Consciousness Wars: Tononi-Koch versus Searle

http://coronaradiata.net/2013/03/17/consciousness-wars-tononi-koch-versus-searle/

The website initially focuses on the ideas of IIT developer Tononi and advocate Koch, and philosopher critic John Searle.

How does IIT account for the consciousness of dreams and hallucinations?

ME: the elements of complex systems are not only connected. They are also interdependent, Diverse, and adaptive. But a complex system arises not as the result of maximizing these Qualities, but by optimizing them. Ie, if all elements are connected, you are more likely to have Statistical regularity than a complex system. (Ideas from teaching co. lecture on understanding complexity.

by John Kubie, Neuroscientist working at Downstate Medical Center in Brooklyn, NY

Kubie's read: I thought the original Searle article was clear and powerful. I've read both Tononi and Koch and never quite gotten IIT. I found the Tononi/Koch letter a muddle, and Searle's reply clear. Since I don't really get IIT, I don't want to take sides.

Koch is best known for his book, The Quest for Consciousness: a Neurobiological Approach. A new Koch book, Consciousness: Confessions of a Romantic Reductionist is largely a description of IIT. I

John Searle is an eminent philosopher who thinks about the brain and is taken seriously by Neuroscientists. Until recently he and Koch were on the same page. For example, Searle has endorsed Koch's concept of studying the Neural Correlates of Consciousness (NCC). Searle frequently writes for the New York Review of Books, and has on occasion generated debate. Notable was Searle's 1995 critical review of Daniel Dennett "Consciousness Explained" that generated a prolonged exchange.

John Searle's review of Koch's book *Consciousness: Confessions of a Romantic Reductionist*, largely a description of IIT,

the January 10, 2013 issue of the New York Review of Books Searle reviews "Confessions" and solidifies his disputative reputation**. The review is devastatingly critical. The essence of Searle's criticism is that IIT employs a mindful observer to explain mind. There is a little man in the middle of the theory; that information isn't information until it is "read" by an entity with a mind. There may be message in the information carrier, but it becomes information when read.***

http://www.nybooks.com/articles/archives/2013/jan/10/can-information-theory-explain-consciousness/

http://virgil.gr/wp-content/uploads/2013/04/searle.pdf

seek5/fund/consciousness/searl.pdf

Can Information Theory Explain Consciousness?

According to Koch's current view, consciousness has no special connection to biology. He agrees with Tononi that the key to consciousness is information theory, which quantifies. It's about bits that can be measured, stored, and transmitted. According to Koch, any system that has processes describable by information theory, has some degree of consciousness. This amounts to saying that consciousness is everywhere. Panpsychism results.

Koch states:

"By postulating that consciousness is a fundamental feature of the universe, rather than emerging out of simpler elements, Integrated Information Theory is an elaborate version of panpsychism…" So computers might be minimally conscious.

(Me: But consciousness arising out if IIT is precisely emerging from the large number of elements; an emergent property of complex systems.)

Searle objects: First, no reason has been given by the authors why there should be any special connection between information theory and consciousness. Second, the theory implies panpsychism, which Searle rejects: Consciousness cannot be spread over the universe like a thin veneer of jam. There has to be a point where one consciousness ends and another begins. So why would a computer be conscious? Why not each part of it? Each microprocessor? Each molecule?

Searle argues that Koch is aggressively anti-reductionist, and I would also say some of Koch's views seem inconsistent with the IIT theory itself:

Koch: "Experience, the interior perspective of a functioning brain, is something fundamentally different from the material thing causing it and…it can never be fully reduced to physical properties of the brain"

"I believe that consciousness is a fundamental, an elementary, property of living matter. It can't be derived from anything else; it is a simple substance… (Whereas he also seems to believe that there is nothing especially biological about consciousness.)

