lightning and earthquakes; the sun god keeps the sun running→the sun is a star that operates of its own volition. Similarly, I believe the now prevalent human-centric view that only humans can have vibrant experience and other objects are inanimate or incapable of experience is false. Having grown up with this view, it sounds strange to claim that computers (or storm clouds, or the sun...) have feelings, but really it's more strange to claim that they don't have feelings - because the only physical system we directly experience (ourselves) has feelings - so shouldn't the first conclusion be that every system has feelings? I recall in my early childhood passing by some hydraulic machines and being completely fascinated by them, seeing them as living beings - that is until the adults around me convinced me that these are "inanimate". We may be unique in being able to communicate our feelings to some degree, but just because other systems can't communicate in our language does not mean they don't have feelings.

[12] I overheard a woman, about my age, on a bus ride talking to a friend about learning and improving her magic and spells, in a serious tone

Do they say they don't believe it but still on some level have a feeling it might be true/real? Do they not believe it at all and pretend to for the sake of others/to put on an act/to get something out of it? Why do we bother teaching children about santa claus and the tooth fairy? Is it some way to get control by brainwashing/ gaslighting/ manipulation of their thoughts and emotions and worldview? Isn't this really rather damaging to their developing psyche? Perhaps the mystification of santa claus (Saint Nicholas, in days when gifts were from parents) began as a way of keeping children on good behavior (or else he'll give you coal!), same as conspiracy theories and religion playing into our innate fascination with an all-powerful agent watching us and controlling gifts/politics/fate as the case may be. This fascination probably develops in our earliest years of being raised by all-powerful parents as our logic and reason (cause and effect, actors and actions) are just starting to develop. The paranoid conspiracists must have had a bad upbringing. The tooth fairy could similarly be a way to get children more complacent about pulling dangling teeth. Bigfoot and other monsters (chupacabra, lake monster) seem to have no real redeeming quantities - they are intended to be believed as real, and used by older people on young and impressionable minds for... for what? Perhaps a sense of control? To instill a dependence? Why is it that children would gather around a fire to hear a ghost story? They must like it to some extent - despite the doubt it places in their minds and how it may screw with their world perception. The good storyteller is respected in society, not cast out. I think children's interest in stories comes from a biologically driven curiosity that incites children to learn about the world and form a coherent mental model (learning and memorizing are some of the most advanced things we do, and we are lazy, so there must be a serious incentive - a hunger for knowledge - that gets us through the "formative years" to a point where we don't give up learning about the world [13]).

As mentioned in Thinking Fast and Slow, our brains evaluate knowledge not based on its actual validity or reality, but by its self-consistency and coherence within our existing framework (because the latter can be verified fully within the brain while the former requires lengthy external experiments or research and is no practical way to build an intuitive model). "The sky is blue" is not very interesting or exciting. "The sky is blue because Aoxotl, the sky god, puts drops of blue water in the air" is self-consistent and sounds consistent with our framework (putting blue paint on something turns it blue, so putting blue water in air turns the air blue), and it provides an actor/action grouping. This makes the latter a believable explanation to a mind curious about how the world works. Because the mind

[13] this is also why it is important for parents to support their children in learning/exploring in their early years, as a long enough time of not satisfying this hunger for knowledge will turn the child to not be interested anymore

really seeks such explanations, the first statement is very unsatisfying to hear - it doesn't explain anything, it doesn't satisfy the curiosity. This is same reason why we immediately want to know who committed a crime on the news and why they did it (even though it really doesn't affect us physically, we still feel the urge to know), and same reason we hate cliffhanger endings but still return to the next episode in hopes of getting a resolution on the storyline - a usually trivial explanation of what or why something happened (when none of it really physically matters anyway). This might explain why the children/recipients come to like a good story, but what's in it for the storyteller to make up a scary monster or some surreal scenario? I suppose in being able to offer an explanation (that is self-consistent, not necessarily correct or valid in real world) that satisfies others' "thirst for knowledge/learning", the storyteller puts himself in position of authority - other people look up to him as wise or specially gifted. He is useful to the community because of his ability to satisfy this innate "thirst". This is how cults work too - some divine higher-up has all the answers and plans, you just have to trust him (his stories) and do what he says. And this is a much more comforting position than being surrounded by a hostile and unpredictable world - with good enough stories the followers don't even notice how herded they are. So there is some dark, selfish desire to rule over others that may be behind weaving stories and tales. Making the tales scary and supernatural makes them more memorable and more emotionally active, enhancing the subjugation of the listeners and the impact of the tellers. It makes the stories more interesting, "juicier", more likely to stick in the mind and be discussed among the listeners. It is a psychological way to manifest and face the listeners' own projections of fears (the less clearly the monster is described, the scarier it seems - the monster is a representation of our personal fears, and specific descriptions lessen this effect). Perhaps this is because in addition to self-consistency we evaluate explanations based on their complexity and level of detail - believing implicitly that the more detailed ones are more true, and the more mysterious ones (recalling the mysterious and eerie omnipresence of the caretaker in the developmental years) are somehow more fundamental and underlie the world and the truth. It is the "pull of the occult".

The end result is that the storytellers who can do this - tell stories that are coherent (self-consistent), emotionally meaningful, and providing some explanation (even to a question they themselves ask), in an actor/action format for easy understanding of cause/effect - gain respect and power over others. They are the people who others listen to - and, on some level, believe (or even fully believe, as in cults and religion). The "intuitive" part of the brain is not very critical - it believes the stories by default, so just hearing a story, even realizing consciously it can't be true, affects our thinking and habits in a way we don't feel. In children especially this is more

pronounced because they don't yet have the ability to consciously refute an idea - especially against an adult's convincing story and explanations. Then the storyteller can purposefully say something he didn't believe, so he could convince others to actually believe it, to hold power over them (still, spend a long enough time telling such stories and you will start to actually believe them yourself). This is a dangerous slope leading away from truthful communication, yet it allows a different level of emotional contact. [14] And by the earlier analysis, all stories are in some way like this. So, stories mess up the mind and prevent rational thinking. Yet we are wired to seek explanations and thus enjoy stories and can't help reading them. [15]

What about clarity of language? There arise situations that share a common element of purposeful obfuscation, consider drug-related online forums: since drugs are illegal, members often use vague language like "product" or make up stories about "elves" or give hidden directions in some secret script - accessible only to the "in" crowd of course. Another example is sarcasm and its use in "humor" (I hate sarcasm - it degrades conversations from informative to emotional). In this case communication is greatly hindered because the recipient can't be sure of what the other person is saying and whether they "actually mean it" or not (whatever that means). This is a big threat for information exchange in communities which can easily turn from a great resource to a toxic verbal dump if exchanges are not kept serious and on-point. Without this constraint, the conversation/exchanges turn to free association by group, which can have interesting but generally not useful results - this is seen again and again on various 'derailed' forum topics (here I still have to concede that some comments - while free association - do provide interesting context or valuable pointers to related information - so it would be hypocritical to say such collaboration is useless). This may be ok for general social banter, but to keep a topic-focused community and develop some sort of communal goal is very difficult against this natural impetus. The government no doubt uses tactics of information dilution - fake knowledge, using code words/phrases with little meaning, hidden/secret/unwritten rules, and misinformation - to hurt undesirable

[14] I suppose individuals must make a choice to participate in purely logical/rational communication (only reading math textbooks) but forego all emotional connections, or allow the satisfaction of emotional communication (stories, fantasy worlds, vague but colorful language) but forego all rational evaluations. Practically individuals will be somewhere between these two extremes, but to the extent that thought patterns are determined by the outside world, indulgence in vague emotional communication means less capacity to evaluate 'cold' physics phenomena.

[15] this is becoming quietly used by advertising companies as "social" or "viral" advertising - telling a story that is odd or memorable and throwing in a product or brand as a memorable section in the story ("I was at a McDonalds getting a Big Mac when I saw my crazy ex ordering 5 Big Macs - weirdo!")

online collaborations or even real world groups (like terrorist cells). Like "feeding the trolls", the increased mental effort to continually make sense of a conversation or article (because of poorly defined language, euphemism, sarcasm, unrelated distractions and tangents, sensationalist or fallacious pretenses, and downright misinformation) quickly becomes exhausting and unrewarding, so voluntary membership is lost and forced membership becomes ostracized and ineffective. It is like giving food with filler to a baby - the filler may not be toxic but it removes the potential food that would have been there and the baby doesn't know any better. This is easy with information because few people look at conversations and online forums in terms of robot-like (rational, logical, effective) information sharing. The same concepts apply to self - one's internal thoughts/feelings/reflections. If they are filled with useless banter/there is no structure or focus, they will take on an instinctive (emotional, irrational) and fully associative pattern. The person would be "information-starved" without knowing it, in the process losing their ability (if any) to think thoroughly and coherently, instead acting impulsively. Humans seem to value some of this "spontaneity" over robot-like rigidity but the latter is certainly more rationally sound. To be able to achieve this state, one must always be honest and exact in one's thoughts and feelings, using accurate and highly specific language in everyday observations.

