Morphic Pilot Theory: Toward an Extension of Quantum Physics that Better Explains Psi Phenomena

Ben Goertzel
Novamente LLC
1405 Bernerd Place
Rockville MD 20851

June 24, 2010

Abstract

While the empirical data supporting the existence of psi phenomena is now quite strong, the search for a theoretical understanding of these phenomena has been much less successful. Here a class of extensions of quantum physics is proposed, which appear broadly consistent both with existing physics data and with the body of data regarding psi phenomena. The basic idea is to view "subquantum fluctuations" as *biased* randomness, where the bias embodies a tendency to convey physical impulse between parts of spacetime with similar pattern or form. In a Bohmian interpretation of quantum physics, this biasing would take the form of a "morphic pilot wave," with a bias to move in directions of greater "similarity of patternment" (or more colorfully, "morphic resonance"). In a Feynman interpretation, it would take the form of a biasing of the measure used within path integrals, so as to give paths in directions of greater morphic resonance a greater weight. Theories in this class could take many possible equational forms, and several such forms are displayed here to exemplify the approach.

1 Introduction

The empirical data supporting the existence of psi phenomena – such as certain types of precognition, extrasensory perception and psychokinesis – is now quite strong. A reasonable survey of several parts of the literature may be found in [**?**]. While there is still considerable skepticism in the scientific community regarding the validity of these results, my own attitude is well summarized by saying that I empathize with the following statement by physicist and psi researcher Dean Radin [**?**]:

"After studying these phenomena as a scientist for about 30 years, I've concluded that some psychic abilities are genuine, and as such, there are important aspects of the prevailing scientific worldview that are seriously incomplete. I've also learned that many people who claim to have unfailingly reliable psychic abilities are often delusional or mentally ill, and that there will always be reprehensible con artists who claim to be psychic and charge huge sums for their "services." These two classes of so-called psychics are the targets of celebrated prizes offered by magicians for demonstrations of psychic abilities. Those prizes are safe because the claimed abilities of these people either do not exist at all, or they're much weaker than sincere claimants may wish to believe. There is of course a huge anecdotal literature about psychic abilities, but the evidence that convinced me is the accumulated laboratory performance by people who do not claim to possess special abilities, collected under controlled conditions and published in peer-reviewed scientific journals.

"There is ample room for scholarly debate about these topics, and I know a number of informed scientists whom I respect who have reached different conclusions. But I've also learned that those who assert with great confidence that there isn't any scientifically valid evidence for psychic abilities just don't know what they're talking about."

But, although the data supporting the existence of psi phenomena is impressive, the search for a theoretical understanding of these phenomena has been much less successful. Recent data correlating the strength of psi phenomena with Local Sidereal time are fascinating in their suggestion of a possible connection between performance and the orientation of the psi experiencer, the earth and the fixed stars [**?**]; but even if correct these data lead us only a very short way toward an explanatory theory.

It is not entirely clear whether the extant psi data is consistent with currently accepted physics theories. One of the many subtle points involved here is the fact that currently accepted physics theories are not wholly consistent with each other; e.g. general relativity has not yet been reconciled with the Standard Model (of the electromagnetic, weak and strong forces) in any generally accepted way. A large variety of unified field theories has been proposed, in attempt to remedy this situation, and it's not entirely clear which would be compatible with psi phenomena. Also, the quantum theory of measurement is still a subject of significant dispute among experts.

A number of theorists have suggested that psi phenomena may be associated with macroscopic quantum phenomena [?], and it is hard to deny the conceptual resonance between psi and quantum peculiarities such as nonlocal correlation. However, quantum physics does not provide any clear explanation of why psi phenomena would occur; and a careful consideration of the likely implications of quantum physics for brain dynamics render it rather unlikely-looking that a purely quantum-theoretic explanation of psi could succeed [?]. The perspective underlying the present paper is that, while a purely quantum-theoretic explanation of psi is not ruled out by our current understanding of quantum physics, it seems more likely that an extension of contemporary quantum physics is needed to account for psi.

Burns [?, ?] has promoted a similar perspective, and has proposed that psi involves the interaction of quantum dynamics with an additional dynamic, outside the scope of currently recognized physics, that *orders* microscopic fluctuations that quantum theory considers random. She has then carefully explored how it might be possible for a biasing or patterning in quantum-level fluctuations to give rise to psi phenomena via an impact on brain activity. According to her calculations, roughly 4,000 molecules must have their fluctuations ordered to initiate a physical action in the brain. Based on this, she has has proposed a model by which various psi phenomena could be produced by the ordering of quantum fluctuations. Within Burns's framework, the hypothesis presented in this paper may be viewed as a more specific theory of how the "ordering" of quantum-level fluctuations may occur.