Begin section 5

The late neuroscientist Benjamin Libet, among others (Germans), found that before a subject is aware of deciding to perform a simple action, his brain is getting ready to do it. The brain has a "readiness potential" which occurs prior to the reported awareness of the onset of an action. This can last a few hundred milliseconds.

(note IONS Dean Radin “precognition” of photo images) The brain decides to act before the mind knows. This could be interpreted as showing that we have no free will, which is Koch’s extreme naive view.

The cases in question are of actions the subject has already decided to do at some point.

Section 6: Standard procedure in biology is to ask the cause of something. Eg, how do brain processes cause consciousness. Koch’s procedure is to just say information IS consciousness, and because information is everywhere, consciousness is everywhere.

2 kinds of information: yes

The story doesn’t end there. The March 7 issue of the New York Review of Books contains an exchange of letters between Koch-Tononi and Searle (not behind paywall).

Update March 18. Panpsychism is a battleground in the Koch/Tononi letter and Searle’s response. According to wikipedia, which seems an adequate source here,

In philosophy, panpsychism is the view that all matter has a mental aspect, or, alternatively, all objects have a unified center of experience or point of view. Baruch Spinoza, Gottfried Leibniz, Gustav Theodor Fechner, Friedrich Paulsen, Ernst Haeckel, Charles Strong, and partially William James are considered panpsychists.

Kubie’s take: both get hits. Searle doesn’t acknowledge the “local” panpyschism of IIT. IIT has a spatially restricted, spatially centered panpsychism, according to Tononi and Koch in their response letter. That’s why my consciousness doesn’t mix with yours. If a theory of consciousness uses panpsychism, especially a special form, isn’t it assuming the very hard part, asking for special help from novel laws of physics?

Update 2 march 19 A few hours ago I re-read chapter 8 of Koch’s “Confessions”, which contains the entirety of Koch’s description of IIT. I also reread Searle’s review of “Confessions”, and the NYRB letter exchange. In Chapter 8 I searched for a clear description of “connectedness” but couldn’t find it. I don’t know if connectedness is statistical or involves causality. I also looked for an indication that IIT’s panpsychism is localized — that it is centered around a local maxima — but couldn’t find it. My conclusion is that the Koch book is, at best, a remarkably incomplete description of IIT. (and the Koch book is what Searle reviewed.) IIT depends heavily on connectedness; to evaluate IIT we must know

what what connectedness means and how a system could detect its own localized connectedness without an external observer.

Counter argument by Bob:

the beautiful thing about IIT is that actually no external observed is needed to read out the information, i.e. it is not a theory with a “man in the middle”. Of course, information in the traditional sense (a book, a CD, and so on) is meaningless until read and interpreted by human beings and Searle’s confusion likely arises from here. But Tononi’s theory and his Phi do not measure the amount of information that is readable by an external observer, but the amount of information which is “read out” by other parts of the system.

This is information has an “intrinsic” sense: you put a whole bunch of interacting units together (could be neurons but also anything else). Then you divide the system into two parts which are sharing information (you can measure this with Shannon’s tools). The amount of information they share is observer-independent: one part of the system generates information which is read out by the other part and vice-versa. Then, you take all possible partitions of the system into two sets (this can be a huge number!). For some partition, the maximum amount of information will be shared and Phi is defined in this way.

The premise of PHI is to ask – given a system in a state, what it can it possible know about itself, given it’s state. This is a mathematical property of the system, not of any observer. And the reason why PHI explains the unity of consciousness is because this intrinsic knowledge is irreducible

Enzo:

So my general view is that information integration is an important feature of consciousness but cannot be the whole story.

One can measure information independently of any observer and this is exactly what Shannon managed to do: a formal theory to quantify information in a channel. This is what made his theory so controversial at first: the separation of information from meaning.

Summing up: Tononi just says that some systems are good at integrating info and some others aren’t. For example, a system of independent, non-interacting units is bad. Also a system in which every unit does the same is bad. In between you have complexity, when cool and interesting things happen, and consciousness has to be here. I wouldn’t say this is wrong, and certainly you do not need an external human observer to decide if the system is complex and good at integrating information. My critique would be that this might be rather trivial.