Today's society faces a problem of too-diffuse knowledge. It is impossible to be a true expert – there are more people writing more things on every topic now, and in addition to reading all that one must also read all the past writings by the increasing numbers of past writers. Probably 1700-1900 was the time that true experts could still exist (in antiquity limited communication meant some experts wouldn't know all relevant things). There are just too many books, on even the most niche of topics. But the brain can only handle a few things at a time. Whereas before these 'few' things were relatively easy to pick out, now they are lost in a sea of choices, where one can easily get lost without a guide. It is thus key to have one's own set of absolute standards for a goal in life against which to evaluate all potential information, without relying on others.

Beyond the diffuse knowledge, there is also a problem with 'expert knowledge' as a whole. There were a number of times I've had to learn a new scientific computer program and its input file format with specific variable definitions and strict text formatting, I felt overwhelmed about all the requirements and wishing the software had been easy to use, with an easy getting started guide, well-commented files, and perhaps using a nicer format like XML for easy to understand specifications of calculation, or at the least one consistent format just within the one software (whereas typically each variable definition seems like it was written by a different person and with a different goal). I even seriously considered writing an interpreter

program that would "compile" a user-friendly XML file into the software-specific input files, which wouldn't have been a particularly difficult task. But upon learning the software enough to use it, my enthusiasm for writing such an interpreter program faded. After all, I already knew how to write the files to accomplish what I need, so this program wouldn't help me any longer. Nor would anyone else using this software have a particular need for such a program. And perhaps also contributing to this was my realization that the interpreter would have to be quite complex to be able to handle all the possible input options and 'special cases' that this software supports, along with the lack of rewards in spending time on it (after all, it just changes one arrangement of text into another). So I never continued work on it, though it may well have been useful to new students in the field. I believe the same issue exists in all expert knowledge - in order to improve it and make it more accessible for learning/easier to understand/easier and more effective to apply fully, one must (on an individual-brain level, not as a group) understand the knowledge well enough to claim expertise, and at that point there is no motivation to the individual to try and improve the structure of the knowledge - rather he is expected and paid to apply/use it, and in order to do so himself he has no further need of simplification, being already an expert. On a psychological level, the expert no longer views the world/topic/subject the same way as the student, so cannot readily find a way to communicate what he knows in a way that will be well-suited for learning; the expert can only share his thoughts and learning remains a task to be done by the learner. I think such examples are readily found even in textbooks and educational resources, the uncritical use of an 'etc' and using multiple different conventions in a work while placing an onus on the student to figure out which of the possible interpretations is the 'readily evident' one [16] - these all point to the expert being content with his knowledge and writing the text for someone who, while reading it, will have the same mental associations - namely, himself.

I think in the long term this has a negative impact, because we are (fundamentally) simple thinkers, and can work much more effectively with well-organized knowledge. But such a potential benefit is not obvious nor provable in a real setting (is the company doing well because of some management decision or because some knowledge it uses is very readily accessible?), so there remain no incentives for experts to work on simplification, standardization, and ordering of knowledge. An example is all the law codes in government and significant differences in fines/punishments/expectations

[16] to paraphrase, "so far we've been using subscripts to specify the different variables, but to keep the formulas readable we now won't write the subscripts explicitly. It will be clear from the context what the formula means." Surely it is clear from the context to the author or to one who already has learned the formulas and derivations, not necessarily to the reader or new learner approaching the topic.

within different agencies or even departments. An overall societal benefit would result from such a change but in the moment it is not profitable to anyone - even the government itself - to hire someone to make such changes. And there may be too much knowledge for a person to take account of at one time (again, this simplification of the knowledge structure cannot be done by group, because one must know the full extent/be an expert to determine the best way to proceed) - this could be resolved soon with machine learning and AI capable of handling huge data sets by human standards.

Today I've been reading the wealth of information on [`eqi.org`] on emotional intelligence - understanding and validating and expressing our feelings. I agree with a lot of the points there - of emotional abuse and unmet needs as leading to self-harm and suicide, of most of society routinely invalidating and ignoring feelings and true understanding, of the seeking of control vs care/love, of schools as institutionalized unnatural repression of students' emotional needs by an artificial routine/rules, of children as more emotionally pure than adults and having a lot to teach us. But there is a sense in which the author's argument - that true understanding our own/others' feelings leads to a better society - sounds too utopian, idealistic. First, there is a part of human psyche which is violent, angry, destructive, which enjoys seeing others suffer. It is no accident that we use torture, and even get sexual pleasure from it - this response is deep within the brain, not a "learned" emotion because our society doesn't raise children to be emotionally honest. Even "nice" kids will sooner or later try to lie, manipulate, exercise their power, and hurt others - as a matter of random exploration at first but later on realizing the benefits they may do so on purpose. It is the same as a no-defect crystal or a no-police honest society - those who lie or manipulate or cheat will win big, so in this way dishonesty is encouraged and honesty is punished. An honest society will not survive long without punishments for dishonesty, just talking about the person's feelings might well not be enough. Second, there is a risk of being too open in emotional communication - open to change or influence from others, open to judgement. The big risk I see is manipulation - since others can't see or feel how I actually feel, I can say I feel a certain way without actually feeling that way (ie purposeful manipulation - guilt trip: "I will feel unloved if you do this") or I can just not understand the full meaning of the word (because I have no absolute reference point!) and say things which convey a different meaning to the other person than what I intended: "I feel depressed" perhaps "sad" or "upset" would be a better choice but how can I teach the right word to a child/student when I can't see what they're feeling and they can't see what I'm feeling? Third, the author suggests talking more about feelings - asking what others are feeling, how much they feel understood. Here again I see an issue with using words - words are unreliable and can be made up and used for purposeful manipulation, or non-purposefully in-

accurate communication. I might say I feel happy but what I actually feel may be very different from what the other person considers "happy" to be. Talking more won't likely help get over this difference, especially talking in other emotional terms. The common ground has to be in physical experiences - including what happened to the person, how they reacted/continue to react, and how they express themselves at the moment in body language. These are things that are difficult or impossible to control on a whim to manipulate others. If a person does choose to manipulate in this way, they will have no choice but to also manipulate themselves, which is more honest than just saying "I feel..." whatever untrue thing and being able to stay in charge by such emotional dishonesty and reliance on anothers' trust and honesty/kindness. Real physical actions/experiences also help me imagine what I would feel if I had to go through those experiences, and then we both have a common reference point for the feeling word - ie "I feel sad" is vague and maybe the person doesn't even know what it is they are feeling or don't know how to express it, "I feel sad because my parent died" gives a physical action which I can use as a reference, then I can say "perhaps it's not sad but grieving - that is a hard/heavy feeling" and thus get accurate emotional closeness and better imagine how the other person actually feels. This way is also closed to manipulation - I won't cry over someone telling me they're sad (maybe they just want me to do something for them, saying "I'm sad" doesn't take much effort) but if they've lost a parent (and this can be physically verified, vs. "I feel sad" which really cannot be, at least yet) I have a deeper understanding of their experience and can show compassion worthy of the situation. Finally, even using physical actions and avoiding manipulation and placing guards for dishonesty, there will still be people whose actual desires/feelings outright conflict with our own. What to do then? My neighbor will only feel content if he can blast radio at 3am, I will only feel content if I can sleep at 3am. Neither of us wants to move out or change routines. Even if we fully understand each other emotionally will there ever be a nice resolution? If I like driving fast but my passenger feels scared, because both of us have different levels of what we feel scared by/of, both of our feelings are legitimate but what should we do? Slowing down, the passenger will feel more safe but I will feel frustrated - again real feelings, but no good optimization exists.

Truly valuing anothers' emotions means changing your life to suit them - and we are, at the core, selfish [17]. A counter-argument would be that I

[17] because we only *feel* our own feelings, because of the way the brain operates. We may hear about others' feelings, but can only feel our own. If we could feel others' feelings, then life would be very different and maybe a 'utopia' along the lines of [`eqi.org`] could be attained. But this sort of feelings-inter-connectedness means accurate and extensive information sharing between individuals - ie letting a larger scale optimization happen: this makes sense, as a utopia is an "absolute optimization" - the less commu-

only feel this way because I was raised in a society which routinely neglects emotions and invalidates feelings, but this society developed this way due to human nature (my deterministic argument, as the case with small→big business, it got this way for a reason!). There was the example of a kid bouncing a basketball in the house and the mother was angry and feared the kid would break something. Telling the kid to play outside would make him unhappy - really he would be hurt for a while because he was enjoying playing inside - but we are willing to inflict this emotional negativity to protect our material things (ie because we are selfish). We enjoy power and control too. Even as a hypothetical parent I can't imagine being so selfless as to truly consider the kid's feelings in this situation and let him keep bouncing the ball. [18] I suppose this is because I am afraid he will not respect my feelings - again societal raising problems - but when only emotional words matter, the kid will quickly figure out he can do whatever he wants by saying a painful-sounding word (recall that words mean whatever physical action they bring about), ie "I feel hurt when you tell me to stop bouncing the ball" - the emotionally considerate parent will think "I believe you, and I don't want you to be hurt, I am only mildly inconvenienced so I will let you keep playing" but this opens up a clear and obvious channel for manipulation and the kid exercising more and more unilateral power, "taking over the household", at the parent's expense. Perhaps this is why cycles exist - sensitive people let others walk all over them because they are too trusting, and in this way they actually encourage the other person to be emotionally distant/manipulative as that easily earns them rewards and carries no penalty/minimal effort. Thus abusive couples can be "enmeshed" and remarkably stable over time despite fighting/abuse - they continue to fulfill each other's needs without consciously thinking of how unbalanced their lives are. Finding a balanced position is hard, lonely, and maybe even unstable. So I would take away this - recognize others' emotional states (based on physical actions/experiences/body language, *not* their words - same for myself, analyze physical actions not the words I think) as this is valuable information for understanding people (ie creating a theory of

nication and understanding we have between people (the less each feels, or in our case takes into consideration, another's feelings) the less possible it is to have a utopia. It is no coincidence in countries or social circles with higher living standards, interpersonal communication and everyday transactions are clearer and more structured/ formal/ polite/ respectful; I would even bet living standards are a consequence of the extent of interpersonal understanding/clarity.

