Notes on time and causality

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# Introduction

What do we know about time, and what *can* we know about it? The short answer is “Not much”. The notion of time is very tightly bound with the way that we perceive the world. Knowledge is accumulated through time and it mostly presupposes the notion of time. And perceptions compose time - they are the material from which time is made. So in order to understand knowledge, we must understand time. But it is also the other way around. This is why this text does not have a very precise structure - it just not possible to describe paradoxes in a precise manner, in fact, this lack of precision is probably the main reason why people don’t study this subject more - why devote our (*ahem*) time to try to understand these subjects when the research is so hard and the results, so meager? My response is because it’s important - time is related to knowledge, to aging/youth, to perception itself. And although most “results” that I have obtained are basically variants of the Socratic “I know that I know nothing”, the writing of these essays has been great for me.

That much we do know about time: the principle of cause and effect is essential, if not for time itself, then for our ability to comprehend it. There is hardly any way around it - almost all of our knowledge is “causal knowledge”. And this is the starting point of my text. So sit back, pour a glass of wine (you might need something harder for the last chapters) and enjoy it.

# On causality as the defining principle of all knowledge and on the subjective nature of all knowledge

If I throw a die or think of a random number and then tell you what that number is, I doubt that you would call this piece of information “knowledge” (unless your goal is to argue with me). This is because this piece of data, when taken by itself, is highly unlikely to be relevant to anything that will happen in the future. I’d define knowledge as all “information that is relevant in the future i.e. can be used to predict it”. So the concept of knowledge, depends on the concept of time - in order to know what knowledge is, we have to know what time is, indeed, in order to have a concept of the future at all, we must be able to perceive time. So let’s examine how do we do that. There are many ways to go about it, I, as a programmer, often tend to think about things in terms of input and output:

0. We can view the \*input\* which our brain receives, and from which the perception of time and continuity is derived, as a collection of frames, pictures of different states of reality which are then, somehow, united in the output.

In other words, the mystery of time can be reduced to the following riddle - we have two pictures and we have to find the elements of the first one in the second one, like a converse version of the “Find the ten differences” game. Seems easy, but it’s not.

1. In order for the perception of time to be realised (and knowledge to be created), the list of frames must be interpreted as signifying some sort of change of object from one state to another, like change of position (motion), change of shape, colour etc.  
  
- If the frames are all alike (like if you are standing facing a wall) you would not be able to perceive change (and time).   
  
- But if the frames are all different i.e. don't have anything to do with each other, you also wouldn't be able to perceive change.

To perceive change, then, we must be able to interpret the frames in such a way that there is an aspect of them which is different for each frame but at the same time stays the same for all of them i.e. we have to postulate the *identity* of objects and events (we don’t need to think about objects separately from events, as they technically are nothing but longer events).

2. The basic form of identity of events and objects (objects being just collections of events) is based on the concept of \*causality\* - when observing event `A` in a given frame followed by another event `B` at another frame, we presume that `A ⇒ B` (`B` is caused by `A`).\*\*

What this means is that identity is just a manifestation of causality, that they are basically the same thing - when I see a given object standing on my desk and then I see a similar object in the next moment I assume that it is probably the same object i.e. the object being there at time x *causes* it to be there at time x + 1.

There are other ways for defining the identity of objects (we can say, for example, for example, that an object is the same only if it is composed of the same atoms), but this is the main way that identity is perceived by people in practice, hence a ship that has all its parts changed at a course of a given period is still the same ship it was at the beginning of the said period, although different in terms of the material that it is composed of.

If we think more about the ship, however, we would discover that identity, when defined in this way, is not set in stone.

3. Causality is in the eye of the beholder i.e. `A ⇒ B` is not a fact about the world, but a mental image. This is so because `B` is party defined by its internal characteristics but it is also partly defined by just being "the thing that comes after `A`" (if `B` just happens without any sign of `A` before it, to what extent would it still be `B`?). In the same way, `A` is partly defined as the thing that comes after some other event.

This is the most essential of all my propositions, so let’s elaborate: imagine that we know that A ⇒ B and we observe A and then observe following from it another event that we would call B' that resembles B in terms of some of its internal characteristics, but is also different in some other characteristics (note that this is not a mere thought experiment, but a general description of the perception process itself, as all events are different from one another).

In this case, we have two choices:

* We may conclude that A is not actually A, but some other event A' and thus discover a new fact about the world - A' ⇒ B'.
* We may presume that because it follows from A, B' must be some manifestation of B and thus expand the definition of A ⇒ B to include this new manifestation.

The first kind of thinking is called empirical, the second one - dogmatic. Only when thinking empirically, do we *obtain* information about the world. Only when thinking dogmatically are we able to *use* the information that we gained by making predictions. Needless to say, empirical and dogmatic thinking are complemental to each other and go hand in hand. They are like input and output, Like question and answer…

With this, we established that dogmas like A ⇒ B are not truths, but just rules for structuring information. We may naively think of them as true because they mostly “work” i.e. allow us to achieve a given goal or false (getting us into trouble), but the fact is that they are not - instances that follow a given rule may only follow it by accident, or because we perceive them as following it. *Instances that don’t follow the rule are simply not instances of that rule* - no rule is right or wrong.

