



Is psi truly impossible?

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CORRESPONDENCE:

DATE RECEIVED:

June 10, 2015

DOI:

10.15200/winn.142676.68278

ARCHIVED:

March 19, 2015

CITATION:

Jacob Jolij, Is psi truly impossible?, *The Winnower* 2:e142676.68278, 2015, DOI: 10.15200/winn.142676.68278

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Over the last weeks, several interesting posts in which psi prominently featured were posted on the web: [one by Alex Holcombe](#), in which he argues that as long as meta-analyses find evidence for psi, our scientific publication system is broken; [one by Sam Schwarzkopf](#) in which he replies to a paper by Bem et al. finding new evidence for psi (that will be published in some time in the future; the study has not been conducted yet); and a [satirical poster](#) by Arina Bones, in which she argues that Bem's presentiment effects were actually rather weak compared to the unlikely results typically published in JPSP...

Now, to be fair, the mentioned blog posts primarily address methodological issues in (mainstream) science, rather than going into the theory of psi, but the posts have one thing in common: psi is implicitly or explicitly assumed to be impossible, because physics! But is psi indeed incompatible with physics?

Some interesting facts

Before going into that question, I'd like to share two interesting pieces of information. Yes, science is broken, and our publication process is largely to blame for it. The fact that we can find evidence for a phenomenon that is allegedly impossible is, according to Holcombe, a tell-tale sign of this. Two important suggestions to improve our practices are preregistration and using Bayesian rather than frequentist statistics. Interestingly, though, psi researchers seem to have a head start in improving their practices. The European Journal of Parapsychology, for example, has offered the option to preregister research, and have a paper accepted on basis of preregistered methods, independent of the actual outcome since the late 1970s. It was big news in the psychology community when the journal *Cortex* started offering this service – only last year...

Moreover, the use of Bayesian statistics is presently advocated strongly by 'professional skeptics' to stop the surge of spurious research results (including, but not limited to psi). Interestingly, the idea to use Bayesian statistics in psi is not new. The *Journal of Scientific Exploration*, a journal notorious for "advocating pseudoscience", published a [critical review of psychokinesis research](#) that explicitly called for the use of Bayesian statistics in the analysis of psi data, because, and I quote, "... a small p-value may not provide credible evidence that an anomalous phenomenon exists". This paper was published in 1990, almost 25 years ago...

What I'd like to state with this: parapsychology as a research field is controversial, and that its topics, theories and results may be outrageous, but that some of its practices may be exemplary for mainstream psychology.

Psi and physics

Anyway, enough about meta-methodology. Time for some physics. Is psi indeed incompatible with physics? Well, yes and no. Psi effects apparently violate basic laws of physics, either because they involve a reversal of the flow of time (e.g. precognition/presentiment) or a direct influence of one body on another without a mediating force (psychokinesis). But which laws are violated?

Retrocausality?

First, can information travel back into time (often referred to as retro-causality)? There are two often-heard arguments against this idea: first, the Second Law of Thermodynamics gives time a specific direction or arrow; second, the Special Theory of Relativity (STR) states that nothing can go faster than the speed of light, which would be required if one would want to send information back into time.

I've argued before that the Second Law of Thermodynamics does not necessarily imply retro-causality is impossible – only that it is **impossibly unlikely**. So, what about this idea that nothing can go faster than light? Well, that's not entirely correct. The only thing that Einstein proposed is that c (the speed of light) is invariant in all frames of reference of space-time. What follows from the STR is that in order to accelerate matter moving at sub-light speed beyond c , one would require an infinite amount of energy. Likewise, to decelerate particles moving *faster* than light ('tachyons') to sub-light speed would also require an infinite amount of energy. So yes, for all practical purposes, nothing can go faster than light, but STR does not strictly forbid $v > c$.

Moreover, c is only constant within frames of reference. Between frames of reference, speeds exceeding c are permitted. However, this does not mean that retro-causality exists. In particular the 'causality' in retro-causality is problematic: in STR, causal relations can only exist between an object and objects in its past light cone (i.e., the points in space-time from which you can potentially see a photon emitted by the object). Even though velocities larger than c are permitted, this does make retro-causality in STR a no-no.

However – there may be a loophole. Or several, actually. Physically speaking, the direction of time is rather arbitrary. Without going into too much detail, there are several interpretations of electrodynamics (in particular the **Wheeler-Feynman Absorber Theory**) and quantum mechanics (**two-state vector formalism** and Cramer's **transactional interpretation**) that explicitly assume time symmetry. Wheeler-Feynman's absorber theory, for example, deals with the question why radiation seems to be emitted rather than absorbed. Maxwell's equations for electromagnetic fields always yield two solutions: one going forward in time, and one going backward in time. We typically discard this latter solution, but for no good theoretical reason. Wheeler and Feynman have tackled this problem by assuming that the waves going backward in time are cancelled out ('absorbed') at a macroscopic scale. Dick Bierman has proposed that some retrocausal effects may be explained by assuming that the 'cancelling out' of advanced waves ('information from the future') has gone astray in some case, in particular when consciousness is involved (paper to be found [here](#)).

Speculative? Sure. Impossible? No.

Quantum waffling?

So, we don't even need quantum physics to save the day, but let's have a closer look. Quantum physics, with all its strange features, is often invoked when trying to explain more mysterious aspects of psychology, in particular consciousness and paranormal phenomena. An often-heard argument against this practice is that it is simply explaining one thing we do not understand (eg., consciousness) with another (quantum physics). Moreover, quantum physics and mysterious quantum phenomena such as entanglement and quantum superpositions are believed only to be relevant at a microscopic scale, and are completely washed out in the 'hot and noisy' environment that is our brain.