[18] this sort of situation may seem trivial, but the message should not be overlooked: even the best parents will have to purposefully impose emotional negativity on their children, because of the way this world is set up. At some point, they will value their material possessions and themselves over their children (recall the selling of children's body parts where famine was so bad people resorted to cannibalism). This makes a very strong case for antinatalism.

mind); don't invalidate others' feelings and seek to provide comfort, but at the same time always be cognizant of one-sided/unilateral/unfair relationships where either I am taken advantage of or I am taking advantage of another - this evaluation should be done on physical actions (how often we talk, how much each person contributes, how often we go out, whose ideas dominate the conversation/actions/choices); finally don't assume I understand another's feelings ("I know how you feel" - No!) and don't allow/ ignore/ mentally flag others who claim to know my feelings - they might get close by learning all my physical experiences in life but they will never know! More than often phrases like this lead to subtle manipulation. Finally (again) trust physics and physical actions over words, always. Never believe "I'm sorry" until I see the person change their actions, never believe "I promise" until I've seen the person demonstrate their trust, never believe "I'm hurt" until I see the experience that has hurt them. This will lead to clearer understanding for both of us and greatly reduce the chance of unilateral manipulation - making it physically impossible, even. This is why I trust physical actions over people's claims - I can claim to love swimming but if I never go to the pool while having the time, then how much do I really love it? If I loved it that much, I would *make* time to go there and ignore other things. So even for myself, words are flimsy, physical actions are solid and real and reliable/true indicators of emotional/internal state and values and beliefs.

Maybe a society that's too perfect is also unhealthy, as people become disposable, not crucial, unnecessary. Perhaps "bad things" like natural disasters or wars make everyone feel useful and worthwhile and necessary again, in which case people are more than happy to help others and make use of their skills - but again, for selfish reasons - to fill the emotional need of being useful. Then the terror management theory will suggest that after horrible events like war/bombings, humans will feel more bonded and secure with partners, and become more fertile - note the high birth rates around the world immediately following the world wars (the worst human-made disasters in history). We all want to be useful. The capitalist system in its current state forces us to do jobs that may be subpar in exchange for money, whereas we would be happy to do something we truly enjoy in exchange for emotional appraisal/feeling necessary and safe and loved - and people are smart enough to see that they aren't necessary working in shitty dead-end jobs, they only do it because they have to get money - can this ever be called an emotionally sane system? We tell people to suck it up, ignore their feelings at the core of their "self", and just work work work to make others happy, to prove to *them* you are worth it, whereas really you don't owe anyone but yourself - if taken advantage of without power, it should be your full right to die. Our society instills the idea of working for others, on arbitrary tasks and on an arbitrary schedule

(ie without regard for personal comfort) even since before school, definitely in school, and continuing smoothly during work. We are expected to spend our most productive life years working and toiling for others - neglecting our own interests - why? Because there is no respect in society at large, there is power and fear and manipulation and coercion, but respect is left by the wayside. This is because respect is hard, it takes real time and real conversation with a person, it cannot be faked, it can only be gained by understanding a person through knowing their physical life experiences and then acknowledging those experiences as real. What teacher, in a 30-person classroom, can respect their students? Can any human-level communication take place? Of course not. The teacher instills discipline by fear - that is easy, everyone can learn to fear corporal punishment, but respect is hard - I don't have time to ever get the respect of all 30 people, that is a too-difficult optimization problem to take their feelings into account, so we tailor to the fictitious "average student", lacking any human needs or desires, and drive actions by impersonal fear and expectations. This indifferent treatment is not lost on the students - they may not be able to put it in words but they definitely feel like cogs in a machine, like nobody really cares. With rising population and technological connectivity, even their peers won't have much time or desire to establish respect or build lasting friendships. So when they get to the point of finding a job, they are content to continue such a crappy unfulfilling existence, because it's what has been taught for years as "normal". Most people are really not crucial to society - yet knowing this on a subconscious level they still find shreds of meaning in making more children/workers for the masters, or pleasing an imaginary father in "heaven", so working conditions degrade and people suffer quietly, trying to convince others how wonderful life is so they can get reinforcement from others that their own life is also wonderful and meaningful (I guess our biological urges also demand us to take on group popular stances, why peer pressure is so powerful).

By this point it has been 4 years since I started the graduate program. 4 years! As cliched as it sounds, I find that hard to grasp. It seems not so long ago I was moving in to the city, exploring it for the first time. I really was a different person back then. Who was this person, what was he like? I only have traces of that in my memory, but I am not the same. I as a feeling/existing entity only exist for the brief fraction of a second that my conscious cascade develops and dies out. The me of 4 years ago is long dead, only his impacts on the external world (and these reflected back into my more stable memory - still not perfectly stable, as the conscious cascade can change it at any moment) remain for me to see. The continuity of "I" is an illusion. We talk about how dangerous and harmful addictions are, and yet food is an addiction that takes up a lot of our time (in fact, by controlling the supply of food, the government can keep us dependent, and

if drugs are a more powerful addiction then a non-government-regulated supply of drugs can lead to subversion of its power). What are we beyond our addictions? I find some pleasure in writing so I do it now, making sure to remember to bring my notebook+pen when packing for a trip, just so I could satisfy this addiction. People go to work every day - after repeating the action for decades, it becomes a habit. Or even an addiction - try to stop a person from going to work! Even if they might say they would love to have a day off, how much work sucks, try to actually interrupt their routine - uncertainty is frightening, they will quickly find other work to do. There is a risk of getting fired - but the bigger reason people will fight to attend work despite your stopping attempts is not the risk but the certainty and sense of routine/purpose that working regularly provides.

There is another illusion established in society, the illusion of choice, very prevalent in tests and most questions, ie "you have the choice". In high school I would do "multiple choice" tests, but is there really any choice when there is only one "right answer"? And despite the english teacher saying there is no right answer, there certainly are ones that will earn better grades, this phrase just being a poor excuse for not being able to clearly and effectively explain what it is that we are even expected to learn in the class ("just do what I want you to!"). And given that there is a right answer, an answer we are expected to give which is pre-determined beforehand by the teachers, isn't it a bit of an insult to give the students the "choice" of an answer? What is even the point of tests? If the knowledge is valuable to the student, the very fact of having accurate knowledge will be enough motivation for the student, and he will seek ways to ensure an accurate understanding, such as by solving his own problems of interest, reading his own choice of books, finding similar-minded people. If the knowledge is not valuable, why should the student be forced to learn and tested for learning? Looking back at schooling, I don't believe it was effective in fully helping me explore and increase my abilities and interests [19], and mostly because of the focus on "doing well" (ie matching the expectation for the right answer, with the illusory "choice" of actually having *freedom* to solve and fail) keeping me from undertaking exploration, and secondly because of rigid structures - not only having to spend time with an arbitrary group of people I didn't like but also each class lasting the same time even if I much preferred to spend all day in shop class/physics class. And this is the real purpose of schooling - the imposition of arbitrary standards, year after year after year, making students stop questioning that good grades (as defined by superiors/teachers) lead to good job performance (as defined by superiors/bosses) and society is full of arbitrary rules (rigid schedules in

[19] I really learned more from programming my TI-84 and making PHP websites than I did from HS classes

school→rigid schedules at work) breaking or questioning which will lead to punishment by superiors.

Also, failing is an essential part of learning; in 'natural' learning (like riding a bike, or social interactions, or language) the brain tries different approaches, most of which don't work while some work, and over many trials the brain gets better and better at figuring out what works. Failing and immediate feedback on how not to fail is crucial for real learning. Sports teams realize this, using practice workouts and matches which do not affect athletes' or team standing, on which immediate feedback is given by the coach. Would it be reasonable to use practice games to judge a team – they would not even be practice games anymore, but then how can the team possibly learn new skills without being hindered? This is seriously contrary to our current test-based model where everything, even the homework, is graded and contributes to passing/failing the class (where failing can 'snowball' into unacceptable and life-changing effects, such as by limiting enrollment to lower-level classes the following year). It selects for the naturally talented who "get it on the first try", and also for luck or plain cheating. It may involve teaching, but barely any learning.