By the same token, we may naively think of the causality maxim (of A ⇒ B) as true (true as in “valid law of nature”, let’s say), because when we perceive A, then (in the most cases) we also perceive B and it is easier to explain that by postulating causality than to just say it happens by accident (Occam’s razor). This may lead us to believe that causality is some kind of law that exist in the world, or rather a meta-law, which implies the existence of all kinds of other laws. In this case, we would be overlooking the following:

4. `B` is not a specific state of affairs, it is just a mental image, a pattern \*we\* begin to search for given our previous knowledge of `A ⇒ B`.

We search for B and often do find it even without there being perfect candidates - If we already think that A ⇒ B we will see B everywhere we see A. In this case, we say that someone sees B *even when it is not really there*, but the fact of the matter is we cannot possibly see anything that *is* there in the way that we see B in this example.

Causality is neither a rule, nor a meta-rule, but a *belief* that every thinking being should hold to some extent in order to be a thinking being.

The last statements probably sound too counter-intuitive, so to be taken as true without some objections, so I will attempt to address some of them using the somewhat forgotten form of philosophical dialogue. Let’s imagine that the physicist Isaac Newton, (who pioneered the modern scientific method) had a chat with the philosopher David Hume (who challenged the principles on which this method is based).

## Hume and Newton

**Hume:** Causality is not a quality of the world, but merely a *belief*. It’s a very general belief and one that every thinking being should hold to some extent or another in order to be a thinking being at all, but still, it is just a belief.

**Newton:** That is nonsense. You can clearly see that the world adheres to certain laws which are unrelated to whether you are observing it. This means that causality is a characteristic of the world in itself i.e. a law.

**Hume:** If causality were a law, there ought to be a way to test it, as we do with all other scientific laws, right?

**Newton:** Yes of course, and as a matter of fact, we do that pretty often. All scientific theories are based on the causality maxim. A scientific theory is nothing, but the assumption that some statement that has the form A ⇒ B is true. And then we have experiments that try to test this statement by making A happen many times and seeing if B follows. In other words, every science experiment that tests whether a given theory works also tests whether causality itself works.

**Hume:** This is true, but many if not most science experiments fail to some extent or another. Doesn’t that, allow us to conclude that causality also fails?

**Newton:** The only reason that experiments fail is that we simply don’t know enough to conduct them properly. Blaming causality for our failure is just ridiculous. If our theory is exactly right, it will produce the expected outcome every single time.

**Hume:** That sounds too theoretical for me. Let’s get an example. Can you construct a thought experiment, even a very elementary one that always gets the expected outcome? If you do that, you win.

**Newton:** Very well then. I suggest the following experiment which uses everyday logic and objects: a pistol is turned to a window. The pistol’s trigger is pressed, therefore the window is broken.

**Hume:** But what if there is no bullet in the pistol? Or if the pistol is broken in some way?

**Newton:** OK, let’s say that a bullet should *necessarily* be fired and that the aim isn’t off. Then the glass gets broken.

**Hume:** What if there is a hole in the glass?

**Newton:** No there can’t be. The bullet hits the damn glass, OK?

**Hume:** OK, but how fast is the bullet moving?

**Newton:** Let’s just say that the bullet hits the glass with *sufficient* speed.

**Hume:** Sufficient for what?

**Newton:** Sufficient to break it.

**Hume:** Look what you did here. You just defined the situation in such a way that the effect is embedded in the setup.

**Newton:** So you are saying that the effect can be *embedded* in the setup? Well, that sounds quite objective, does not really look like a belief to me.

**Hume:** Look, there may be possible cases where you will be able to *guess* whether the glass gets broken, but this does not make the general principle true. Because there is no general principle, in a first place, only a mental image and situations which remind you of the mental image.

## References

* Dogmatism and Empiricism are two schools of medicine in ancient Greece and Rome. Dogmatism was pretty much lame, but Empiricism, also known as Pyrrhonism (and later skepticism), is the origin of many of the ideas that I discuss here.
* The definition of identity and the example with the ship are from the treatise of human nature by David Hume.

# On the different systems of knowledge depending on the goals that a given individual has and on urges and emotions as the ultimate source of truth.

Let me describe to you a natural phenomenon that I observed. It is a very weird one - at one moment it is green, but at the second it fades to black and then it becomes invisible. I suspect it can take some other colors too… It sometimes produces sounds too, but here is no way you can tell what it is going to do next. Such phenomena may very well exist (it might be completely random or it might be governed by some laws, that we just cannot perceive), but there is neither a way for us to know that it does exist, nor a reason for us to be interested in it.

0. A mental image (or dogma, as we called it earlier) is a set of many impressions united in order to be perceived as one. All objects and events that we perceive are actually just mental images.