Kubie:

reply to Enzo (above). I think Searle, and McGinn (and perhaps I) would say that you're confusing message with information. The firing of the cell and the zipped file contain message. They only become information when observed by a mind.

Intended as a reply to Enzo and a general comment. The window we have on consciousness is our subjective experience. Does the IIT fit with subjective experience? I'd say not too well.

Bionic:

As with all laws of nature currently produced by science, IIT is merely a description that may/may not correlate with consciousness, and will therefore be devoid of all explanation.

An analogy: Consider Newton's 2nd law F=MA, the force correlates of acceleration. It presupposes the (conscious scientific observer) and says nothing about _why_ F = MA. It only says that, to a presupposed observer/conscious scientist, the universe will appear consistent with F=MA. There is no explanation of inertia here. There is merely description and prediction.

Not because explanation is impossible, but _because we haven't ever actually explained anything!_ Ever.

Kubie:

But IIT does propose a mechanism via local panpsychism; that is, by some magical methods, if a localized region of space (mostly, cerebral cortex) both contains sufficient information, and the information is 'connected' across regions (?synchronized?) then consciousness will emerge. This goes way beyond known laws of physics, but it is a mechanism, not a correlation.

Bionic:

In my world the way an explanation of consciousness would look is: "The appearance of brain electromagnetism is how consciousness presents, to itelf, the natural world in the act of delivering consciousness. This too is mechanism devoid of explanation. Like IIT is devoid of explanation. It also includes IIT insofar as the EM field contains the integrated information itself.

Phiguy:

Tononi's updated 2012 account of the IIT that he makes explicit that he is no longer using Shannon information or the "Kullback-Leibler divergence" to measure the difference between two probability distributions.

Also, Searle didn't get the theory AT ALL! He was stuck on the idea that information requires a conscious receiver to make sense, but the IIT is the exploration of the notion that a system, if "wired" in a particular way can be its own information channel, sending and receiving causal information about itself to itself. In this kind of system information doesn't become divorced from meaning as Shannon information did; rather, when the system is integrated, information BECOMES meaning.

Reply ↓

jkubie on January 24, 2014 at 11:50 pm said:

phiguy110 I appreciate that either Searle didn't get it; or he destroys IIT. No middle ground. I'm a little stale on the material, but here goes. 2 deep problems with IIT; first panpsychism. While a nice idea, physical support is lacking. If we accept panpsychism its probably possible to make other "consciousness" explanations. Although Koch and Tononi appear to be late in admitting to panpsychism, they (or at least Koch) are fully committed. See Koch's recent Sci American blog post ("is Consciousness Universal?"). Second is locality. How are pieces of information connected? Axons are not an adequate answer. Need a physical process that can differentiate local and non-local informative structures.

Reply ↓

phiguy110 on February 4, 2014 at 4:41 pm said:

Just to respond to your two points.

First, panpsychism you say is lacking "physical support." I don't know what sort of "physical support" you would be looking for. Panpsychism, if true, emerges from a proper conceptual analysis of how consciousness is generated. If consciousness is integrated information, and if integrated information systems are causally autonomous, as the theory predicts, then panpsychism would have to hold, as all real, irreducible causation would have to be "conscious" on some level. (Though certainly the consciousness of a system with only two states, like Tononi's photodiode example, would be so minimally conscious as to make deep sleep look existentially rich by comparison.) Still, some consciousness, however minuscule, is not no consciousness, and the IIT predicts a conscious state that is truly, irreducibly minimal, containing 1 bit of information. ??? As for other "consciousness explanations," I suppose we'd have to evaluate what those were and whether they were as conceptually and empirically rich as the IIT. We are not accepting the IIT because we accept panpsychism, we accept panpsychism because of the IIT, and that makes a world of difference. Also, the idea that Tononi was late in accepting panpsychism is a canard; his book with Edelman years ago was titled "A Universe of Consciousness" and the IIT has always been explicit about panpsychism, as the photodiode thought

experiment shows. Perhaps it's just that, being a rigorous scientist, Tononi was reluctant to go full-on Deepak Chopra in his articulation of the theory and choose not to stress the panpsychism as people have confused notions of what panpsychism really implies.