Another source of inspiration for the present ideas is Rupert Sheldrake's [?] notion of a "morphic field." According to Sheldrake's view, psi is related with a "morphic field" that causes forms or patterns in one part of the universe, to bias the formation of other forms or patterns in other parts of the universe. This biasing is proposed to occur in a manner that does not depend on distance in the same way that known physical forces do, and that is consistent with observed psi data. The idea is conceptually appealing, and harks back to earlier philosophical notions such as Charles Peirce's "tendency to take habits" [?]. However, in Sheldrake's work the laws of behavior of the morphic field are not specified, nor is the relation between the morphic field and the known physical forces – limitations that make the morphic field hypothesis very difficult to rigorously test.

In this brief, speculative conceptual paper, it is suggested to explore extending quantum physics in a manner that supports the biasing of quantum-level fluctuations according to morphic-field type dynamics. The idea is only sketched here, and requires much more elaboration and calculation before it can be considered a precise physics hypothesis. However, at a coarse level, the idea appears consistent with existing physics data, and also provides a conceptual explanation for many aspects of the body of data regarding psi phenomena. The basic idea is to view "subquantum fluctuations" as *biased* randomness, where the bias displays properties roughly similar to Sheldrake's "morphic field," – i.e. a bias to convey physical impulse between parts of spacetime with similar pattern or form. In a Bohmian interpretation of quantum physics, this biasing would take the form of a "morphic pilot wave," with a bias to move in directions of greater "morphic resonance." In a Feynman interpretation, it would likely take the form of a biasing of the measure used within path integrals, so as to give paths in directions of greater morphic resonance a greater weight. Theories in this class could take many possible equational forms, and a few such form are displayed here for sake of concreteness; however, the main point of the paper is not to propose a particular equation, but rather to identify a promising-looking class of theories.

2 A Morphic Pilot Wave?

The starting-point for my proposed extension of quantum physics is the de Broglie - Bohm variation of quantum mechanics [**?**, **?**] – also called "pilot wave" theory – which provides a deterministic, non-local hidden-variables theory consistent with ordinary quantum mechanics. According to the pilot wave theory, the universe consists of a configuration $q(t) \in Q$ of the universe and a pilot wave $\psi(q,t) \in \mathbb{C}$. The configuration space Q can be chosen in various ways, e.g. it may be the space of positions $\mathbf{Q}_k$ of N particles; or in field theory, it may be the space of field configurations $\phi(x)$. The trajectory $q(t) \in Q$ is similar to trajectories in classical mechanics, but the wave function $\psi(q,t) \in \mathbb{C}$ is essentially the standard one from quantum theory. So, at every moment of time there exists not only a wave function, but also a well-defined configuration of the whole universe. And unlike in classical mechanics where accelerations are given by forces, here velocities of particles are given by the wavefunction. A human brain, as a participant in and observer of the universe, is identified with some part of the configuration of the whole universe $q(t) \in Q$.

Regarding quantum measurement, it's interesting to note that collapse of the wavefunction never occurs in de Broglie - Bohm theory. Collapse is seen as a subjective phenomenon, which occurs in a phenomenological way from the perspectives of specific observer systems. Bohm's original papers leave this a bit fuzzy, but Holland [**?**] makes it clearer, pointing out that what makes one possible state of a system appear to have "collapsed" is the presence of configuration variables q corresponding to that state.

To frame the theory more precisely, suppose the configuration q of the universe is described by coordinates q^k; this configuration is then proposed to evolve according to the guiding equation

$$m_k \frac{dq^k}{dt}(t) = \hbar \nabla_k \operatorname{Im} \ln \psi(q,t) = \hbar \operatorname{Im}\left(\frac{\nabla_k \psi}{\psi}\right)(q,t)$$

where $\psi(q,t)$ is the standard complex-valued wavefunction known from quantum theory, evolving according to Schrodinger's equation

$$i\hbar \frac{\partial}{\partial t}\psi(q,t) = -\sum_{i=1}^{N} \frac{\hbar^2}{2m_i}\nabla_i^2 \psi(q,t) + V(q)\psi(q,t)$$

These equations specify the de Broglie - Bohm variant of any quantum theory with Hamilton operator of type $H = \sum \frac{1}{2m_i}\hat{p}_i^2 + V(\hat{q})$; the approach has also been extended to deal with field theory and curved spacetime [**?**].