Because the of fact that we only see mental images implies reality as we perceive it is not objective, many (weird) philosophers have argued that we are actually living in a dream or a simulation of some kind, and that reality as we perceive it is not at all related to the reality that actually exists. But for me that is clearly not true - while mental images themselves do not say anything about the real world, *the fact that we have gotten the habit of creating mental images* does say something - their existence is a proof (the only proof?) that the world is not completely random.

But there seems to be a contradiction there:

* Mental images would only make sense only in a non-random world - in a world that is completely random there will be no point nor reason to combine several things as one.
* The concentration on different aspects of reality and the usage of different sets of mental images results in widely different interpretations of reality (none of which are correct).

The collision between those two statements has naturally led to many philosophers to despair - basically, they mean that 1) there exist some truth in this world, but at the same time 2) we can never know this truth is.

To reconcile this paradox, we should consider what truth really is, as our current everyday notion of it is obviously wrong - truth does not exist in the world, truth is subjective. Reality is like a canvas that contains the form of the world, but it is up to the observer, to us, to draw the contours: we circle one spot and say “This is A”. Then we take another picture and search for where A went, or for other instances of A.

But where does A originate from initially? What provokes us to start perceiving the world in terms of A-s and B-s and not just gaze at it and wonder what the hell is happening all the time? Up until now, we spoke a lot about the subjective aspect of knowledge, but we never said anything about the *subject* AKA the human, animal, robot, god or other lifeform that (who) actually perceives reality, makes these assertions and has these thoughts. But how do we even define what a subject is in this context? I claim (you will see why shortly) that it is defined by the things they *want* - their will, urges, wishes, emotions etc. or their “goals” as I will call them here.

Now, a goal is not a specific state of affairs of the world - there may be many states of affairs that constitute the realization of a given goal - rather a goal is a kind of mental image that a given observer has, with one more detail, that it is associated with feelings of pleasure.

1. A goal is a mental image representing a state of affairs which is for some reason desirable for an individual, or the opposite - undesirable.

With that in mind, let’s go back to the distinction between dogmatic and empirical thinking. As we said, when thinking empirically, we *obtain* information about the world, and when thinking dogmatically are we able to *use* the information that we gained. We said that empirical and dogmatic thinking go hand in hand, that you cannot have one without the other, but another way to look at it is that they are actually in conflict - one makes you smarter, but unable to do anything - the other turns you into a mindless machine that can only chase windmills.

Furthermore, when comparing the two modes of thinking, we may say that the empirical part is somewhat more “legit” than the dogmatic one. When thinking empirically we enrich our representation of the world. If we have goals, empirical thinking helps us find more and more ways of achieving these goals. If our aim is knowledge and precision, we should only think empirically and practice suspension of judgment, collecting all info and enriching our knowledge without ever trying to unite and structure it, as every structure is a simplification.

The reason we think dogmatically is just because of our (living beings’) modus operandi and it is pretty simple - we sometimes *have* to act. The situation is “do or die” for some of these goals as (as abstract they are) sometimes our whole existence depends on achieving them.

If this factor wasn’t there, our whole world would be different - we would just watch reality forever, studying getting more and more intimately knowledgeable with the way it is, but doing nothing more. But we get hungry. And when that moment comes, we *have* to assume we know enough and switch to dogmatic mode in order to try to catch some prey, or to get to the grocery store. It is at this moment is when the mental image is formed. The image of food is a product of the fact that we get hungry, as is any other mental image, in any other lifeform:

2. All mental images that a given individual forms are either desirable (or undesirable). So all mental images are trivially associated with or are themselves goals (or antigoals).

A corollary of that is:

3. No mental image or a piece of knowledge that relies on mental images is objective - all of them are actually a product of the individual's characteristics.

For example, the pistol and glass example is associated with the desire to break the glass for some reason.

Now, where were we? Oh yeah, we were talking about truth (I know such detours make the reader wish to take a pistol themselves and point it at either their or my head but bear with me, please). As we said, mental images are not, by themselves, true and false. This is so because (let’s reiterate it once more) we can assess whether a given mental image works, only by applying it and interpreting the result, but we can only do that using *other mental images*. We cannot see reality outside of the mental images, so, when considering it by itself, we cannot call an image true or false, we cannot even compare one image to another and say which is better or closer to the “real world” (because, again, we only perceive the “real world” through images). I love Wittgenstein’s essay “On certainty” and especially the opening sentence which was written as a response to G. E. Moore’s argument against skepticism, that consisted in raising his hands and saying “here is a hand and here is another one”. Wittgenstein’s response:

1. If you do know that here is one hand, we’ll grant you all the rest.

That is, if we have a starting point if there is one thing that we know to be true, then everything else can indeed follow from it. But we do not have such starting point, so that is why mental images are by themselves neither true nor false.

The situation changes when we observe mental images with their connection to goals. Goals are by definition desirable (or undesirable), they cause pain (or pleasure), they make us fed (or hungry). And it is based on these sentiments that we deem the mental images that correspond to them true (or false).