Second, pieces of information are connected through mechanisms which have the power to cause a difference that makes a difference to other mechanisms. Mechanisms can exist on any spatiotemporal scale. Re-wire the Internet to integrate information like a brain and the mechanisms can span the whole world, the important thing is that they work as one and the behavior of the system cannot be reduced to any partition of its parts. In fact, discover the irreducible systems of integrated information in the world and you've truly carved nature at its joints. In a brain, Tononi speculates it's a central corticothalamic network made of cortical columns that act as the elements in the brain's "dynamic core" (a term he used more with Edelman), that is to say, the system of columns in your brain which is wired to behave as irreducibly and maximally one from a causal point of view. It is this system that generates human consciousness, with other parts of the brain feeding in information to the system but not contributing to it's irreducibly intrinsic phi value. Also, information can only be counted once, so a mechanism can only contribute to one irreducible structure. He calls this the "exclusion principle." Because of exclusion, in the IIT, consciousness has real spatiotemporal borders.

Reply ↓

jkubie on March 15, 2014 at 7:37 pm said:

Sorry for the late reply. By "physical support" I would be looking for something from physics, (subatomic physics) to be an implementation of panpsychism. What I see is a wish or an assertion. Its not there in standard physical models as I understand them (which is a pretty low level). Its not clear to he how "proper conceptual analysis" bridges this problem. Either integration is part of nature or it isn't. Using 'consciousness' as evidence of integration is circular. I'd be looking for evidence of integration in nature. Perhaps "entanglement" is a start (I really don't understand entanglement).

Reply ↓

phiguy110 on March 21, 2014 at 5:15 pm said:

How about the brain? That's in nature. Why privilege the subatomic? It's not "more real" than biology. Also, Tononi has a note in one of his papers suggesting a way to see quantum systems as, perhaps, fundamentally irreducible systems, though generating little (though not nothing) in the way of consciousness (compared to a brain).

Also, this is just my opinion, but it's consciousness science that will ultimately be most fundamental (especially a theory like the IIT with it's basic conceptual picture of order, entropy, mechanism, and causal autonomy) with physics something that consciousness DOES.

Finally, there are nascent attempts to incorporate the IIT into subatomic physics by Max Tegmark, but I don't think he really gets the concepts right and I find the math impenetrable (though that's just my cognitive weakness perhaps) so I can't really evaluate the validity of his ideas. Here's the paper: http://arxiv.org/abs/1401.1219

jkubie on March 21, 2014 at 5:32 pm said:

Phiguy100, There are two responses to "what about the brain?" I can think of.

First, "connection" in the brain does not, in and of itself, make an entity. Imagine an assembly of neurons that fire together whenever an apple is viewed or thought of. They represent are the brain representation of apple. Moreover, there are synapses that directory, or by means of few intermediaries, interconnect all members. All we have is a set of neurons that fire when the concept of apple arises. I can imagine a zombie with an artificial brain composed of neurons that fire together when apple is present. And this zombie would behave as a human would to apples. Would the zombie have a conscious subjective experience of "apple"? I don't see why or how. The individual neurons in my brain or the zombies would fire as part of the cell assembly, but they would not know they were part of an apple representation. Importantly, they would have no way of knowing who they are connected with or why the fire. They just fire. The connections of the assembly are only visible to an outside (conscious?) observer. If, no the other hand, there were a physical principle, such as entanglement, there would be a possibility that a neuron would know the state of other neurons in its assembly, and be part of an assembly concept, as in a hologram.