Now, these equations do not *intrinsically* give rise to quantum mechanics. However, if one makes the additional assumption that the configuration is distributed according to $|\psi(q,t)|^2$, *then* one can show that the results agree with those of standard quantum mechanics. Furthermore, one can show that if the configuration is distributed according to $|\psi(q,t)|^2$ at some moment of time t, this will continue to hold for all times! Such a state is named quantum equilibrium.

However, Valentini [**?**] has made the intriguing suggestion that this sort of quantum equilibrium should be viewed as an *emergent* phenomenon vaguely similar to macroscopic thermodynamic equilibrium, rather than simply assumed. He begins without this assumption, and then constructs a *subquantum entropy* P which, when coarse-grained, increases with time, reaching a maximum when $P = \|\psi\|^2$. His "H-theorem," via predicting subquantum entropy increase, explains the emergence of effective locality and uncertainty from a deeper nonlocal and deterministic theory.

And this is where, I suggest, the potential for psi may enter in. What if Valentini's H-theorem doesn't tell us enough about the relevant subquantum dynamics? What if, instead, we sometimes get *far from quantum equilibrium* dynamics on the subquantum level?

My suggestion is that the configuration q of the universe, in the pilot wave theory, is only *approximately* distributed according to $\|\psi(q,t)\|^2$. I suggest that the true configuration may be distributed differently, and perhaps in a manner conceptually reminiscent of Sheldrake's "morphic field."

2.1 Information Based Priors on the Universal Configuration

Specifically, what I call *morphic pilot theory* is the hypothesis that

1. one may effectively model the configuration q as a Turing-computable entity, with a computable state defined at each computable time-point

2. at each computable time point, the computable configuration may be understood to be distributed according to some function

$$f(s(q,t), \|\psi(q,t)\|^2)$$

where f is monotone increasing in both arguments, and $s(q,t)$ is a measure of the *informational simplicity* of the configuration q at time t.

One obvious possibility for the combination function f is

$$f(s(q,t), \|\psi(q,t)\|^2) = s(q,t)\|\psi(q,t)\|^2$$

The simplicity s could be measured in many ways, and I will review several alternatives here, without positing one as most promising. For instance, one straightforward approach would be

$$s(q,t) = s_{past}(q,t) = 2^{-I_M(q(t))}$$

where

$$I_M(A,B)$$

denotes the length of the shortest self-delimiting program running on Universal Turing Machine M that computes A given B [**?**]. What this says is that there is a bias for the configuration to be as compactly describable as possible.

Many other variations on the idea may obviously be formulated, e.g.

- If the exponential decay in the above formulas is too steep, a polynomial may be substituted

- One may replace I_M (the algorithmic information) with Schmidhuber's "speed prior" [**?**] or one of the weighted combinations of program length and speed described in [**?**].

- The choice of universal computer M is also a nontrivial issue – what is the universal computer underlying the universe?
- Rather than thinking about (q, t), it may be simpler to look at (q, T) where T is a time *interval*, and then to look at formulations like $s_{now}(q, T) = 2^{-I_M((q,T))}$, and think about the configuration as being distributed like $s(q, T)\|\psi(q, T)\|^2$ for time intervals T, for an appropriate simplicity measure s

The variety of possibilities here is why I have described the morphic pilot theory, at this point, as constituting a *class* of theories rather than a specific physical theory. However, morphic pilot theory is not so unusual in this regard. For example, what is typically referred to as "string theory" is in fact a broad class of theories, and current physics data is not adequate to select between the variety of possibilities (nor in fact to tell us if string theory as a class of theories makes empirical sense).

2.2 The Morphic Pilot Wave

While the details may be worked in many ways, the basic flavor of morphic pilot theory may be understood independently of them. If the configuration of the universe is distributed according to a simplicity bias, then the pilot wave is effectively moving through a configuration that is structured according to what Peirce called "the tendency to take habits." That is, it is more likely to move in a manner consistent with configurations that display common patterns throughout different parts of space and time, because these common patterns will give that configuration a shorter description length. This is what I call a *morphic pilot wave.*

The morphic pilot wave is actually described by the same equation as a regular de Broglie - Bohm pilot wave (the standard Schrodinger equation in the simplest case, or variations to account for field theory or curved spacetime) , but the universe in which it moves is biased so that a pattern in one (spacetime) spot is improbably likely to pop up in another spot. Thus, Sheldrake's intuitive notion of a "morphic field" is retained, but the "field" is the computable, far-from-quantum-equilibrium de Broglie - Bohm universe configuration.