3. A mental image has a degree of reality, that can be equated with the degree in which its corresponding goal is desirable for the individual (based on an individual's own subjective criteria). Comparing mental images with one another is a converged way of comparing the goals for which they stand for.

Notice that I don’t say that the truth can be equated with how often the goal is successfully **achieved** by the individual. Achieving a goal is abstract, having it influence our worldview is not.

In our everyday thinking, we don’t always associate truth with pleasure and falsity with pain, for example, we have expressions like “truth hurts” that representing the conflict between mental images and reality. Let’s talk about how perception evolved to get to that point.

## Evolutionary perspective

The behavior of the simplest organisms that have no brain or have a very rudimentary brain can be described by the stimulus-reaction model - they perceive an object and react on it immediately in the manner that they are predisposed (with natural selection clearing out inadequate responses). A little more complex, but still fairly simple are organisms that can also judge whether a given reaction was “good” or not (e.g. by using pain detectors) and store in their brain a lot of good stimulus/reaction pairs e.g. seeing a predator and running away. These pairs resemble rudimentary memories but unlike real memories, they don’t require for an organism to have concepts of time, causality or any of the other related concepts in order to exist, as these pairs:

* Do not constitute sequences of actions or events.
* They are not related to one another in any way i.e. there is no before and after.

Such organisms can also work with concepts (a concept in their case being just a collection of memories that resemble one another), but they are still very simple. For them, the concepts of truth and falsity (if we can call them that) are equivalent to the feelings of pleasure and pain.

More complex are organisms that have the ability (or perhaps it is more correct to say “the ambition”) to predict the future. Indeed those are the ones that have a concept of a future and past at all, as the concept of a prediction is the same as that of the future. Predicting the future requires more than just taking stale pictures of things and figuring out what you need to do in case a similar situation arises: it requires the organism to have the concept of a *world* (or of “substance” as it is sometimes called). This can allow organisms to produce images that:

* Have multiple steps that lead toward a common goal.
* Can be organized in a hierarchy, where one goal can be a step towards a bigger goal.
* Are self-enforcing (we will say more about that later).

The main difference between the two is different types of knowledge - simple organisms can only have knowledge that has *limited scope*, while more complex ones have knowledge that is *universally valid*. The two types of knowledge correspond to the two types of Aristotelian syllogisms

* Some A-s are B (limited scope)
* All A-s are B (universal)

We need to think only a little about how those two types of knowledge are acquired to see that, although comparable, they are drastically different from one another:

Simple organism who thinks in terms of statements with *limited scope*, thoughts are only a means for gaining a more favorable feedback from reality, which means that their significance is limited e.g. a simple organism that has an apple which is not tasty would be “unhappy” about the sore taste, but it would not ever be unhappy about the *fact that his assertion turned out to be false*.

A simple organism just abandons an idea, as soon as it feels wrong to it, being wrong does not lower his self-esteem, it does not bring it an existential crisis, nor does it cause it to abandon some other related ideas that it has.

Furthermore, a simple organism would not feel the need to unite several different phenomena that it experiences under one common cause, nor does it feel the need to ponder over why things are the way they are and not some other way (as I do currently). The simple organism is humble - it just does not hope that it can ever know what the things that it says really are and so it does not bother itself with them.

If they could talk, simple organisms would probably say that they are *wrong by default*, whereas we, because we are “smarter” consider ourselves correct by default.

4. Statements that have only limited scope can be justified only by \*observation\* - if I observe two or three objects that I categorize as `A`s (e.g. "apples") and I find that they possess the property `B` (e.g. "tasty"), I can conclude that `Some A-s are B` based on those observations alone i.e. based on my instincts.   
  
Statements with universal scope, on the other hand, are axiomatic by their nature - they create reality as much as they describe it. My basis for saying `All A-s are B` is not at all different from my basis for saying `Some A-s are B`. What is different is my decision to assume that this piece of knowledge is universal.

## References

* The idea that mental images are goals is probably due to Immanuel Kant - Kant says that concepts resemble *rules* of perception and from there it is easy to speculate that rules define goals.
* The idea that everything is uncertain due to the lack of a starting point when it comes to our thoughts and judgments has been around since forever, but it has been articulated best by Wittgenstein and later related results were formalized by Kurt Godel and Alan Turing (both of which were influenced by him).
* David Hume has written a lot about emotions (“passions”) in the second part of his treatise of human nature.
* If you want to know more about the evolutionary perspective, check Robert Sapolsky’s lectures on behavioral biology.

# On the concept of the world and of determinism as the “default” worldview

The things we know (i.e. assume are true) shape our worldview. But a worldview is not the same as the world - in the world, there would always be things that clash with our worldview. Sometimes when that happens (when we perceive new things that we did not expect) we adjust our thinking so as to take these things into account. But if there is no way to adjust our thinking we just ignore the things that don’t fit into our worldview as if they do not exist. If there is an event (or even a whole aspect of reality) that does not uphold to our worldview we would not be merely unable to *make sense* of that event or aspect (as seeing an event without being able to make sense of it would indicate that we can theoretically comprehend it by merely adjusting our thinking), we would not be able to perceive it in any way, even if it happens before our very eyes.

