How the Peer-to-Peer Simulation Hypothesis Explains Just About *Everything*, Including the Very Existence of Quantum Mechanics

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In my recently published article, "A New Theory of Free Will"[1], I argued that several serious philosophical and empirical hypotheses – hypotheses which have all received and continue to receive serious discussion by philosophers and physicists, and which may all turn out to be true – jointly entail that we are living in the *functional equivalent of a peer-to-peer (P2P) networked computer simulation*. Not only that, I argued that this *P2P Hypothesis* explains the very existence of almost *all* of the most puzzling features of our world:

1. Quantum indeterminacy and measurement problems.
2. Quantum entanglement.
3. The apparent irreducibility of conscious experience to physical objects, properties or functions.
4. The intuition that our personal identity, as conscious subjects of experience, is irreducible to any form of physical or psychological continuity.
5. The apparent "unreality of time" in the *objective* physical world, along with our *subjective* experience of the passage of time.
6. Our experience of ourselves as having free will *despite* our experiencing the physical world as causally closed under the laws of physics.

§1 of this essay briefly summarizes (a) the philosophical and empirical hypotheses that jointly entail the P2P Hypothesis, (b) how the P2P Hypothesis explains all six features of our mentioned above, and (c) the P2P Hypothesis's *four distinct empirical predictions*.

§2 then shows something new: that even if the P2P Hypothesis is true, our world differs from the *kind* of P2P simulations we have constructed in one profound, fundamental way: a way that implies that reality *cannot* be reduced to mere quantitative information of the sort dealt with in the hard-sciences (i.e. "it's from bits"). Reality has fundamentally *qualitative* elements that cannot be understood as "information" in any traditional sense.

§1. The Basic Case for the P2P Hypothesis

Consider the following seven hypotheses:

> *Eternalism:* the hypothesis that past, present, and future objects and properties all exist "timelessly."
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> *The Multiverse Hypothesis:* the hypothesis that the observable universe is merely a small part of a *multiverse*, which contains a vast, possibly infinite array of possible pasts, presents, and futures.
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> *The Holographic Principle:* the hypothesis that in order to unify quantum mechanics and general relativity, the universe must be understood as comprised of 2-dimensional information "written" on the cosmological horizon.
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> *Mind-body Dualism:* the hypothesis that the mind, or at least certain properties of it, are non-physical.

[1] Arvan (2013).

Subjectivity About the Flow of Time: the hypothesis that the passing of time is not in the objective physical world but rather fundamentally within *us* (i.e. within consciousness).

The Further Fact Theory of Personal Identity: the hypothesis that personal identity is a brute, simple fact that cannot be reduced to any sort of physical or psychological relation.

Single Commonly-Experienced (or "Actualized") Timeline: the hypothesis that only one physical universe – our Universe – is experienced by conscious observers.

None of these hypotheses are unambiguously known to be true. However, there is presently some serious evidence for all of them. Eternalism has many defenders on philosophical and empirical grounds.[2] The Multiverse Hypothesis and Holographic Principle have many notable proponents in contemporary physics.[3] Mind-body dualism has what appears to have an *increasing* number of defenders in philosophy, due to the simple observation that whereas all physical objects and properties appear to *relationally definable* (e.g. an electron *is* that which obeys certain equations, mass *is* that which warps space-time, etc.), properties of conscious experience (e.g. what *red looks like*) are so simple that they are utterly indescribable, *non-relational,* and therefore a *fundamentally different kind of thing* than all physical objects or properties.[4] Etc.[5]

Notice that if these seven hypotheses are all true, our reality has the following structure:

- The physical world is an eternally existing array of 2-dimensional (physical) information comprising a vast array of possible pasts, presents, and futures.
- External, nonphysical entities – each person's consciousness – subjectively reads that physical information in "real time", in such a way that,
- The joint choices of all of the nonphysical entities – choices which are in no way causally determined by the 2-dimensional physical information – interact so as to generate a single, commonly perceived "external reality."

Now consider an ordinary online computer simulation, such as the popular videogames *Halo* and *Call of Duty*. Here is *their* structure:

- Each game DVD consists of a two-dimensional array of information containing a vast range of possible "pasts, presents, and futures" within the game (i.e. possible positions and environments players can exist in and perceive, "rocks", "automobiles", etc., within the simulation).
- Each game player's experience of the simulated environment "in real time" (i.e., how the events of the game play out) is the product of an entity outside of the 2-dimensional information on the DVD – namely, the laser-apparatus and computer processor of the game console. This laser-apparatus reads a particular string of physical information on the DVD, and the computer processor thereby "actualizes" it. From the perspective of anyone in the "physical" environment within the simulation, these mechanisms would count as nonphysical.

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[2] For a brief literature review, see Ibid: fn 1, pp. 7-9.
[3] For a brief literature review, see Ibid: fns 2&3, pp. 9-11.
[4] For a brief literature review, see Ibid: fn 4, pp. 11-12.
[5] For brief literature reviews of the hypotheses I have not examined in detail here, see fns 5-7 and pp. 12-18.