Another role schools serve is in essence babysitting. We force parents to work full-time to get by, give them no advice or education or resources on how to parent effectively and with kindness and to build strong emotional connections with their children, so that parents do whatever they can without regard for the child's welfare, and understandably get fed up with the huge commitment and are very happy to give the kid to day care then to school so they don't have to actually take care of it. It is quite absurd - make a child to satisfy some innate desire, then proceed to largely give it to others you pay to take care of it, seeing it only for an hour or two before and after work, spending most time together asleep in separate rooms.

Why even make a kid at that point? It becomes a burden on the parents (who want/have to keep working full-time) and then a burden on society (in the form of child care and later public school systems). [20] After that questionable "joy of youth" (all adult-structured, at least from what I see in current society), the children are thrown out to the world and left to fend for themselves. Also consider that children are evolutionarily driven to learn 'the rules of the game' about reality just as adults do, but with the creation of "childhood" as a distinct category of individual, their 'rules' are different – so to appease our wants to have 'cute' children to take care of we make the children learn two different sets of rules: the parent-imposed childhood rules and the real-world adult society rules, [21] which is also seen

[20] childbirth does benefit governments and corporations, though, who get to siphon off the resulting money flows without having to do any child-rearing work

[21] In terms of competition for survival/resources, parents and children are necessarily opponents. I believe on a subconscious/primal level parents don't "really want" children,

with school → work transition that nobody teaches about or provides support with. This is unjust to the child, who has spent a long time learning "childhood" rules only to find out (indirectly/made fun of for 'immaturity') they weren't "real", and probably contributes to teenage angst. The schools, in all their usefulness for teaching subservience and following the established order, don't even bother to teach about how to search/apply for jobs or how to do taxes, least of all how to have safe sex and how to raise children. Or how to fix a car, how to buy a car/house, how to pay bills or set up a bank account, or what to put in a will, or how to do CPR, or how to grow food, or how to be assertive or emotionally competent or logical in a debate. [22] Basically, zero life skills that *actually* matter to all of the students - and college is really no better. But we do learn PEMDAS, or whatever other acronym nonsense they've come up with (again how does an acronym help my math skills?). So it is not a malicious conspiracy to create slave workers - that would be giving everyone involved too much credit. [23] It is just following old, traditional ways that worked before and extending them past the point of logic - falsely flipping the idea "smart people do well in school" into "people going to school become smart" (happening now with universities - a few centuries ago only the already intelligent would be willing to go to college, sacrificing stability of life to do so - now people go to college and pay for it to magically be turned into intelligent people - or so the story goes. Surely some only go with the goal of having a degree/title but probably still buy into the idea that doing so makes them smarter. Most of the illusion comes from the self- and pre-selection of students into

as they pose threats to their dominance. Of course superficially the parents dismiss and over-compensate by claiming to love their children's flaws, and fully embracing the parenting lifestyle and associated challenges. But on an underlying level, all parents hate their children to the extent they are independent beings that have caused them pain/effort (childbirth and baby care) and are potential competitors (this is seen very clearly with narcissistic parents, who don't try to hide it - readily picking favorites among their children and making them dependent/non-competitors). Parents like cute dependent babies because they satisfy their urge to be useful but not the child as an individual that will compete with parent for resources, and even take up parent's free time and other abilities without a re-payment in the way of control or submission or emotional validation. This might be the reason for the creation of childhood (the children certainly didn't come up with it - they act how the adults in society instruct them!), as a time period when the parents can fully enjoy "owning a human pet".

[22] Independent thinking is antithesis to mass schooling so maybe there are realpolitik reasons to not teach it or to teach useless words like "democracy" by peer pressure (I remember everyone in history class having a laugh at "commies" while I thought, are we learning anything here?). But at least teach us how to apply for jobs? How to pay taxes? How to open a credit card? Won't all this make for better "slaves" to the system?

[23] But maybe I'm wrong and what makes better slaves is a sense of no control, a clueless/confusion, a purposeful avoidance of teaching fundamental skills/'life manual' making the population dependent on authority rule rather than trying to evaluate rules critically and follow their own rules.

various college tiers and then such students excelling of their own volition - it is entirely fruitless to teach students who don't genuinely want to learn, whereas those who do want to learn will find ways to learn to their satisfaction whether through college or not). And in the lie of "schooling is necessary to make you smart" we isolate children from a chance to make *real-world* choices, ones which can lead to inherent feedbacks rather than arbitrary "good/bad" grades: yet without the risk of real failure there isn't a real success (just like IIT qualia don't use all neurons firing, but the ones that don't fire must be capable of it, not merely absent). Instead of letting children solve meaningful and interesting tasks, we force them to stay in school and do arbitrary tedious work they mostly don't like, which I suppose in itself is an appropriate enough introduction/indoctrination into the workforce world. [24] Looking at schools this way really solidifies the idea raised in [Waste Streams of Ignorance], that just like factory farm animals, we humans are raised and put through the system and used up for the benefit of Government and Business (operating as evolutionarily established 'organisms' for the sake of their own continuation), schools are the "incubators", impersonal and uncaring, for the future workforce. Ultimately everyone is selfish, parents will not care for their children unless doing so benefits them, there is no unconditional love (or even love at all, beyond infatuation/physical attraction). Fuck it is depressing to look at my life and realize all along nobody really cared. I got here through accident and then sense of guilt/responsibility, and later as just another kid in the system. Was anyone happier due to this? [25]

In a lecture on scientific writing, I remember hearing that a paper should not have unreferenced 'floating' figures or tables - all of the data should be discussed in the paper, making a coherent and connected whole. Similarly it wouldn't make much sense if books had 'floating' chapters that didn't show up in the table of contents or were otherwise referenced anywhere. So I would imagine, in a rational society, mandatory schooling would serve as a means to connect all the diverse skills of life, to give a complete 'table of contents' to the students so they are well versed in what to do in life, yet looking back at school all of its subjects are disparate and no connection is even attempted to be made to 'real life'. There are huge gaps as nobody really teaches everyday life skills like cooking and property own-

[24] the barriers that funnel us into this workforce meatgrinder are all mental - no cages or walls (but perhaps police with guns from time to time) - if I want to escape the "lifescript" others so fervently and readily follow, I must tread into uncertain territory and remain willing to trust my own answers/abilities, with the risk of real failure ie death.

[25] even 'happy/carefree' child's play has an evolutionary purpose and is guided by parents who teach children stuff, we are at the mercy of our biological programming to survive in evolution and that is *all* we do, there is no rest, no joy or happiness or contentment - these are just illusion/delusion words we use to stay sane when describing ourselves, the same way we use religion to describe the external world.

ership and taxes – it is everyone do for themselves as they may randomly learn from parents/others which is bound to be ineffective and damaging. Consider that many basics like hygiene are never taught in school, some people have to learn from the internet – how does that reflect on the "education" system? In my view the education system should serve as a foundation such that all life skills are linked together in the mind. This is doubly so for parenting, as it is easy to mentally damage kids without realizing it. In fact, I would argue that schooling should be required for parents/adults and not children. The external environment of the child, especially parents in the developmental years, has a tremendous influence on the child's personality, interests, and desire to learn and contribute to society (or not). Children are sensitive emotionally, and a parent will likely emotionally scar them without even realizing it, as emotional awareness carries little respect in our culture (people will make fun of vegans for being too sensitive about animals' suffering). It would then make sense to have parents required to attend parenting class, where proper methods for raising well-adapted children are explained and pitfalls are described so they can be avoided. The parents have an incentive to learn this material because it will help them use already developed methods to (say) calm the baby's crying, understand children vs adult needs, know what activities to do with kids and at what age - overall reducing stress and uncertainty. The parents then employ their newly learned parenting knowledge [26] to raise the child to be happy and comfortable, while the parents stay confident in knowing what to do. This parenting would include educating the child - teaching reading, algebra, and other basic necessities, all in a warm family environment with one-on-one interactions rather than an impersonal daycare/classroom. Social interactions for the children could be organized at first by parent groups and eventually the responsibility handed over to the children, and the activities would be those the children enjoy without the imposition of an academic/hierarchical rigidity. Why even have school for the children at all? After all, adults are more capable of learning structured/complex material, sitting through lectures, doing assignments, and making good use of the knowledge.[27] I would argue it makes more

[26] instead of the current absurdity, where parents with a new baby express surprise at the lack of non-manipulative guidance "they just let us come back from the hospital with this baby, it's ours now, we have no idea what to do with it!" - would it be a surprise that in their later desperation and lack of knowledge they take some actions which harm the child mentally or physically? why are parents expected to magically know how to raise a well-functioning child?