3 A Feynman Path Integral Interpretation

It's also interesting to explore the manifestation that the morphic pilot may take in the Feynman formulation of quantum mecanics. To keep things simple, consider the case of a single particle's movement during a single time-interval. More general cases may be treated similarly.

In this case, the standard Feynman path integral looks like

$$Z = \int e^{\mathrm{i}\mathcal{S}[x]/\hbar}\mathcal{D}x$$

where

$$\mathcal{S}[x] = \int_0^T L[x(t)]$$

is the *action* of the classical problem in which one investigates the path starting at time $t = 0$ and ending at time $t = T$, and $\mathcal{D}x$ denotes integration over all paths. In the classical limit, $\mathcal{S}[x] \gg \hbar$, the path of minimum action dominates the integral, because the phase of any path away from this fluctuates rapidly and different contributions cancel.

However, in some cases, for instance a particle moving in curved space, we also have measure theoretic factors in the functional integral:

$$\int e^{iS[x]}\mu[x]\mathcal{D}x$$

It would seem that, in the Feynman perspective, the cognate of a bias in the de Broglie - Bohm configuration would be a special measure μ biasing the path integral. What if

$$\mu(x) = 2^{-I_M(x)}$$

for example? Or one may introduce other possibilities similar to the different algorithmic information based configurations suggested above.

In this sort of biased Feynman integral, one still calculates the amplitude of a quantum event via summing a factor based on the energy over all possible paths. However, in the sum, each path is weighted according to its simplicity. So paths that are more computationally compressible are favored. More computationally compressible paths will have more common patterns throughout their course, thus again presenting "morphic" effect.

Exploring the mathematical connection between the de Broglie - Bohm variation presented here and the Feynman variation presented here would require significantly more formalism that we have given; however, the two formulations embody the same idea, and it seems likely that under appropriate conditions they can be proved equivalent.

4 A Speculative Possible Relationship with Gravitation

As a brief digression, it is interesting to note that the sort of extension of quantum physics presented here could potentially be of value in the quest to unify gravitation with quantum theory, as well. Masreliez [?] has described a tantalizing theory in which the Schrodinger equation emerges from very high frequency, small amplitude, temporal *subquantum excitations* in the metrics of a Minkowskian spacetime modeled as in general relativity. If one assumes a subquantum domain populated by metrics oscillating at the Compton frequency, one finds that the momentum relation of Bohm and de Broglie follows directly from the geodesic equations of general relativity. Setting part of the Ricci scalar equal to zero gives a covariant wave equation, and the Schrodinger equation becomes part of a more general solution that also models quantum jumps – portraying the quantum wavefunction as resultant from amplitude and phase modulations of very high frequency oscillations in the metrics of spacetime!

Masreliez's theory is certainly very speculative, as are its numerous competitors in the area of unified field theory. A skeptic could easily view it as mere mathematical gamesmanship. However, I mention it here just to show the broad scope of potential conclusions that might be drawn by exploring various sorts of fluctuations in the subquantum universe-configuration proposed in the de Broglie - Bohm theory. Masreliez wants this subquantum domain to consist of rapidly oscillating spacetime metrics; my proposal suggests that it may be distributed according to considerations of algorithmic simplicity, leading to systematic deviations from quantum equilibrium. Future theories based on more refined relevant data may reveal yet stranger possibilities. It is not wholly implausible that some psi effects could rely on a simplicity bias in the space of possible subquantum oscillations of spacetime metrics, for example.

5 Conclusion

Suppose one assumes that

- The corpus of published psi data is largely correct
- Psi phenomena exploit some of the strange properties of quantum physics, but are not fully explained by it

Then what? Then it makes sense to explore the space of possible extensions to quantum physics, which are consistent with known physics data but also appear capable of encompassing the known psi data. I have described one class of such extensions here.

The morphic pilot, as described here, displays many of the same intuitive properties as the "morphic field" proposed by Rupert Sheldrake. On a qualitative level, it seems to have many of the same consequences: it suggests that patterns existing in one place or time in the universe will tend to pop up in other places and times in the universe, even without any ordinary causal connection. However, unlike Sheldrake's morphic field, the morphic pilot's relationship with known physics is relatively clear and simple.

Also, the morphic pilot theory provides a clear explanation for the general weakness and unreliability of psi results, along the lines explored by Burns [**?**, **?**]. If psi must rely on the coordinated buildup, among multiple correlated molecules, of biases in subquantum fluctuations – then it's no wonder the effects tend to be small and somewhat fussy.