Surely, skepticism towards the all-too-liberal use of quantum physical concepts when explaining is warranted. In fringe and pseudo-science, quantum physics is often distorted and misunderstood. However, the same thing sometimes goes for debunking attempts from skeptics. Let's look at some

(mis)understandings.

(Mis)conception #1: Quantum physics is not relevant in biological systems such as the brain, and therefore irrelevant in the study of psi.

Can we use quantum mechanical concepts in order to explain weird mental phenomena, such as psi, or even consciousness itself? No, the skeptic argues – the brain is too hot and noisy to allow for any quantum physical phenomenon, such as entanglement or superposition, to occur. Quantum physics is only relevant when studying tiny particles in isolated systems!

Both these assumptions are not entirely correct. To start with the former, empirical evidence is accumulating that quantum processes (in particular quantum coherence) do play a role in living systems, for example in **photosynthesis**. Direct evidence of quantum processes in the brain still lacks, though. However, it may not be completely inconceivable that quantum processes do play a role in brain functioning. Does that open up the possibility for all kinds of spooky actions at a distance in human cognition? Well, that's a really, really long stretch. For starters, the fact that quantum effects have been observed in plants does not mean plants are conscious entities that can do telepathy, precognition, and psychokinesis. Second, and more importantly, our understanding of the relation between brain processes at the microscopic scale and cognition is still quite limited. It is very difficult to imagine how quantum processes that play at the scale of single cells or even individual receptor sites would influence cognition and behaviour. However, simply stating that quantum physics by definition has no role in human brain function is not appropriate, I'd say.

Second, is quantum physics only relevant for studying microscopic isolated systems? No. Quantum physics is the best description of reality we have. There is no theoretical limit that states why we cannot describe macroscopic objects in the 'language' of quantum mechanics. Actually, we could consider classical Newtonian physics as a special case of quantum mechanics. The discrepancy between the quantum and classical world is rather an empirical observation we do not yet completely understand- there is not a theoretically prescribed boundary of at what scale we should start to use either classical or quantum mechanics to describe Nature. This brings us to a philosophical problem in physics: the measurement problem. According to some (controversial) interpretations of quantum physics (in particular the Von Neumann-Wigner interpretation), consciousness has a special status in physics, because it 'collapses the wave function'. I will not go into all specifics here, as this is a blog post, not an article (yet), but this is rather significant: if consciousness is instrumental to a basic physical process, this means it cannot be reduced to physical processes, or more specifically, brain activity. From this point of view, whether or not quantum physical processes play a role in brain processes is a completely irrelevant issue.

As I argued earlier, I think the most pressing reason to study psi is that demonstration of psi would falsify physicalism – the assumption that we can reduce consciousness to physical processes. We all too easily make this assumption when talking about consciousness, even to such an extent that we forget that it is an assumption. Back to psi – many psi effects could in theory be explained if we assume that 'mind' or 'consciousness' can be directly entered as a system in equations. The calculations would still work – however, the interpretation of the calculations would be rather outrageous... And whilst we're on that page...

(Mis)conception #2: Quantum physics allows for free will, telepathy, psychokinesis, absolute idealism, Chopra-ism, etc.!

So, quantum physics, in some interpretations at least, gives us a 'loophole' to escape Newtonian determinism – we can have a free will, and if the Von Neumann-Wigner interpretation is correct, we can even 'create' reality with our minds!

Er... no.

For starters, quantum physics is probabilistic in nature. Even if consciousness does collapse the wave

function, the outcome of that collapse (e.g., finding a particle at a given location or not) will be completely random and unpredictable. As I argued in an [earlier blogpost](#), that is not a very desirable feature of free will, or reality shaping in general. So, I would say free will and creation of reality are safely out of the scope of quantum mechanics.

So, what about psi? For the sake of argument, let's assume quantum effects are somehow related to psi. Suppose that psi effects are the result of quantum entanglement: you, the observer, become entangled with a physical system far away in space and/or time, and for some reason something happens to the distant system. This means it would affect you instantaneously, because you and the distant system are entangled. However, quantum weirdness can never be used to communicate information at supraluminal speeds, which would be needed for causal psi. In quantum information theory, there is such a thing as [the no-communication theorem](#). In order to make sense of the non-local interaction that happened (or even be aware that something happened at all), you need to correlate your state with the state of the distant system. This correlation can only be done via 'classical', sub-luminal communication.

This rules out any kind of 'causal' psi. With this I mean that quantum-based psi cannot be used to change your behaviour to avoid a given future, for example (i.e., the [Final Destination](#) scenario). What may exist in this framework, though, are correlational effects, such as proposed and reported by [Von Lucadou and Walach](#).

Does psi violate physics?

Well, as it seems, not necessarily. There are interpretations of physics that do allow for psi-like effects to occur. However, these interpretations are not your main-stream ones, and do take some background in physics to fully comprehend. As physics laymen, we as psychologists/neuroscientists are often tempted to dismiss any interpretation that falls outside the ordinary stuff we learnt in high school or undergraduate physics courses. Perhaps rightfully so. However, stating that psi is impossible because physics? Hm, I'd be very careful with making that statement. Best not to calibrate our statistical methods using a phenomenon that actually might exist after all...