- Finally, each player's choices on their own game console are processed by the network so that the joint choices of each player – choices not causally determined by any "physical law" within the simulation – lead each game console hooked up to the system to read complementary lines of code on the DVD to ensure that the physical laws of the simulation are not broken. This allows each player on the network to experience the same virtual environment from different points of view.

In short, if the seven hypotheses about world ar true – and again, they may all *be* true – our world is *structurally identical* to an online simulation. And not just any kind of simulation: a *peer-to-peer* (P2P) simulation. Let me explain why.

Due to technological limitations, most online videogames today utilize what is known as a *dedicated server* network environment. On a dedicated server, some one computer – the "host" – represents *a determinate simulated environment* which all other computers on the network access and represent in turn. A dedicated server simulation is therefore *inconsistent* with quantum mechanics, which tells us that there *is* no single determinate, objective location/velocity of fundamental particles.

There is, however, a different type of network environment that some online simulations utilize: a *peer-to-peer* (P2P) network. On a P2P, *no single computer* on the network represents "the" simulated environment. Instead, the simulated environment is comprised by nothing more than a number of independent computer consoles, each of which has its *own* individual representation of where objects in the virtual environment are. Different users on the network experience *approximately* the same environment because of the manner in which the independent consoles are network coded to *error-correct* one another. P2P simulations are relatively uncommon because of the sheer amount of processing power necessary to achieve error-correction in real time. Without adequate error protection, different computers on the network can provide their respective users with *blatantly contradictory* experience. For instance, without adequate error protection, I might experience *myself* (in, say, the game of Halo) as shooting and killing you before you kill me, but *you* might experience yourself as shooting and killing *me* before I kill you. Without adequate error protection – which takes an incredible amount of processing power – users can experience a P2P simulation as an "unplayable" incoherent series of events.

But these are just technical problems resulting from limitations in processing power. P2P networked simulations are *possible* with enough processing power and error-correction – and here's the crucial thing about them: *the reproduce all of the fundamental and most baffling features of quantum mechanics*. For consider once again the very structure of a P2P simulation. A P2P simulation is one in which *no* individual computer represents "the" reality that all users within the simulation experience. On the contrary, the simulated reality *just is* the network of individual machines connected to one another *taking "measurements" of where things are in the environment in real time*, utilizing error-correction algorithms to ensure that different machines' measurements don't come apart "too far." Further, notice that in any P2P simulation, *there will have to be random divergences* between the measurements of different machines, and indeed *the same* machine at different instants, due to "noise" within the simulation. Because information cannot be transmitted instantaneously, but must instead flow from machine to machine with some (perhaps minute) "time lag", anytime an observer in a P2P simulation takes a measurement of their external reality, they not only (a) affect the entire network, thus *altering* measurements taken by others (i.e. a direct analogue of quantum-measurement problems); because of the inherent "noise" within a P2P simulation (each individual computer is continually error-correcting itself against others on the network),

it's also the case that (b) observers will only be able to develop a *probabilistic* theory of the fundamental properties of their simulated environment.

In other words, *quantum phenomena* – the quantum measurement problem and quantum indeterminacy – emerge *naturally and inevitably* from any P2P simulation. Not only that: P2P simulations reproduce a strong analogues of *quantum entanglement.* There are clear cases of non-locally entangled states within existing online simulations. I've experienced them before when playing Halo. If one steps on a particular patch of ground, another patch of ground elsewhere may instantaneously shift to a different state (with no information transfer observable to individuals in the simulated-world reference frame).

Now consider the many other *philosophical* problems the P2P hypothesis reproduces and explains. Empirical theories can be understood as *predictive models*.[6] A good theory of our reality – a good *predictive model* of the world – should reproduce as much of our experience of our world as possible, particularly its *strangest, most puzzling features*. And here's the thing: any P2P simulation presents observers within it – let us call them "Halo Scientists and Philosophers" – with *all* of the same deep philosophical puzzles we confront in our world.

First, Halo Scientists and Philosophers would have the sneaking suspicion – just as we do – that their "minds could not be physical." Why? Because, in a P2P, just about all of the simulation is "physical." When Halo Scientists and Philosophers examine physical objects within their simulated reality, they would be able to develop an empirical theory of "Halo physics" just as we develop empirical theories of *our* world's physics on the basis of our measurements of it. *And yet* there are simple and obvious reasons why observers in a P2P simulation would feel that their *minds* could not possibly be physical. The reasons? Their minds *are* non-physical in a relevant sense: their minds *make up the measurement apparatus* that exists in a higher reference-frame (the reference frame of the simulation network coding) and which *cannot be reduced to any physical property or measurement taken within the simulation*. But this is precisely what *we* appear to face. We can measure "red wavelengths" of light; we just can't explain in physical terms – in terms of measurements within our world – why red looks like *this.*