1. Mental images of the particular shape the mental images of the general. Having the image of `A ⇒ B` in our head, when we search for a new image, we will search for it only in the space which is not occupied by `A`-s and `B`-s so the new image would be supplementary to `A`-s and `B`-s, like a jigsaw puzzle and hence our whole worldview.

The only way to prevent that is to assume that the world is unknowable in a first place (i.e. that it is unlawful by its nature). However, we can only do that to an extend - assuming that something is not lawful is simply a dead-end in terms of thinking about it - it just halts our ability to perceive and process. This is why we (mostly) assume otherwise.

When applied to large-scale thinking, this assumption establishes determinism as the “default” worldview and makes us contain non-deterministic phenomena in a system which is inherently deterministic: the mental image that represents “the world”.

1. The mental image of the world (let's call it `M`) is the central dogma, controlling the world is the central goal.

(Where the goal (“controlling the world”) is encoded in the defining characteristic of the mental image (determinism)).

In deterministic systems, non-deterministic events can be only explained by “hidden variables” theories, that basically say that the only reason why you didn’t predict something is that you are not good enough and you don’t know enough - this is a good stance to adopt for evolutionary reasons, as it constantly pushes us to analyze and systematize everything around us, but it’s bad when we take it too seriously.

It would be pretty weird if the world was deterministic - we perceive the world using mental images and mental images are just subjective representations, established with an aim for the survival of our species so being able to model the *objective* world deterministically using our *subjective* mental images would not make much sense.

True, we are able to model *some* aspects of the world *some* of the time, with *some* precision but being able to model the world itself would only be possible if someone created this world especially for us. I, personally, don’t find that plausible, so my opinion is that the equivalence between the mental images in our mind and the world is an illusion. - the only reason mental images, among which is M exists is to satisfy our urges. If there were a state in which our urges are really satisfied, time for us would freeze and we would reach some kind of perfection due to which our world (M) will just disappear. But that perfection is unattainable and that is not due to limitations of the physical world, but due to the limitations of our inner world, of ourselves as “non-gods”.

You can view God as a being that possesses what Kant calls “active intuition” i.e. who’s thoughts are, by themselves, reality, as opposed to the thoughts of normal organisms that don’t alter reality in any way. This is why God is, by definition only one and unique. This is why *she* is by definition immortal - not only because, as a supreme being, she would be capable of not dying, but because her death does not make sense unless the world itself dies with her. Simply put God’s mental image (M) *is* the real world (W) and the M of each human being bears some resemblance to W, as far as we can view this person as created by God in Her image.

In the many ways in which we are not God, we can say that M is not the same as W, although they are often observed as similar. M is deterministic, i.e. it is lawful and in a way that is always observable, while W is not. Mistaking M for W (or rather not recognizing that they are different) can lead us to the conclusion that W is deterministic too i.e. that everything that we perceive that is not lawful is some kind of illusion. The truth is the exact opposite - unpredictability is actually reality’s defining characteristic, that differentiates it from dreams - when we are not observing anything unpredictable, this means that we are perceiving the world against a preestablished set of images i.e. *dogmatically*. And perceiving the world *empirically* is essentially the same as seeing its unpredictable side. This goes to show that M and W are not only slightly different (e.g. one is not contained in the other) - they don’t overlap at all! And that is not because they are not at all similar, but simply because they follow two different, I’d say opposing, principles.

2. The real world (let's call it `W`) is our source of empirical knowledge.

(the development of physics is a perfect illustration of my thesis - although it was a discipline that had determinism as a given from its inception, physics is slowly moving from completely deterministic (classical physics) to probabilistic models (quantum mechanics).

The principle that is behind M is, of course, the same principle that is behind all other mental images - *the principle of causality*. To discover what the principle of W is, let’s start by examining the concept of a mental image again. If we think about it, we will realize that mental images are not so much descriptions of some particular substance or material but a description of a class of *arrangement* of the substance (and causality, describes how these arrangement change). However, given a set of arrangements of some atoms, molecules, or any other elements, there would be some arrangements that can be classified as instances of mental images and (and that follow the principle of causality) and some that cannot, where the second type of arrangements are only much more probable to exists (e.g. 99.9 per cent of the random arrangements of bricks are not buildings), but much *more probable to develop into* (given enough time an ordered arrangement of bricks will eventually crumble to an unordered one). This is just a paraphrase of the second law of thermodynamics, stating that the entropy of a given closed system increases over time.

3. If `M` is based on information based on the principle of \*causality\*. We may say that `W`'s defining characteristic is the somewhat reverse concept of \*entropy\*.

