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Free Will, Randomness & Non-Locality

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What Does it Mean to be Free in a Totally Interconnected Universe?



Note: this video follows from my previous video titled “[How Much Free Will do You Have?](#)”. I recommend you watch it before this one, as they are best watched together.

Script:

Ok, let's talk about another extreme definition of free will now, which I introduced you to in my previous videos, where I



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covered Bell's Theorem and also Conway & Kochen's Free Will theorem.

100% Free Choices?? Randomness and Free Will in Quantum Mechanics

This definition of free will requires the ability to make choices which are 100% free from all past or external influences. This presumably would also include our past mental states, so effectively, this definition completely disregards our feedback memory systems, the fact that we tend to get stuck in certain patterns or habits, and so on... Think about it. This notion of free will is probably just as extreme as the notion I was discussing earlier which required that we must be able to 100% self-determine not only the way we play our cards but also the cards we play with.

In this case, a 100% free choice, in the context of a quantum physics experiment, is defined as the kind of choice that can only be correlated to variables in its causal future, but not its causal past. Note that, in this definition, the emphasis is not on self-determination or control, but rather, on the ability to make a choice which somehow does not depend in any way on past history or external influences of any kind. For all intents and purposes, a 100% free choice, according to this definition, looks like a completely random choice, that is, a choice which could not in any way be correlated with anything else in the past history of the universe or any other external events taking place away from us in space-like separated points of the Universe. A 100% free choice, according to Bell and Conway & Kochen, would be a choice which could only be correlated with events in its own future light cone.

As I was saying in [my previous video](#), requiring a human being to be able to perform a 100% free choice sounds a bit unhuman to me, because, it seems that we are equating this human free choice with a random choice. Are we humans really able to make completely random choices which are not influenced by anything at all? As John Conway points out, we only require that humans are able to perform some of their choices in this manner, of course not all of them. We could call this kind of free choices non-responsible, inconsequential free

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choices. It is almost as if, in the context of a quantum physics experiment, what we are requiring is that, at least sometimes, human experimenters need to be able to perform completely random choices, which are not at all influenced by their past history or external events.

So I guess it is important to realise that, in the context of a quantum mechanics experiment, we are not talking about the type of free choice involving a decision such as what I am going to eat for lunch, what clothes I am going to wear for a job interview, or who I am going to marry... I would definitely hope that in these situations the past history of the universe – my own past history! – would guide and influence my choices! That my experience of life, what I have learnt, my memories, and so on, would be causally linked to my choices. No, in this case, we are talking about making a choice between options that will not carry any significant consequences for us, a choice that should not really matter at all to us, such as choosing between up and down, right and left, and so on... We are in fact only discussing the idea of whether a human being is actually able to make a completely random choice which is not correlated with anything else at all.

And it is a free choice in the sense that we can indeed make sense of the idea that “I could have done otherwise”, because a) I assume Nature to be intrinsically indeterministic and hence the choice was not pre-determined at all and b) because I am able to visualise distinct future timelines, one for each possible choice.

Still, the kind of free choice needed in a quantum mechanics experiment is the type of free choice which does not at all imply a responsible decision of the kind which would require our past history to play a significant role, in particular, the kind of choice that would require the use of our memory to ensure that our decision was not random, but a partially self-determined one, for instance, the choice of whether or not to marry someone. I wonder, are we human beings able to tap into nature’s randomness to make the kind of 100% free choices required in a quantum physics experiment, in exactly the same way as a machine or a quantum random number generator may do? Are we able to completely free ourselves from memory and habits in order to make a completely

random choice? Maybe, sometimes... I have my doubts.... Difficult to tell without proper experimental testing... We need to start performing quantum physics experiments where human choice plays an essential role.

In any case, at least with this particular kind of inconsequential choices, it seems like a reasonable approximation to require that our past history cone is not correlated at all with our present choice, to think that we are able to spontaneously come up with a random choice without any need for deliberation and without any information associated with our past influencing the outcome of our choice. We can start by assuming that this is indeed possible, then put our assumption to the test, see what happens in our experiments, and of course compare the results with those of other similar experiments where random number generators have been used to make the so called free choices.

Personally, I have my doubts that putting human beings, particles and machines at the same level in a quantum mechanics experiment is sensible at all. In particular when it comes to free will, it seems rather unreasonable to me, as I believe that most of our choices are usually not the same as a random choice, but instead they involve partial self-determination.

Our choices may in general be influenced, while not be uniquely determined, by our past history cone, and I think this may probably be the case even when choosing between simple options such as up and down, right and left, and so on... Nothing is set in stone, the future is open, but we are still influenced by everything else, including our own actualised pasts, which we can access thanks to our memory. This means that we need to stop thinking of free will as an all or nothing capability. Quantifying our decision space and modelling reality, including our choices, in a probabilistic, non-deterministic manner, seems a more reasonable option to me...

Free Will, Intent and Non-Localities

Having said that, here is a very important point worth

mentioning. If I understand it correctly, the requirement that the experimenter's choice is 100% free from past influences means that his choice must be 100% independent from the hypothetical local realistic causal mechanism which would pre-determine his actual choice. In other words, this definition of freedom is based on the assumption that choices are made according to Einstein's principles of local causality.

But, if Nature is in fact operating non-locally and if, in addition, non-realism is true, then the whole free will assumption, since it was defined in line with local realism, may need to be completely re-defined. If Nature, at its core, does not really operate according to local realism, and entanglement is really a non-local phenomenon, as all our experiments suggest, then how justified are we in assuming that our choices and intents operate only according to local causality? Because if even our intents and choices do not necessarily operate according to local causality, then it seems reasonable to consider the possibility that our intents and choices may also get entangled with the external world!!