Second, Halo Scientists and Philosophers would have the sneaking suspicion – just as we do – that somehow they *have* "free will" even though, from measuring their physical reality, they would see no "room" for freedom of choice in their physical laws. Halo Scientists would observe their simulation's physical laws as *completely closed*. They would, as we have already seen, develop *probabilistic laws* to explain their physical reality, and they would think – just as we do – that there is no room for *minds* to make free choices, since truly free choices would have to *break* the probabilistic laws of physics. And yet Halo Scientists and Philosophers would probably still *feel* – deep in their bones – that they can make truly free choices. *And both answers would be right*. Let me explain. When one plays a game of Halo online, one's free choices in the frame-of-reference outside of the simulation – one's joystick movements as the game's "user" – generates an *unbroken series of events* within the simulation. Once a game is complete, one can go back, rewind it to the beginning, and watch all of the events transpire *inexorably* from start to finish. Notice what this means. From the perspective of observers within the simulation, *their laws of nature are closed*. Everything that happens will look like it "must" happen under their laws of physics. But this is only true *from their frame-of-reference*. The fact is, in a *higher frame-of-reference* – the reference frame of the user interacting with the simulation from the outside – *choices completely undetermined by the physics of the simulation* (the choices of the "user") give rise to the

[6] Ibid: 28.

appearance of complete causal closure within the simulation. Observers within a P2P simulation *really are free*; it just necessarily appears from the physics of their reference-frame *as though they are not*. But of course this, plausibly, seems to be *our* situation. When I act I experience myself as *making free choices*. But it's hard to see how this can be given the physics of our world (where everything follows from the quantum wave-function). The P2P hypothesis explains how *both* can be true. We are *free-relative-to-a-higher-reference-frame* but *not-free-relative-to-our-reference-frame*.

Third, Halo Scientists and Philosophers would have the sneaking suspicion – just as we do – that their *persistence over time* (as the same conscious persons) must be something more than merely continuity of their physical bodies or psychology. *And again they would be right*. The fundamental nature of personal identity is *inaccessible* to observers in a P2P simulation: it is comprised by the "game consoles" in the higher frame-of-reference that comprises the functional architecture of the simulation.

And so on. The P2P Hypothesis *reproduces and explains just about all of the fundamental features of our reality that have baffled philosophers and physicists for millennia*.

Finally, the P2P Hypothesis is falsifiable, thus qualifying as a legitimate empirical theory. It implies, at least in its present form, four[7] distinct empirical predictions. It implies that:

(a) The Holographic Principle will be verified.
(b) Lattice quantum chromodynamics (LQCD) will be verified.
(c) We should observe minute and unpredictable violations of the quantum wave-function in human brains (resulting from free choices in a higher reference-frame)
(d) There should be *error-correction* codes embedded in the fundamental structure of our world.

There is, I believe, *some* possibility that another form of the P2P Hypothesis may be true if the first two of these predictions are falsified. The Holographic Principle and LQCD both imply that our world is a *digital* P2P simulation. However, might our world be an *analogue* P2P simulation rather than a digital one? I leave this question for another day.

§2. One Momentous Difference

In "A New Theory of Free Will", I raised an obvious question about the P2P Hypothesis: namely, can we ever know whether our world is the "ground floor", or might we be living in a *simulation within a simulation*? I do not believe that, short of somehow "escaping" from our world – much as the character "Neo" does in the famous *Matrix* films – we can ever know the answer to this question.

I do believe, however, that we can know the answer to *one* important question: which is that, if we are in a P2P simulation, there is one fundamental sense in which it *differs* from the kinds of simulations (P2P or otherwise) that we have constructed in our world: simulations such as *Halo, Call of Duty*, *The Sims*, and so on. Notice that all of these simulations are *mere structure*. That is, they are generated by *quantitative data*. The data and network coding that comprise, say, the online world of Halo are just that: *programs*.

Human consciousness, on the other hand, is – if philosophers who defend mind-body dualism are correct (and I think they are[8]) – fundamentally *qualitative* in nature. It cannot be

[7] In "A New Theory of Free Will", I only discuss the first three predictions (see pp. 39-42). I have developed the idea that the P2P Hypothesis implies the existence of error-correcting codes from James Gates, a noted string theorist who argues that error-correcting codes *are in fact* embedded in quantum mechanics (at least on a string-theoretic interpretation). See Gates (2010).

[8] See Arvan (2013): 11-13.

reduced to *mere structure*. Somehow, if we are living in an otherwise functional analogue to a P2P simulation, *the qualitative features of human consciousness* play a fundamental role in a way that has no obvious analogue in the simulations we have created. Although it is certainly true that *something* approximates conscious observers in the simulations we have created – namely, the game consoles or computers that process the game and network codes – the measurement-taking in that case is *purely quantitative:* it is a computer "crunching code." In our case, it is somehow *qualitative consciousness* – our experiences of *redness*, *blueness, now-ness* (the passage of time), etc. – that somehow interact and measure the quantitative data that comprise the external world we measure. *How*? This, I believe, is the grand mystery, and not one that science, no matter how well developed – as a result of its inherently *quantitative* nature – can ever hope to answer. Our world is not simply quantitative: it is not simply *bits* of information. It is somehow partly qualitative. And so science, as much as we might wish the contrary, must always remain an incomplete picture of our reality.

References

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