The real, objective world (W) tends to naturally go against any kind of mental appropriation and therefore against the principle of causality - as entropy in the world increases, the ability of observers to predict the way in which it would develop decreases i.e. for them there are less and fewer things happening and moreover all mental images become obsolete.

The entropy of our human world (M) rarely decreases, M is ordered and predictable, but only because *we ourselves make it so* (if I were to sit down and just observe in a world without life and other individuals then there will be nothing much to observe). What we *do* creates order and makes causality work. This is when we circle back to my most essential propositions and try to amend it

4 "Causality is in the eye of the beholder i.e. `A ⇒ B` is not a fact about the world, but a mental image." It may seem that we are using cause and effect to understand order, but we actually use it to act and through our actions, create order.

## References

* The world as an idea is the central concept of the (somewhat) eponymous work by Arthur Schopenhauer
* The concept of God having active intuition I got from the Robert Paul Wolff lectures on Immanuel Kant
* The dichotomy between causality (or information) and entropy is inspired by Hans Reisenbach’s book “The direction of time”. See chapter 4, “The time direction of macrostatics”.
* The book “Lost in Math” by Sabine Hossenfelder discusses the role that human prejudices play in physics and in how our criteria of beauty and simplicity predisposition the physical theories that we create

# On the ability to memorize and on the way our thinking becomes more and more dogmatic over time as a contributing factor of our notion of time. On the self-enforcement of deterministic subsystems, due to mental images and goals which are mistaken for the actual world.

Practitioners of mnemonics have long realized that the easiest way to remember a bunch of unconnected pieces of information is to make up some connections between them. This is because our brain is very bad at capturing raw perception data and very good in capturing mental images and causal connections - we only remember events that are connected with one another.

0. Because we necessarily see them as connected, all events that we remember form a structure that is known as a causal chain.

An event that has nothing to do with our causal chain is simply not perceived by us (or, it is perceived but not remembered even for a second). So in many ways, placing the event in the causal chain is perception itself.

Furthermore events that are part of the causal chain can be compressed further, by imposing additional structure - e.g. if I just remember that I went to school yesterday, I don’t have to remember going out of the house, locking the door, waiting for the bus etc. as all this is implicit (some computer compression algorithms are based on the same principle).

1. Because of the way that memories work, mental images have the power to reinforce themselves with time - having the image of `A ⇒ B` in our head, we would see `A`-s and `B`-s all over the place.

The more time passes and the more compressed our memories are, the more “stylized” they become, replacing more and more perception data with mental images. This is why older people as a rule are more dogmatic than younger ones - it is not about older people having more knowledge (real knowledge will make you less dogmatic if anything), it’s about having more dogmas.

Aside from their degree of abstraction, mental images also have a degree of realness - in our everyday thinking, we often refer to all things that we talk about as either real or unreal (just like in logic we split statements to true and false) e.g. Stephen Hawking is real and Professor Charles Francis Xavier is not - an event is either in the chain or not. This line of thought, however is too naive. To see why, one just has to look at a more abstract concept, e.g. is true love real, and does it exist? It all depends on how you define it, and defining it in too robust terms is impossible, as the definition would rely on many other concepts. the “realness” of a concept is not just a matter of whether something exist or does not i.e. if you had or had not seen something that resembles it, but a matter of how much does the concept resonate with the concepts that constitute our worldview. Changing these concepts would then change our whole experience not only of the present, but also of the past.

2. The causality chain is modifiable and past events that we remember are mere projections of the mental images that we use at this instant, as unstable and as subjective to change as our future projections.

However in practice we cannot do that, as our memories are always “stylized” to the mental images that we had used when we perceived them. Because of this, we cannot really use our memories to make any *new* mental images, but only to extrapolate on the images that we already have.

## References

* Nassim Taleb often deals with the humans inability to see and account for uncertainty.

# Appendix

## Table of M and W

                  | M | W |  
Defined by | Fragmented | Unified |  
Mode of perception | Dogmatic | Empirical |  
Defined by | Causality | Entropy |

Note that M is unified in some sense, since M obeys common principles, while W does not obey any principles. But W is unified in a much deeper way - the more chaotic and unstructured a given arrangement is, the more everything is connected to everything else, while our Mental world is fragmented in the sense that you can easily view a given part of it by itself.

## Rules of life

Don’t focus too much to particular interpretations of reality and to the aspect of reality which is ultimately known as based on them - practice empirical thinking.

Don’t mind mistakes - anything worth doing is worth doing poorly.

Don’t compare things in terms of quantity, instead, compare them in terms of quality - buying more stuff will not bring you closer to happiness, just like living longer years will not bring you closer to immortality.

## Short history of causality, determinism and time

*~-500* - ***Zeno of Elea*** points out the issues with the concept of continuity and the way it clashes with our everyday notion of time in his famous set of paradoxes.