[27] because they've already internalized the "basics" of the world, like handling emotions and social interactions and determining life goals/aspirations - namely they are mature; additionally they have grown past the impulsive/playful stage of childhood brain development which was evolutionarily designed to get children to learn the aforementioned basics by playing and is presently wasted by forcing them to sit quietly and listen to the

sense to send the adults to parenting school, and then the parents teach their children from a young age, and school doesn't start until later (perhaps 13) when the children need to learn "adult skills" like hygiene and emotional/ethical awareness and taking care of a house and money management and sex and of course parenting. Any more specific skills would be taught on the job, or for scholarly pursuits, in college (the original role of college, not a company-money-saving substitute for job training as popularly assumed today). Wouldn't this make a society more coherent, more aligned and sane in its goals and aspirations, more like a well-connected network forming one complete whole 'organism' instead of the vagueness and uncertainty that pervade most of everyday decisions now? It seems without such connectivity, society stumbles along like an amoeba, fully at the mercy of random runaway cycles, while with such connectivity (so every person feels like they have a "life instruction manual" and are confident in what they do/why they do it) society can take form and make real progress in achieving its desired goals, acting as a higher-order and robust organism capable of doing more complex optimizations. [28]

I encountered a grant for designing an education module for young kids to learn about water. Out of curiosity on how kids 8-12 learn and how to present material to them (from my experience at science events and summer camps for kids, the kids just mess around and don't really take the time to find any underlying trends - they're too young to care about science, why teach them, let them play/have fun!), I read some guidelines on education - which were mostly bureaucratic ramblings ("teachers should inspire self-guided thinking and experimentation in students" - very nice, but how can they do that?). But while reading this, I wondered - what does it actually mean to learn something? As alluded earlier, words by themselves are meaningless. So are concepts. All of language and human knowledge is meaningless without actual physical humans to use it and apply it to the real world. So I suppose this is the ultimate goal of learning: to affect a human's behavior such that other humans are affected in a specific (beneficial?) way - that is, a physically relevant effect (but physically relevant only has meaning when there are humans to be affected by it - which is why I explicitly mention an effect on other humans). So, we educate (teach) an engineer, and one that has learned engineering is now affected so as to be able to build things and thus contribute to society.

teacher

[28] it is interesting to look at wartime societies with this lens - in war everyone has the same goal and confidence in achieving it (kill the enemy! destroy rape and pillage!), jobs become assigned and clear expectations arise for people to take specific roles in the army like a type of "life instruction manual", and the society becomes extremely streamlined and capable of great technological progress - we are still 'riding the wave' of progress made during the world wars.

Using knowledge of past scientists/engineers in textbooks and lectures, the student engineer becomes turned into an "engineer mold", carrying on a specific mindset and worldview developed and refined by engineers of past, and developing and refining it more in the process, perhaps contributing to the mindset's/mold's evolution as new concepts are conquered and added. But things don't have to be so nice and clean. If we measure whether someone's learned a subject via tests and exams, what we are doing is conditioning behavior for a career test-taker, not engineer, even if the subject is nominally engineering, as the necessary mindset is not cultivated or tested by exams. So it may be that today's engineering graduates indeed learn engineering on the job and forget most of their classes. So - learning is behavior modification to achieve a specific behavior. Can I be more specific? Does learning that "mitochondria is the powerhouse of the cell!" or that "we are made of cells, and cells contain DNA" mean anything? If I don't know what are cells or what is DNA, the last phrase is almost useless - but not quite, as it tells me that DNA, whatever it is, exists inside of cells, whatever they are. If I don't know what "contains" or "made of" mean, though, the situation is much harder. Then we are back to how babies learn (which is also how adults learn, but adults have a huge established store of "background knowledge" so they can learn some things through words alone) - by association and seeing human-compatible patterns hundreds of thousands of times, the brain constantly performing complex statistical analysis, and eventually knowing - where knowing means having a coherent relation map (self-consistent and consistent with outside world/physics) of a word/concept. Having seen "contains" many times, the brain creates a mental structure - of the word as referring to something being a part of something bigger - the mental notion of "contains" which is by definition undescribable as it is a purely brain-hardware thought construct. Of course having this structure changes behavior - at least when reading the word "contains" - so we say at this point the baby has learned the word (when it uses the word appropriately vs just saying it randomly - experimenting to test its associative model is accurate).

Using the word appropriately of course means that it is in line with our own/societal mental constructs, over many instances of use giving an indirect signature of the underlying mental construct and allowing an external observer to evaluate the construct even though it is inexpressible, like identifying an animal by its tracks/feces/food, or identifying a message by a number of hashes. How does a societal construct emerge in the first place? It may be by a similar process to neuron synchronization in synapses, seen also in audience applause becoming rhythmic - this requires that individuals tend to adjust their clapping to coincide with the most audible/loud clapping frequency, resulting in an eventual runaway of one frequency to dominance by chance "thermal" perturbations that may have made it only

slightly louder than its neighbors initially. So, enough people point to a frog and say "frog", even if the first uttering was by chance, and a societal construct emerges - children calling frogs by another name will be corrected because now "frog" is correct. Once they are in line with society in calling frogs "frog", they are considered educated on that topic/they have learned it. In a sense, my brain/my thoughts/my whole experience is nothing but a conglomeration of such links between arbitrary/disparate sensory inputs and mental constructs, and perhaps consciousness itself is just the result of any system which can sustain such a mapping, and perform such information transforms. My vision of the world comes from transforming visual input into concepts (chair, green, pen, jeans, paper, writing); hearing comes from transforming audio input into frequencies/chirps/notes/words/identifying sources; sense comes from transforming body input into a given location and expected nature of touching object. All this is also learning. So, why teach children about water? So they can conserve it, use it as power, use it as a chemical, build a better society, perhaps. But children cannot be taught to be self-guided learners, they must want to learn - we all "want" to learn as part of our survival (evolutionarily), but some more so than others, and this is not something a teacher can control.

While here, I will mention that emotions are a poignant example of the dynamic of learned words and mental states. I can observe a baby, and based on how it acts and what's happened to it recently, I can say "the baby is happy", or say to the baby itself, "you're so happy!" [29]. Over time the baby learns about what happiness is, though I can never transmit my actual experiences of happiness to it; my "happy" may well be another's "sad", but we can never directly compare, only by observing outer behavior. In this sense google knows more about me than I do - it has my search patterns and thus can predict my mental state/mood/knowledge as well as likely future actions. I wouldn't be surprised if companies like google use this data to make 'societal forecasts'; just as weather forecasts are useful and people will pay to have that information, there will certainly be groups that will want to know a societal forecast describing what will likely happen in politics and consumer preferences, and the big data companies can generate this. Did these companies implement automated search completion (sending live keystroke data and potentially influencing user's choice of search) and provide cloud email services (gmail storing all emails on their server - huge inbox space provided for free) and cloud storage (google drive - lots of storage on their server for free) and chat/messaging apps (realtime

[29] and perhaps there is a reason the coloration of our eyes makes it very clear where we are looking, unlike many other animals, as this helps a mother understand what the baby is looking at and thus teach shape recognition and otherwise participate in world-learning with the baby by tailoring her words to what the baby is presently doing so the baby builds an accurate associative model

communication analysis) and mapping/location apps (realtime location and desired location tracking) and voice control (speech analysis) just because these services would make the users' life more convenient? The companies seek data of human activity, because the more data they have the better forecasts they can make, and these forecasts are more accurate (due to richer data) and more powerful in their implications than any weather forecast, because we can't change the weather by much but we can certainly adjust the course of societal progress, or at the least make serious money from it - this is like the time-travel goldmine of knowing the winning lottery numbers before they come up (here it would be stocks to buy and companies to open and policies to implement so as to benefit from future trends). As in The Minority Report, this could even be used for preventing state-level crime before it occurs, with sufficient psychological knowledge and the big data that today's information companies surely have. [30] In fact just because I was born as myself doesn't really give me any privileged knowledge about myself - I live as a consciousness of the moment, only remembering the most recent things, and not as a "whole person". I learn about myself in an abstract fashion (ie "I like lemons" - an abstract statement, not a feeling/mental construct) by (knowingly or not) performing and recording experiments on myself throughout daily life, thus getting a sense of who I am. If I were not educated in language (which I was because language has shown itself evolutionarily stable on a societal level) I would not be able to do any of this analysis, living on an animal-like instinct level and not really knowing myself, much less the many systems in which I would have been embedded.