The second reason I go back to fundamental particles is that I find it hard to imagine that such an important thing as consciousness arose in such a small segment of the evolution of the universe. Was there a pre-conscious universe? When did consciousness first arise in the universe? How did it arise?

Kubie:

I'm a neuroscientist. I record single neurons in behaving rats and make models of neural networks. I feel I understand networks of neurons much better than physics. But I don't see an easy way that networks of neurons could create conscious experience.

(I've read about Tegmark, and I'll look at the paper, but I doubt I'll understand the math.)

phiguy110 on March 21, 2014 at 6:51 pm said:

I think all your concerns are exactly the kind of objections that the IIT attempts to solve. So, just a couple points:

1. "'Connection' in the brain does not, in and of itself, make an entity." Agreed. In fact the IIT is a hypothesis about exactly what kind of connections, or wiring scheme, is required to create an entity, which, in the IIT, is the same thing as an causally irreducible conscious state. A system has to be wired in such a way that the amount of information generated by the system of connections as a whole cannot be reduced to the behavior of its parts. ??? Comprehending this with a system as complicated as the brain is almost impossible, but the point can be clearly demonstrated mathematically with simple systems consisting of only a few elements. It's the principle that is important.

GOT TO HERE

2. As for your zombie, well, I would say if it was really wired in such a way that the organization of the brain replicated the causal activity of a human exactly, then yes, it would have conscious experiences, and therefore not be a "zombie." (Whether that kind of artificial brain is possible as an engineering feat is another question.) According to the IIT, even though aspects of conscious perception and cognitive processing are spatially localized in the brain, it's not exactly right to say that "that's the part of the brain where the apple representation is formed." The system, the whole system, is, again, irreducible, and all perceptions, modes of thought etc. are a product of the whole. So, while the red apple does ignite neurons that we can associate with "red," understanding why those neurons serve that function can only be understood by analyzing how they relate causally to the rest of the system to which it is irreducibly connected. Think about it like a conscious state itself: just as the apple occupies a PART of my visual scene, the whole scene cannot be reduced to just the apple. Localization is real, both in physical space and in consciousness, but ultimately only in relation to a totality. The straightforwardness of most of our concepts (like apple) mask they deep contextual integrations in our conceptual structure; the concept "apple" to be acquired at all, requires that you already have a very complicated conceptual model of the world within which something like an "apple" makes sense and has meaning. This is why AI scientists are always perplexed that computers get "simple things" wrong all the time. Most "simple

things" require an ridiculously large background of information to be understood. Fundamentally, probably some absolutely primordial sense of space and time (and therefore memory) is required as a platform from which complicated concepts like "apple" can "bloom," conceptually. If there ever is AI, it's gonna have to evolve; top-down strategies will never work for this reason.

3. "The connections of the assembly are only visible to an outside (conscious?) observer." This is the central point the IIT REJECTS. It's really the crux of the theory. If wired in a certain way, (a causally irreducible way) a system can generate information about itself as a single thing, making itself its own conscious observer by "measuring" its own state. It's either right or wrong, but the whole theory turns on this point.

3. There actually is something to hologram idea, though showing how the IIT can be re-imagined as a holographic metaphor is not a flight for my wing. (But given the holographic principle in physics, probably ultimately a valuable idea.)

Google IIT as holograph

4. "The second reason I go back to fundamental particles is that I find it hard to imagine that such an important thing as consciousness arose in such a small segment of the evolution of the universe. Was there a pre-conscious universe? When did consciousness first arise in the universe? How did it arise?" On this the IIT is clear: consciousness is a fundamental ingredient of reality and occurs whenever and wherever causation occurs (the IIT is as much a theory of causation as consciousness), though most of the universe would be, according to the theory, extremely simple from a conscious point-of-view. Almost like nothing, but not quite. Evolution is the process wherein reality better "wires" itself to increase its own causative powers, allowing it to succeed in the environment and evolve.