In a race, the quickest runner can never over­take the slowest, since the pursuer must first reach the point whence the pursued started, so that the slower must always hold a lead. (as recounted by Aristotle, Physics VI:9, 239b15)

*~-520* - ***Heraclitus*** points out the allusive nature of the causal chain and its connection with the idea of the self

We both step and do not step in the same rivers. We are and are not. Moreover, we step into and out of the river as different beings.(B49a)

*~360* ***Zeno of Citium***, the original founder of Stoicism, had a simple but powerful idea of the causal chain - every event has a cause, and that cause necessitates the event and that given exactly the same circumstances, exactly the same result will occur.

It is impossible that the cause be present yet that of which it is the cause not obtain.

*~300* ***Euclid*** publishes his *Elements* - one of the first and most famous axiomatic (formal) systems, showing how a very complex deterministic system can be developed from a very small set of rules using inductive reasoning.

*~ 210* - ***Sextus Empiricus*** nailed it with his critique on inductive reasoning, positing that a universal rule could not be established from an incomplete set of particular instances:

When they propose to establish the universal from the particulars by means of induction, they will effect this by a review of either all or some of the particulars. But if they review some, the induction will be insecure, since some of the particulars omitted in the induction may contravene the universal; while if they are to review all, they will be toiling at the impossible, since the particulars are infinite and indefinite.

*1687* - ***Isaac Newton*** published his *Principia Mathematica* one of the most fundamental scientific papers ever where he: - Invented calculus as a way to deal with the problem of continuity (and thereby resolving, or at least circumventing, the paradoxes of Zeno of Elea). - Cemented the idea that the that there are absolute laws that are governing the entire universe - Posited the existence of absolute time.

“Principia…” laid down the idea that later became central for all of physics, except quantum physics (i.e. classical physics) - the idea that the world can be modelled using a set of formal walls, a-la Euclid’s postulates.

Absolute space, in its own nature, without regard to anything external, remains always similar and immovable. Relative space is some movable dimension or measure of the absolute spaces; which our senses determine by its position to bodies: and which is vulgarly taken for immovable space … Absolute motion is the translation of a body from one absolute place into another: and relative motion, the translation from one relative place into another …

*1739 - 40* - ***David Hume*** publishes *A Treatise of Human Nature*, most famous for his critique of induction (resembling that of Sextus Empiricus) and lays down the groundwork for the modern views on the topic of causality, insisting that (while completely valid) the connections we make using the concept of cause and effect are subjective and imaginary.

This deficiency in our ideas is not, indeed, perceived in common life, nor are we sensible, that in the most usual conjunctions of cause and effect we are as ignorant of the ultimate principle, which binds them together, as in the most unusual and extraordinary. But this proceeds merely from an illusion of the imagination; and the question is, how far we ought to yield to these illusions. This question is very difficult, and reduces us to a very dangerous dilemma, whichever way we answer it. For if we assent to every trivial suggestion of the fancy; beside that these suggestions are often contrary to each other; they lead us into such errors, absurdities, and obscurities, that we must at last become asham’d of our credulity.

On Newton:

While Newton seemed to draw off the veil from some of the mysteries of nature, he showed at the same time the imperfections of the mechanical philosophy, so agreeable to the natural vanity and curiosity of men; and thereby restored her ultimate secrets to that obscurity, in which they ever did and ever will remain.

*1781* - ***Immanuel Kant*** reads Hume’s treatise and decides to refute it, an effort which results in probably the most serious work on the subject of causality, “The Critique of Pure Reason”. In it, Kant says that causality cannot be the result of experience, because it enables experience and plunges in a multidisciplinary investigation to discover what it actually is while refuting Newton’s notion of absolute time in the process.

Now let us proceed to our problem. That something happens, i.e., that something or a state comes to be that previously was not, cannot be empirically perceived except where an appearance precedes that does not contain this state in itself; for a reality that would follow on an empty time, thus an arising not preceded by any state of things, can be apprehended just as little as empty time itself. Every apprehension of an occurrence is therefore a perception that follows another one. Since this is the case in all synthesis of apprehension, however, as I have shown above in the case of the appearance of a house, the apprehension of an occurrence is not yet thereby distinguished from any other. Yet I also note that, if in the case of an appearance that contains a happening I call the preceding state of perception A and the following one B, then B can only follow A in apprehension, but the perception A cannot follow but only precede B. E.g., I see a ship driven downstream. My perception of its position downstream follows the perception of its position upstream, and it is impossible that in the apprehension of this appear­ ance the ship should first be perceived downstream and afterwards upstream. The order in the sequence of the perceptions in apprehension is therefore here determined, and the apprehension is bound to it. In the previous example of a house my perceptions could have begun at its rooftop and ended at the ground, but could also have begun below and ended above; likewise I could have apprehended the manifold of em- pirical intuition from the right or from the left. I n the series o f these perceptions there was therefore no determinate order that made it nec- essary when I had to begin i n the apprehension in order to combine the manifold empirically. But this rule is always to be found in the percep- tion of that which happens, and it makes the order of perceptions that follow one another (in the apprehension of this appearance) necessary.