A person can be kept from fighting by physical restraint or by mental restraint - one can walk into a lion cage after the lion has been fed. But the real world is brutal, it is a fight for dominance by vicious cycles. Thus any sense of peace or play or fun or relaxing must all be seen as mental restraints, keeping us from challenging the powers that be, staying in line. And maybe it's good to have the powers that be continue to stay in power. Of course if they convince me that's the case that would be placing effective mental shackles on me as I would never challenge them! This is the hidden factor behind the transition from slavery to 'equal' economy, there is no reason to assume the role of slaves has disappeared with the physical restraints

[30] the key here is fully believing in determinism, and then all our actions - even the misspoken words, typos, stutters, pauses in speech, distractions, and subconscious word/phrase choice - are representative of some part of the "self". There are no 'accidents' or 'errors' or 'mistakes' in human actions, only unrecognized patterns. See [clinical introduction to Lacanian psychoanalysis]. Recognizing these patterns requires both a cognitive capacity to track them, and an external environment which gives the individual enough independence for such tracking so the cause/effect chains are more readily seen. An advanced AI will see patterns that we just cannot due to our cognitive limitations, and this has the eerie implication that we would be powerless against its influence.

gone - the mental restraints of the modern ‘slave’ are just as real and binding but needing much less centralized effort to maintain. This ought to be a factor in more recent feminism and genderfluid movements - no politician, no matter how much they swear on democracy, would take an action unless it has clear reinforcing/positive impacts on their continuing power and influence (if they did, they would lose the dominance contest to become a politician - the government organism’s method of intrinsically selecting people that will perpetuate and protect government). The popular support for any movement is a nice "natural resource" that is tapped into for the resulting money flows and population dynamics change, both of which will come to be predicted and modeled with increasing sophistication by the elite power circles of above that have access to big data. This is not to say one has to fight, but rather that he should be aware of patterns that allow him to not fight, and not be ignorantly swept up in them. "Rise above the pattern" - is that even possible? For once you do, you become part of another pattern. [31] But not being aware of the patterns/reality is like blindness: a blind man can fight but his sword will be aimed at random, mostly unsuccessful. With awareness of patterns I become less blind in the logical realm, thus able to accomplish my goals more readily, and pick more realistic goals in the first place. Awareness comes from language that clearly describes the world as it is (as outlined in Thinking Clearly). Maybe this is why politicians like "political correctness"/euphemisms, because it keeps people who use such language from having any chance at fighting for real power, because there is no possibility to see the patterns with muddied and unclear language (because this language defines what thoughts are possible and the extent and precision of mental inferences that can be drawn). The most dangerous thing is seeing events as a chance/random/fluke (just a typo, strange weather today, passed by an accident on the road, prices fluctuating) because that means explicitly ignoring some bigger pattern. One can make a model of reality with such random flukes, and I think most people do just that (ie free will, god’s blessings) but such models will necessarily not be optimal and will hide true sources of influence.

I remember when on a long hike I was getting tired and started "seeing"

[31] indeed, any power the predictive models of big data may claim, only exists on the condition that the population at large does *not* have access to big data or the predictions (or doesn’t care, as with climate change). Without this access (which sets up a feedback loop, an essential ingredient in conscious experience) they have no choice but to follow their set pattern, but if they somehow get access then a new and unpredictable pattern will emerge. This is played out regularly in the current stock markets: if a company makes an algorithm that can ‘beat the market’, they can employ the algorithm and win, but this winning is dependent upon other companies not knowing the algorithm or not having access to similar timing/monetary requirements. As soon as other companies follow this winner, the algorithm is no longer effective and a new one must be made. There is something to be said here about the structure of life itself.

familiar symbols (like people, store signs) in various trees/rocks/shadows: perhaps when tired my brain just interprets the world in "easy" symbols, not being capable of handling the full complexity of the world. This is interesting for better interpreting how children view the world - literally using easier interpretive symbols. It is clearer here to see why simplistic animations seem appealing to such a view of the world. This is to say, our conscious representation of a scene is not a photograph but an already fully interpreted set of symbols/concepts which can become more/less true-to-life in its complexity depending on our awareness and tiredness (and capacity for handling large amounts of information at once). I once encountered an unexpectedly large collection of weird animated youtube videos with millions of views, supposedly made for children who nowadays sit in front of a tablet with such videos on autoplay, videos of the likes of peppa pig/finger family/nursery rhymes. The repetitive nature of the videos (repeated sound effects, rudimentary animation using a limited variety of stock images/faces which typically vastly exagerrate the emotional features, ie smile=huge grin) was annoying but these obvious emotions/limited expressions/basic actions creates a sort of patterned simplicity that perhaps babies love because it is so much simpler than the real world - appealing to some subconscious processing that can feel success at every step due to the straightforwardness of the presented images/symbols. Yet after watching such videos I felt distinctly "dumbed down" and also frustrated at having to deal with the slow/boring/complicated real world and longed for a return to the simple entertainment.

Good and bad feelings are a physical phenomenon, rigorously reflective of reality in a similar manner to $F = ma$; this seems hard to accept because all our words to describe (and think about) feelings are so inadequate and imprecise that it is easy to assume feelings themselves are imprecise. As I argued in the case of turbulent/energy-spreading structures, feelings are created in any system which faces an "optimization" problem of how to spread the energy given the imposed constraints (the energy that is ultimately dissipated as heat in our electronics represents heat that was *no longer* available in the steam of the power plant turbine - that energy took a much more circuitous spreading route due to the constraints of the turbine+electrical network. The network, if it were conscious, might look at itself and be amazed that such complex structures can spontaneously arise, being unaware of how humans are putting in conscious effort to make the network possible as it serves some of their selfish needs - the search for good feelings). Feelings have a real physical effect: we are driven to seek good feelings and avoid bad ones. In fact this is the sole driving force in all we do, and I will argue the sole driving force in any physical phenomenon. Why should an atom bind with another atom into a molecule? Because it feels good. What other reason can there be? Formulas on paper remain

just that - lifeless symbols. We can think about formulas and use them to describe "dumb" atoms because we have feelings and capability for thinking, but extrapolating from this that atoms actually are "dumb", what is the reason for them to do anything? Just to satisfy some formula? The idea of 'systems devoid of qualia experience' is an unsubstantiated fantasy. A person can lie/cheat/manipulate all he wants, but at the core reality he will always seek good feelings and avoid bad ones. It's what *drives* us, it's what makes us take action. I claim it's a physical reality that drives other systems as well. Feelings are physical tools of the universe - really good pleasurable feelings are something we seek, really bad painful feelings are something we avoid, the stronger the feeling the stronger our drive to act on it. The universe allows both pain and pleasure, it is indifferent to what we feel just like it is indifferent to whether we use tools to create or to destroy artefacts. Evolution has used feelings rather haphazardly, making brains that are capable of experiencing unnecessary or unresolvable pain, just whatever survived+bred was good enough to continue evolution, as evolution cares only about continued survival and not feelings. But feelings drive evolving organisms to try and survive, so the evolving organism must have pain associated with self-destructive things and pleasure associated with reproduction/raising kids, as well as a shield (like an infinite boundary, to the same extent as the brain/blood barrier) to not be affected by the painful feelings of organisms it eats/depends on. So when parents "have a baby" they are creating a new feeling organism whose feelings are closest to what we ourselves can experience but yet wholly different and independent. They are creating an entity capable of suffering and that will have to fight for its survival in the world, brought here without its consent. The parents are not "having a baby" - this objectifies the baby, they are making a person. [32]

I watched the documentary [Earthlings] about animal killings, and while in terms of violence it wasn't as bad as some slaughterhouse documentaries, it was powerful in showing the vast extent of suffering humans inflict on the less powerful: not only in slaughterhouses, but in the wild (fishing), for entertainment (circus), for clothes (fur trapping), and for science (monkeys, mice). It is more testament that the only laws are laws of physics, and might does make right. And sure the natural world is also cruel, animals get eaten alive (even from within by parasites), have to always compete,

[32] Making a person on the other hand gives too much credit to the parents. Making a home-cooked meal takes more mental effort than "making" a baby, in fact the baby puts in all the effort, developing a placenta to leech nutrients from the mother and arranging these nutrients for its own growth. All the mother needs to do is eat and attend to basic bodily functions, and the father even less. So a more accurate phrase is "fertilizing an egg, which will then develop into a new person". But that sounds much less romantic and desirable than "having a baby".

and exposed to other situations where they cannot escape pain. But we, as a higher species, do not just stand by (much less to say help - but how can we help? do we save the parasite or the host, and why?) but we actively create extra suffering - we breed animals, bringing new conscious beings to life, and these beings are forced to live in conditions so far from what they evolved for that every day must be mental/psychological and physical agony, torture, until their gruesome and painful death. This is the most despicable part - it would be futile to pretend people are harmless angels, nature is pure, and we are its saviors - humans are predators and we love to hurt and nature is cruel, but why do we actively add to the cruelty in new and scientifically merciless/robust ways? Perhaps some people believe animals don't feel pain - at this point it's not even worth continuing the debate as they simply lack emotional sensitivity to accept such a conclusion even if presented with dozens of scientific studies. I imagine others accept animals feel some sort of pain, but don't really care - these are the real psychopaths. But in acknowledging such people exist I must acknowledge that such thinking is part of being a human, that I could think just like that given the right circumstances. Why? Humans have a dark, primal urge to make others suffer, and they get carnal satisfaction from this feeling of complete domination. In this sense, animals are not unique in our treatment - the evidence of slavery and holocaust and wars and interrogations show abundantly that humans can treat other humans just as despicably, and here one cannot honestly argue the other human doesn't feel pain or suffering. What about modern society? The constant threat of economic→physical punishment keeps people in line, keeps them working for decades in dark windowless rooms, keeps them away from family, keeps them distracted from the miseries of life. We are also the livestock today. Why is BDSM porn/art popular and a turn-on? Why should it be sexually gratifying in any way to see a person bound/immobilized and forced into doing painful activities? The art (like vore) can get more extreme, and I question whether I would still find such extremes sexual if the scenarios were real-life, and yet there seem to be people willing to recreate the art in real settings. It is sick, but this really primal sexual urge is there in my mind (and by virtue of the art being made and published and then shared on forums, I know I am far from the "most twisted" out there), and it is immensely pleasurable. It is a driving force to seek power and dominion over others, to know that I can inflict pain if I want and be spared from it myself. It is perhaps part of what drove humans to develop science (power over nature/disease/famine).