Hope that was clear, even if you disagree. Thanks for the exchange. I can't recommend reading Tononi's papers enough, especially the footnotes.

Reply ↓

jkubie on March 21, 2014 at 7:00 pm said:

I get back to panpsychism. What I see is a description of how it would behave, not a mechanism. If it were a mechanism, it should be testable. IIT's panpsychism relies on "information" being a real thing, not a description of a system. There must be something — like particles of information or information fields or something. While it is nice to have mathematical descriptions, math is a descriptive system, not

an essence. As I understand it, some mathematicians and physicists have speculated about information particles. That might solve the problem. But there's no basis I know of, other than offering a cute solution.

Reply ↓

loz on May 27, 2014 at 4:09 am said:

IIT is not Panpsychism in the traditional sense.

Panpsychism claims that everything is imbued with awareness ad-hoc.

IIT claims that awareness is a spefic organization of matter – the brain has specialized mechanisms which share their information with each other, the resulting 'mixture' of information from these mechanisms is 'integrated'. At this point we are no longer describing a physical structure, but an Information Structure.

IIT posits that when information integrates into an information structure, it will feel like something to be that structure.

For components to be sharing/integrating their information, there is a back-flow of information between all structures contributing to the integration. If these mechanisms are receiving information which is altering the info it holds and shares then they become irreducible to the larger info-structure.

IIT is similar to Panpsychism in that it is not matter/substrate dependent and therefore any matter could be conscious.

But again – IIT claims it is not the MATTER, but the ORGANIZATION of that matter that makes the difference.

it's like magnetism – a certain organization of elements creates the field, and if two fields interact strongly, they become one field.

Reply ↓

jkubie on May 27, 2014 at 2:31 pm said:

Ioz, thanks.

As I see it, IIT requires a “special” panpsychism, not standard panpsychism. IIT panpsychism, for example, has distance constraints. Nonetheless, like standard panpsychism, and unlike magnetism, IIT panpsychism requires a fundamental addition to standard physics. This is how IIT addresses the “hard problem”. But IIT may succeed without addressing the hard problem. In a recent paper, Tononi creates postulates, axioms and a single identity.

The identity:

specific brain states create specific consciousness states (qualia).

The the task of IIT is, therefore, to define the “differences that make a difference”, the set of brain states. This is a big task, and an important one. But it is one that does not address the hard problem. IIT’s panpsychism proposes a structure for the hard problem, and one that would complement IIT.

Reply ↓

ILYA 伊利亚 Илья on May 29, 2014 at 4:13 am said:

Joun, thank you so much for your post, I’ve really enjoyed reading it along with comment threads. My major is analytical chemistry, but the need to comprehend subjectivity led me to neuroscience and eventually to IIT. I’ve been digging into consciousness topic for a decade. Tononi’s IIT approach so far is the closest to my understanding of it’s phenomena. Though I can not claim that I comprehend it to the tiny details, but hopefully got the major points

To me as for the scientist hypothesis should poses a bit more than just a peace of mind for the bearer. Viable hypothesis should be useful as a framework for understanding of current observations and be able to predict new phenomena … From your understanding which phenomena IIT can help with?

Reply ↓

ILYA 伊利亚 Илья on May 29, 2014 at 6:03 am said:

Typo: “possess” of course :)

Reply ↓

jkubie on May 29, 2014 at 11:21 am said:

Tononi has been trying one application: Using Phi to calculate levels of consciousness in people anesthetized for surgery and people who are in coma or vegetative states. While this may not appear to be a challenging or high-level goal, it is a test, and, furthermore, may be useful. The presently available tools for analyzing level and anesthesia and coma are imperfect.

Reply ↓

ILYA 伊利亚 Илья on May 30, 2014 at 10:37 am said:

John, thank you for the reply.