(…)

If, therefore, we experience that something happens, then we always presuppose that something else precedes it, which it follows in accordance with a rule. For without this I would not say of the object" that it follows, since the mere sequence in my apprehension, if it is not, by means of a rule, determined in relation to something preceding, does not justify any sequence in the object.d Therefore I always make my subjective synthesis (ofapprehension) objective with respect to a rule in accordance with which the appearances in their sequence, i.e., as they occur, are determined through the preceding state, and only under this presupposition alone is the experience of something that happens even possible.

On Hume:

I freely admit that the remembrance of David Hume was the very thing that many years ago first interrupted my dogmatic slumber and gave a completely different direction to my researches in the field of speculative philosophy.

*1814* - ***Pierre-Simon Laplace*** invented the modern concept of scientific determinism:

We may regard the present state of the universe as the effect of its past and the cause of its future. An intellect which at a certain moment would know all forces that set nature in motion, and all positions of all items of which nature is composed, if this intellect were also vast enough to submit these data to analysis, it would embrace in a single formula the movements of the greatest bodies of the universe and those of the tiniest atom; for such an intellect nothing would be uncertain and the future just like the past would be present before its eyes. A Philosophical Essay on Probabilities

*1905* - ***Albert Einstein*** publishes the paper “The Thermodynamic of Moving Bodies” where he proposes the special theory of relativity which slowly killed off Newton’s concept of absolute time, confirming some of Kant’s views on space and time in the process (although Einstein himself famously opposed Kant’s formulation and specifically the idealistic aspect of it).

the same laws of electrodynamics and optics will be valid for all frames of reference for which the equations of mechanics hold good. We will raise this conjecture (the purport of which will hereafter be called the “Principle of Relativity”) to the status of a postulate, and also introduce another postulate, which is only apparently irreconcilable with the former, namely, that light is always propagated in empty space with a definite velocity c which is independent of the state of motion of the emitting body. These two postulates suffice for the attainment of a simple and consistent theory of the electrodynamics of moving bodies based on Maxwell’s theory for stationary bodies. The introduction of a “luminiferous ether” will prove to be superfluous in as much as the view here to be developed will not require an “absolutely stationary space” provided with special properties, nor assign a velocity-vector to a point of the empty space in which electromagnetic processes take place.

On Kant:

The very fact that the totality of our sense experiences is such that by means of thinking (operations with concepts, and the creation and use of definite functional relations between them, and the coordination of sense experiences to these concepts) it can be put in order, this fact is one which leaves us in awe, but which we shall never understand. One may say “the eternal mystery of the world is its comprehensivibility.” It is one of the great realizations of Immanuel Kant that the setting up of a real external world would be senseless without this comprehensibility. (Albert Einstein, Out of My Later Years)

*1935* - ***Einstein*** (again) along with *Podolsky* and *Rosen* argues that the universe puts forward what is now known as the *EPR paradox*, and argues that the quantum-mechanical wave function must be an incomplete description of the physical world. But the real significance of the paper is that it takes as a given the assumption that the universe is deterministic.

While we have thus shown that the wave function does not provide a complete description of the physical reality, we left open the question of whether or not such a description exists. We believe, however, that such a theory is possible.

Or in Einstein’s own words:

I, at any rate, am convinced that [God] does not throw dice

*1964* - ***John Stewart Bell*** publishes a paper titled “On the Einstein Podolsky Rosen Paradox” where he makes the simplest and at the same time most ground-breaking discovery in this list by just realising that there exist some quantum phenomena which cannot be accounted for any deterministic model of the universe (that is unless you are willing to believe that two particles can “communicate” with each other so that they can synchronise their states, and they can do so faster than the speed of light). This article is largely an effort to examine the philosophical implications of Bell’s inequality are outlined in this article.

Einstein said that it is theory which decides what is ‘observable’. I think he was right - ‘observation’ is a complicated and theory-laden business. Then that notion should not appear in the formulation of fundamental theory. Information? Whose information? Information about what? On this list of bad words from good books, the worst of all is ‘measurement’. It must have a section to itself.

On Euclidian geometry

I agree with them about that: ORDINARY QUANTUM MECHANICS (as far as I know) IS JUST FINE FOR ALL PRACTICAL PURPOSES. Even when I begin by insisting on this myself, and in capital letters, it is likely to be insisted on repeatedly in the course of the discussion. So it is convenient to have an abbreviation for the last phrase: FOR ALL PRACTICAL PURPOSES = FAPP.

(…)

I expect that mathematicians have classified such fuzzy logics. Certainly they have been much used by physicists. But is there not something to be said for the approach of Euclid? Even now that we know that Euclidean geometry is (in some sense) not quite true? Is it not good to know what follows from what, even if it is not necessarily FAPP? Suppose for example that quantum mechanics were found to resist precise formulation. Suppose that when formulation beyond FAPP was attempted, we find an unmovable finger obstinately pointing outside the subject, to the mind of the observer, to the Hindu scriptures, to God, or even only Gravitation? Would that not be very, very interesting?

From “Against ‘measurement’”, Physics World (August 1990)