I think there is an evolutionary component that justifies this search for suffering (ie I can and will hurt another for my enjoyment): the ability to drive us to hunt and use other animals to sustain ourselves. Early humans had few materials available, so beyond the use of meat for food,

animals provided useful sustenance with fur/leather. The human brain is wired for compassion: we must be able to care for and emotionally connect with/support our lovers, children, and social group - as this helps effective communication and group survival (a group that cares for one another will survive better than one where each person is ready to kill another). But if we have too much compassion we would be hurt mentally by the actions needed for survival: the killing of animals, and the killing of competing groups or otherwise threatening humans. Wholly compassionate humans would put down their weapons and get eaten by the next competitor, those who survived had to have the ability to ignore others' suffering, and a natural urge of pleasure to counter the unpleasantness of a sympathetic sense of suffering/guilt seems an appropriate mechanism to do just that. If I took every person as an equal, the neighboring tribe that enjoys fighting+killing would try to kill me and I wouldn't fight back because my brain would not allow me to. But when I get provoked, I feel a sense of enjoyment and pleasure in making the other party suffer and beg forgiveness as I control their lives, and it is this pleasure which drives me to fight, torture, and kill. The holocaust happened not because Hitler was evil, but because the people of Germany felt threatened by Jews - a threat brought to words by Hitler but if it weren't a real feeling before those words nobody would have taken him seriously - and such a feeling of helpless desperate threat was enough to drive people to seek this pleasure in hurting a fellow human being - it is not like the soldiers didn't know or didn't realize what they were doing, and they still managed to care about and sympathize with family members, but this primal urge drove them to willingly complete atrocities against fellow humans just because they had the power to do so - the pleasure is real and it is a driving force of human action, dark as this sounds. Our brains are evolutionarily wired to follow driving forces that lead to increased survival, not to highest morality, or to least suffering, or to best education, or to clearest understanding of the world, or to rational+optimal behavior. Solely survival, even if it means loving and caring about one fellow human and torturing and killing the next, never hearing their pleas and cries. In this picture, it is sadly clear how fruitless the plight for animal welfare would be - we are willing to put fellow humans through this, so is there even hope we could consider how wrong it is for the animals? We call animals cute and have petting zoos, then on the other side of the fence throw these animals in cramped cages and eventually kill them to eat them. This cruelty comes from evolution being a ruthless competition for survival - put down your weapons (physically *or* mentally, ie too much empathy) and get killed+eaten, and we are slaves to evolution, so perhaps it is inevitable one way or another. Excessive empathy would be bad: recognizing the state of the world at large (animals eating each other, rarely if ever dying of old age but rather by being eaten alive) and of the human condition, would

drive one mad, so our empathy is limited and closed off to just people we 'like' and animals that look 'cute' (the people we like also happen to look cute). Mostly we just follow primal urges, which we then rapidly justify to ourselves with a 'cover story' for why we actually did the thing necessary to satisfy the urge, this happens in love/relationships, friendships, everyday decisions, even childbirth. This is seen with labels, by labeling people we mentally treat them as objects, and this is a convenient way to get through everyday life and interact with others and be happy and content, by convincing ourselves that others' feelings aren't real or important. "He is just a kid, he'll get over it" "he's a high-school dropout, what does he know about life" (ie his feelings can be safely ignored), "this is just what boys do", "she's a cashier, she sees it all the time", "don't worry, she's got a thick skin" (ie the hurtful words didn't actually hurt her, ignore the effect on her or even the possibility of such an effect). [33] Actually treating other people as wholly conscious entities like oneself is paralyzing and detrimental to competitive success, paradoxically even in social connections/relations. [34]

But why does destructive action have to be associated with pain? Why do we feel pain as this unbearable experience, why can't it just be an abstract feeling like a thought or rational plan of action? If I program a robot, I would add in code which tells it precisely what to do if a part of it breaks - what motions to avoid, how to get replacement parts, how to do the fix, how to time actions so as to be able to do the fix before experiencing more damage. Surely it wouldn't make sense to have it scream and be flailing around, helpless and too distracted by the sensation to do any useful action (for its own survival). Why does pain exist? In the case of programming the robot, I have to give it all the above knowledge - what to do and how to do it and when. But a living being does not get born with knowledge - only with hardware pre-wired for certain activities and capable of learning the rest. Pain serves as a required feedback mechanism in the learning apparatus - it is the sole physical reality driving force that teaches the organism not to do something, with its intensity being a factor in how much not to do something and how much to avoid similar things. So we have nerves in our teeth because this helps us learn to apply the proper amount of force so we don't crush our own teeth - a fairly advanced task of generating a force and motion profile while eating textured/complex foods. But then we get chronic dental pain - just an unfortunate side effect of having this

[33] Of course the ubiquity of such labeling for "inanimate" objects makes it sound lunatic to argue that these objects can be capable of qualia experience. But this is only because we have been taught the labels by society. I think as children we readily expect other objects to be living things like us, until evolutionary-competition-driven adults teach us to ignore others' (and most certainly objects') feelings so we can also compete and stay sane doing so.

[34] I would not be surprised if sensitivity correlates with loneliness/alienation

type of mechanism to learn everyday chewing motions. Does pain occur in every learning system? Does it have special characteristics that can be delineated in terms of how it affects the brain's energy dissipating (conscious) structures? This I would like to answer but cannot yet without physical evidence as to how it all works. In general I think all "original" human actions are reflective of the underlying feelings and urges/desires, necessarily vibrant pleasure and pain sensations that are good/bad of their own sake, so we can't help but pursue one and avoid the other. These are the driving forces of humans and of human society. Consider musical instruments: at some point humans started with almost nothing, living in caves, now they have musical instruments. Why? It is because in every generation humans were driven to look for and improve musical implements - driven by the inherent enjoyment/pleasure of music, which for whatever reason our brain considers a source of pleasure. We could live just fine without music, but there is an intrinsic feeling-level urge for music, so we go out of our way to create instruments and melodies/songs. As with the concept of making guns harder to obtain leading to fewer mass shootings (because the shootings+gun obtainment were both driven by an inner human urge: making getting guns harder does nothing to alleviate the urge, so the human will do whatever he can, in desperation trying to satisfy it), banning musical instruments will not stop music - because music is part of our primal driving urges, black markets will immediately appear and people will continue to make instruments (perhaps in cruder form+more expensive now that information/knowledge is not legally allowed to flow) and make music. This is the current situation with drugs - we have an urge for the pleasures drugs provide, but instead of letting such pleasures be readily available we ban and make them hard to obtain, for we cannot fix the inner urge - it is part of being a human, for better or worse. The reason we don't have easy drugs is because then money would no longer be the driving force it is today - the urge for drugs far outweighs that for money, and that leads to instability as no single coherent currency can be maintained - how could any government tax that? [35] The reason we have science and math is because of a driving force/urge to understand and control - it is no coincidence that "popular science" videos are cool, just as magic is - there is an appeal in taking control of the unknown, in creating miracles, in exhibiting the extent of one's power over nature. It is an inherent part of being a human, yet again a feeling that is good for its own sake, the experience of which is pleasurable just as a fact of what it *is*, so we as learning systems seeking pleasure are naturally driven to such unnatural and unintuitive actions as studying science and math, doing experiments, building tools - with no obvious reward,

[35] the self-reinforcing cycle of government fighting gangs and the associated money flows should not be ignored. The government will claim it wants complete disappearance of drugs, but is this really what it seeks?

when this scope of activity is considered it should be clear just how strong and ever-present the underlying urge/driving force is - it is not taught and cannot be taught, [36] it has been evolved to be there in surviving humans. It is a physical reality of feeling - the only physical aspect I can sense is that such feelings are not conserved - with two organisms, if one suffers the other won't be better off by the same amount. In fact it is possible for both to be suffering or both to be doing well (however this may not be true, perhaps the conservation is done by "inanimate" systems that experience these feelings but cannot communicate about it). I can more confidently claim that these feelings are spatially and temporally bound.

Design is typically seen as an "open" process - using ill-defined things such as creativity, spontaneity, and imagination. While this freedom makes design interesting, it also means that there is no assurance that the design is optimal or even close, by whatever metric. Constrained, or deterministic design, is an approach which in a sense makes design boring - taking all the fun out of it - but at the same time showing potential solutions which are actually better suited to solving the desired task even if they are not intuitively obvious or even welcomed from the more traditional approach. Deterministic design will first clearly state the problem and what constitutes a solution. Second it will define metrics of success. Then all imagined approaches that constitute a solution will be evaluated. Ultimately the best one will be selected and perhaps modified and judged by the same criteria. Deterministic design "coldly" picks out the best design / optimal approach to a problem, and avoids the pitfalls of intuitively "correct" solutions and biases towards "elegant" mechanisms or solutions we inherently may prefer emotionally. But applying this indiscriminately leads to a robotic lifestyle: there is no utility placed on variety or style or non-technical features or even the fun aspects of a product, at least in typical design considerations - perhaps because these are very hard to quantify. Strictly rationally, we don't need different car colors - we can save money and effort and materials by having all cars the same exact color. But we like to see our cars as unique so different colors are a selling point - such human factors cannot be excluded from deterministic design if a successful product for the current marketplace is sought.