In other words, we can still talk about free will, but we may need to open our minds to the idea that our intents and choices can be influenced non-locally by things or events we perceive to be external to us; equally importantly, we may also need to open our minds to the idea that the opposite may also be true, namely, that our own choices and our intents can in fact influence the external world non-locally! If everything is interconnected non-locally, then so are choices and intents. Causality as we understand it from the local realist perspective goes out the window and so do our simple, mechanistic definitions of free will.

This ties in with the idea that intent may be able to non-locally affect the probability distribution of an experiment's outcome, that it could do so while not being constrained by local realistic causality. Again, this is material for another video, of the fringe science variety that I would really like to explore in much more depth!

Quantifying Free Will – Quantum Cryptography and the Super-Deterministic Universe

In any case, going back to our local definition of free will, the issue of whether the freedom in our choices can be quantified, of whether our choices may be said to be 100% free, not free at all, or any of the shades of free in between, has indeed been discussed within the context of quantum mechanics. Furthermore, turns out that the answer to this question may have extremely important consequences, particularly in the field of quantum cryptography, which for instance describes how best to use quantum communication in order to exchange a key securely.

In 2010, physicists Nicolas Gisin and Jonathan Barrett suggested a way to quantify free will in the context of a quantum mechanical experiment that uses entangled particles. They found that non-locality could be mimicked by the loss of just one bit of free will. What this means is that, if we assume Nature to operate locally when it comes to our choices (that is, according to the principles of relativistic local causality), the smaller our decision space is, in the sense that there are more constraints imposed on the total number of possibilities we can choose from, the more likely that the loopholes cannot be closed and hence the higher the probability that someone could construct a local hidden variable theory which exactly reproduces the predictions of quantum mechanics. Hence the more likely that the universe is super-deterministically conspiring to make our quantum mechanical experiment results such that we inevitably come to the wrong conclusions.

Leaving aside all the philosophical implications, and focusing on the practical consequences now, this loss of free will on the part of the experimenter could imply a potential flaw in quantum cryptography. If an eavesdropper constrained the options of two people using an encrypted link – in other words, if the eavesdropper reduced their effective free will by constraining their decision space – she might be able to crack the code. Luckily, an encrypted link can remain secure even when there has been some degree of manipulation.

Note that when Gisin and Barret talk about losing a certain amount of bits of free will, what they mean is that the choice of measurement settings the experimenters need to make, are no longer assumed to be completely random, but assumed to

be correlated with local variables. Their paper essentially states that, the more our choices can be correlated with local variables, or put another way, the less random our choices are, the more likely it is that somebody can come up with a local hidden variable theory which exactly reproduces the results of quantum mechanics, hence the more likely it is that the Universe is in fact a super-deterministic conspiring machine. If the super-deterministic conspiring machine concept sounds totally alien to you, I recommend you watch my previous two videos on quantum mechanics and free will to understand where all these strange ideas come from...

As I was discussing earlier, I actually have my doubts that that the process of making choices is carried out following only principles of local causality. The idea that choices are made only according to the mechanisms of local relativistic causality is one of the essential assumptions in all the quantum mechanical experiments I have discussed so far, in my previous videos. It may be a logical and simple assumption to make, but I am not really sure this assumption would make sense in a truly non-local Universe, where all things, including human choices, might be interconnected... Because this interconnectedness would be one that exists not only beyond our everyday notions of space and time, but also beyond Einstein's relativistic description of space-time, and this is why using simple local mechanistic models to describe human beings choices may not really be a wise assumption to make. This is pure speculation on my part, of course...; still, something worth pondering about, don't you think?

Entanglement & Non-Separability: What does it Mean to be Free in a Totally Interconnected Universe?

So! We have reached the end of this video! Free will is a notion that is often loaded with completely unnecessary baggage. I suppose it is inevitable, because we all tend to be a little bit biased, depending on what world view we identify the most with. Personally, I quite like the notion of taking free will as a fundamental axiom. However, I think that taking any extreme position on this matter is not helpful at all. There is plenty of room for a reasonable notion of free will without the need to require 100% random choices or 100% self-determined choices. But how can we define individual

freedom in a totally interconnected, non-local Universe? How free are the parts as compared to the whole? Is the Universe fundamentally free at the core, and do we, as individual expressions of the Universe, share this freedom too?

Think about entanglement, for instance. It reveals a very important property in the Universe – non-separability – which basically throws reductionism out of the window. Still, we need to redefine what it means to be free in a Universe where, at the core, everything is one. I find it really interesting that Conway and Kochen, in their Free Will Theorem paper which I discussed in my last video, talk about the idea that entangled particles – if we insist on looking at each one as an individual separate entity, that is – can only be described as being semi-free rather than 100% free.

However, the important point here is that entangled particles can no longer be viewed as two separate individual entities, because they now behave as one single entity, and can only be described by one single wave function which describes the system as a whole. If Nature is truly non-separable at the core, if everything is one, then the freedom experienced by each individual part may only be an incomplete picture of reality, because as long as we insist on seeing the parts as completely separate entities, freedom will always appear somehow constrained... What do you think? Is freedom an all or nothing concept? Or is there plenty of room for all the shades of grey, depending on what point of view the universe is experienced from?

Thank you so much for watching. Don't forget to give this video a thumbs up, comment, share and subscribe! If you have the financial means and really enjoy what I do, please consider supporting my channel by donating either via [Paypal](#) or via [Patreon](#). Cracking the Nutshell cannot survive without your help; even if you can only donate \$1 dollar per video, your help will be greatly appreciated! Thank you ever so much for your support! See you soon!

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