The text below is just my thought and notes but I hope it will be useful for readers.

Just today digging dipper in to Tononi’s article “IIT of Consciousness an Updated account” 2012 … ops…Digging into pubmed for the link I’ve just discovered very recent article with theory update … http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4014402/

But anyway at the current stage I see that Tononi and Koch, saying consciousness = exerience (or quale), do not distinguish between the awareness and attention.

e.g. I’m sitting in the cafe in the middle of shanghai typing this message, being aware of my environment and feelings in my body but not actively attending to it. There is couple in conversation beside me, so i’m registering that their dialog is going on … but do not attend to the content of it. But some times my attention is being pulled… to the conversation when I here familiar words (the talk in mandarin)… Do you see what i mean? To your understanding to what extent do “subconscious” processes are part of the experience (Quale)?

Once again thank for this post, food and environment for thoughts.

Kind regards.

ILYA

P.S.

Christof Koch and Giulio Tononi on Consciousness from FQXi Jan 5th 2014

Allan on June 30, 2014 at 8:36 pm said:

"Information will exist in an entity when it has information and is connected."

Did you mean consciousness will exist?

Reply ↓

jkubie on June 30, 2014 at 8:41 pm said:

Thanks. Corrected.

Reply ↓

Rachel Bowman on July 12, 2014 at 2:03 am said:

I'm very late to this conversation, but intrigued. Are you aware of Walter Freeman's take on consciousness? He uses dynamical systems theory and his own extensive research on neurodynamics, but also integrates pragmatist philosophy. I find his take on consciousness more compelling than IIT. I am fresh from reading Tononi and Koch's 2008 "Neural Correlates," and I also read some of "Confessions," and find them muddled as well. But in fairness I'll say that I don't know much about IIT other than those works.

Reply ↓

Google walter freeman neurodynamics

Pingback: From Informatics to Consciousness - early extract from my new bookMark Skilton

AlexanderWilson on August 30, 2014 at 1:27 am said:

I know I'm late to this conversation but thought I'd chime in. I just read a bunch of papers on IIT by the main protagonists. I feel it does have something going for it. It is Searle's objection I fail to understand. Indeed I don't abid by the idea that there could be information "out there" in "the wild" without some observer observing it. If information is difference that makes a difference, then it already implies that it makes a difference for some experiencing observer or that it could potentially mean something for an observer (entropy). Searle seems to think that there is such a thing as data "in the wild", what is sometimes called "dedomena". But when you think about it, it is difficult to see how such a thing could exist: it simply would not qualify for information if it did not make a difference for some observer. An example I like to give is that of what cosmologists call the "observable universe". In our cosmological bubble, it seems there is a limit to the amount of data that can be registered. This limit has to do with the reciprocal constraints between the forces and constants of the universe from our point of view. The planck length is the smallest size anything can have in the observable universe, and therefore limits the degrees of freedom of the universe, and thus the amount of bits that can be registered within it. But the very fact that this limit is tied to the "observable universe" implies that this limit is not observer independent. So, outside this inflationary bubble corresponding to our universe within the "champagne glass" multiverse it potentially floats in, there may be more degrees of freedom allowing more data to be registered, but of course, this data would then only potentially "make a difference" for the observers in those universes. Essentially, Phi is an extrinsic measure of the information that is intrinsic for a system, according to the irreducibility of that information to the information generated by the parts of the system.

I am still unsure about what to make of their probabilistic account of the "cause-effect repertoires" the theory depends on. How do these probabilities translate into temporal experiences? If a system state "constrains" the past and future of the system as they claim it does, does this mean a system can potentially experience one single event of experience for ever as long as its state stays the same? Isn't experience intrinsically temporal? What happens in between the states? How is a continuity of experience experienced for such a discrete laplacian system?

Reply ↓

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ME: How can you possibly get self awareness out of a bunch of interacting units?