I remember watching some cartoons/movies as a kid where the villain was out to destroy the world, and I would wonder: why destroy the world? Won't that destroy the villain as well? Why not just rule the world? Why kill all life including self? But having written this view on a philosophy of conscious beings and seeking to maximize happiness, I can see how killing everyone would be an act of kindness, ending their actual and potential

[36] which gives a perspective on the ongoing 'forced' teaching of STEM subjects to students and the unsurprising result

suffering. Maybe I am turning into a villain. But if I go beyond the selfish "maximize my own happiness", then the only guiding light is to maximize total happiness and minimize suffering, and the surest way to do that is to enable happy peaceful deaths. Because on my deathbed, will I really look back on my life objectively? I will see everything depending on how I feel just then, we don't want a happy life [37] but rather a happy death. If I had a great life but a painful death, my last moments would still be pain. There is now talk of ambitious missions to make a civilization on mars. A typical claim is that this is fulfilling humanity's dream, but I can't help but think that undertaking such a mission puts an uncomfortable spotlight squarely on what exactly the meaning of our existence is. As I posited before, I think we exist to help the universe's natural/intrinsic progression from low to high entropy, just like all other lifeforms. We just happen to be able to think abstractly and communicate about it, and the earliest humans faced with this came up with some explanations - grasping at straws - finding meaning in religion, customs, and traditions. Why would tribes get tattoos? To symbolize "becoming a man" or something, and that was something kids could strive towards. But why should they care about becoming a man? Because it is a status in society. And I suppose all our "life meanings" ultimately point to such societal expectations - we are social animals after all, so it is no coincidence the church (or any group really) will form into specific roles that will play along, and fulfilling that role - being useful to a group of people - will "give life meaning". No wonder depression goes along with feeling useless and lonely - even if your life is materially well-off. But - say we do go to mars, spend tremendous resources and manpower to go there, even set up a colony - now what? How are we at all better off? Astronauts spent months flying at an incomprehensible speed farther and farther away from the safety of earth and hopefully being able to land on another planet lacking in resources and protective features like radiation shielding. If anything fails it is quite literally impossible to again traverse the space to get back home. We romanticize space travel in fiction, portraying it as a transatlantic cruise or piloting an airplane, but "cooler" (because actually piloting an airplane just isn't cool enough anymore as it is so commonplace). The reality is that space travel is vastly different - in a movie I can get on a rocket just like I get on a plane, and reach my destination, hooking up with some hot girl on the way. Space is hostile because it is empty and vast beyond comprehension - vacuum of space easily beating what we can achieve even with ion vacuum pumps. So why even bother going? To satisfy the dreams of our ancestors? But come on - they were just as romanticized, leaving out all the inconvenient and

[37] arguably, we never have a happy life - there is always the want for more and more and more

dangerous parts of a real space journey and just using the concept of space to retell a millenia-old tale (archetype) of discovery/exploration/excitement but in a new-sounding way. Why should that be a reason to go? Frankly I don't think we have a good reason to go - but saying this is equivalent to saying our lives don't really have a meaning, and maybe even meandering towards an indifference between life and death - physically accurate but complete heresy in our life-reinforcing societies. [38]

Then why do we continue to exist, to survive, to do anything at all? I think that we have a psychological shield against meaninglessness - a fixation on problems that we make ourselves believe are critical by limiting our own solution space. Society can also limit our solution space - for example parents telling me to study hard so I can get good grades (but why? You'll find out later...). This is easily seen in individuals who have a "perfect" life - for instance wealthy or powerful individuals who could have their every whim addressed (modern humans are also more or less like this - most work today is artificial, self-reinforcing, you work because I need your product so that I can work and vice versa - but wait, why are we even still working at all? Do all these people claiming to want vacation time really want an absence of a work purpose in their life?). Simple reasoning says that, having all their human desires addressed, they should have been happy and joyful. But they felt frustrated, useless, their life meaningless, so they created artificial problems they could solve - celebrations, rituals, sports, collections, "snobby" interests like wine tasting, card games. Solving these created problems satisfied their need to feel useful, so they thus found meaning in life. The rest of the people followed along because doing so gave *their* lives meaning - do this so that the boss/king is happy, that's all you have to worry about - no need to look at the terrifying big picture. For in the big picture it is all entropy and systems evolving, stable states remaining, unstable states decaying, self-reinforcing states growing. And entropically it is just unlikely to have a perfectly happy life, so sorrow and pain make their way in, like defects in a crystal lattice, and us addressing this sorrow gives the illusion of a meaningful, purposeful life. Even I am not immune - I still cling to the belief that writing this text or taking whatever actions I can to minimize others' suffering will give *my* life meaning - though in the grand scheme of things it really won't make any difference once I'm

[38] Consider eating eggs: if my goal is to reduce suffering, would it be better to buy eggs or buy chicken meat? The meat could mean the chicken is killed sooner and endures less suffering/ovulation (which probably isn't too pleasant), but we instinctively like to say that eating eggs is better as it saves the chicken. But this makes no sense - like "saving" puppies at a shelter. They will all die anyway, so why is keeping them alive a bit longer considered honorable? Did those puppies even want to be alive in the first place? By that logic, I will start setting stuff on fire and if you try to put out the fire you are a terrible murderer, if you let the fire burn (continue existing) you are a savior, and if the fire burns out "on its own" it is a very sad occurrence. We are all just slow fires after all.

dead.

So why go to mars? Why climb Mt. Everest? Why do tricks on a skateboard? Because it sounds/looks awesome. Because it is enjoyable to both the person doing it and the person watching. We all like seeing and doing amazing "magical" things - things we didn't think were possible - as a consequence of our biological thirst for knowledge and exploration, which has made us evolutionarily successful, for now. So, we go to mars because we want to, because we are explorers by nature - an essential element of being human that has even gotten us to the point of having rockets and science in the first place. So, we might as well go to mars, just to prove that we are human, and humans are awesome.

Conclusion

Science - the search for truth - burns away hope, coincidence, will. In relentlessly seeking and finding the answers, we are uncovering more and more knowledge, at the cost of destroying more and more dreams. Science is a cold and ruthless process, seeking complete control, picking one possibility out of infinitely many. At one point, all of Earth was mapped out, and then no more tales of strange mysterious lands could be supported while upholding rationality. Now slowly the myths of bigfoot/chupacabra/ghosts/loch ness monster are dying out as omnipresent camera devices and internet access instantly disprove their existence. Religion will soon follow the same path, and it has been adapting to this by changing to more of a social gathering/group interaction function as opposed to true education or soul guidance as in the past. We are an evolutionary experiment - preceded and followed by countless others - the only known lifeform to be able to understand evolution and even surpass it in recent years. But we find ourselves in a universe where interacting atoms can experience feelings and emotions, and where it is conceivable for an organism to have an existence filled with nothing but pain and suffering. Such horrifying possibilities ought to make us question our purpose here, but instead we live off the flesh of animals killed for our pleasure (animals that once, too, felt pain and were afraid of death), and pretend that all the "inanimate" systems around us have no feelings or experiences just because they don't have a face and can't speak. Adults slowly drift further and further from their childhood dreams, having gained the knowledge that the dreams were misguided and unrealistic. Children, not having as much life experience, don't see the barriers that adults do; they still have the spark of excitement which jealous people call 'naivete'. They also get glimpses of the world as it is - a cold place - glimpses so terrible they lead to hours of crying and definite mental blocking of such a logical worldview, instead seeking escape in emotional comfort, love and hope. Those who study science, the natural philosophers, must stare at the void without the luxury of comfort. If a rudimentary model says the end is nigh, well maybe we missed some stuff here and there. But we keep looking for truth and - if an empirically proven accurate model says the end is nigh, you better prepare for the end. But why keep kidding, we already know the

end as far as our lives are concerned: everything turns into heat, distributed and uncoordinated motions of atoms. Even this book, and your memories of it, will eventually fade into the heat bath of the universe; it is only a matter of when, not if. Seeing the world through this lens is overwhelming, it removes any hope for a miracle, it shows the real limits to what will be, to the future that we like to delude ourselves into thinking will be better than the past. It shows that human systems are irrational and arbitrary, and that as humans ourselves we are a rather incoherent combination of evolutionary qualities. But it also shows the amazing resilience of lifeforms, the operation of the world, the ways to gain true control. It shows physics as the language of the magic spells of our universe, not the spoken orders of fairytales but the real magic of turning a bunch of atoms from the earth into a car or computer or nuclear reactor. I mentioned earlier that the universe doesn't care about numbers, or energy, or models. It sounds absurd to say this, and I would have disagreed before writing this text, but analyzing consciousness as it relates to the rest of our physical world makes it clear: The universe cares about feelings. I can only hope that you would seek to improve the life of the atoms you care for. To make the deterministic world a warmer place.

References

In line with the premise of determinism, it is inevitable that the ideas I have discussed are some result of my world experiences, of other thoughts I have been exposed to. The references below are ones which I feel have contributed significantly to the message of this book.

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