In order to explore the connection between the morphic pilot theory and particular experimental results about particular psi phenomena, one would need to choose a particular variant of the simplicity bias and then make calculations about the experimental situation in question. This doesn't seem like an outrageously difficult enterprise, and I hope to find time to undertake it in future. Precognition experiments such as described in [**?**] would seem to be a natural place to start.

It's also interesting to ask: If the morphic pilot theory is indeed correct, then what sort of experiments might be useful for assessing which particular simplicity measure best captures the "morphic" structure of our universe? One possibility would be to look at variations on the standard random-number-prediction precognition protocols, in which the subject is asked to predict other properties of a randomly generated sequence besides the mean, e.g. to predict whether a certain more complex pattern is going to occur in the series soon. Studying how success in this sort of trial depends on the nature of the pattern, could be quite informative. However, given the well-known difficulties of psi research, doing this sort of experiment well would require a large number of trials and subjects and hence a large expense.

Another deep question is the extent to which psi phenomena depend on literal quantum dynamics as opposed to quantum-informational dynamics. Aerts [**?**, **?**] makes an argument that certain complex "classical" systems should actually be modeled using the mathematics of quantum observables. This pertains to the issue of whether artificial intelligences or simulated human brains, implemented on digital computers, could ever demonstrate psi phenomena.

Finally, while I have presented the morphic pilot theory here mainly in terms of the de Broglie - Bohm formulation of quantum physics, and noted its possible manifestation in the Feynman formulation, it's not clear if the most elegant formulation will ultimately involve either of these. There are many mathematically equivalent views of quantum physics and it may be that some other formulation matches more naturally with the morphic pilot theory, perhaps giving some conceptual insight into the most appropriate simplicity measure or underlying universal Turing machine.

There is a long way to go before the theory of psi catches up with the large store of empirical data and the refined experimental methodology that has evolved. The ideas presented here are plainly speculative. However, in the absence of a solid theoretical understanding, the time seems ripe for brainstorming a variety of scientifically plausible ideas, conceiving ways to explore and test them, and seeking to move toward a future where experimental and theoretical psi research advance in a more closely coupled manner.

References

[1] Aerts, D. (1982). Example of a macroscopical situation that violates Bell inequalities. Lettere al Nuovo Cimento, 34, pp. 107-111.

[2] Aerts, D. (1991). A mechanistic classical laboratory situation violating the Bell inequalities with 2sqrt(2), exactly 'in the same way' as its violations by the EPR experiments. Helvetica Physica Acta, 64, pp. 1-23.

[3] Bohm, David (1952). "A Suggested Interpretation of the Quantum Theory in Terms of "Hidden Variables" I". Physical Review 85: 166179

[4] Bohm, David (1952). "A Suggested Interpretation of the Quantum Theory in Terms of "Hidden Variables", II". Physical Review 85: 180193

[5] Burns, Jean (2002). Quantum fluctuations and the action of the mind, Noetic Journal, 3(4), 312-317.

[6] Burns, Jean (2003). What is beyond the edge of the known world? in J. Alcock, J.E. Burns, and A. Freeman (eds.), Psi Wars (Exeter, UK: Imprint Academic), pp. 7-28. Reprinted (2008), in R.M. Schoch and L. Yonavjak (eds.), The Parapsychology Revolution (New York: Tarcher).

[7] Burns, Jean (2006). The arrow of time and the action of the mind at the molecular level, in D.P. Sheehan (ed.), Frontiers of Time: Retrocausation Experiment and Theory (Melville, NY: AIP Conference Proceedings), pp. 75-88

[8] Chaitin, Gregory (1988). Algorithmic Information Theory. Addison Wesley.

[9] Durr, D., Goldstein, S., Tumulka, R., and Zangh, N. (2004), "Bohmian Mechanics and Quantum Field Theory", Phys. Rev. Lett. 93: 090402:14.

[10] Durr, D., Tumulka, R., and Zangh, N. (2005)., J. Phys. A: Math. Gen. 38, R1R43 (2005).

[11] Holland, P. (1993), The Quantum Theory of Motion: an Account of the de Broglie-Bohm Causal Interpretation of Quantum Mechanics, Cambridge University Press, Cambridge.

[12] Masreliez, Johan C. (2010). A possible link between General Relativity and Quantum Mechanics, `http://www.estfound.org/quantum.htm`

[13] Radin, Dean and Roger Nelson (2000). Meta-analysis of mind-matter interaction experiments: 1959 to 2000. `www.boundarylab.org/bi/articles/rngma.pdf`

[14] Radin, Dean (2010). `http://www.deanradin.com/NewWeb/bio.html`

[15] Radin, Dean (2006). Entangled Minds: Extrasensory Experiences in a Quantum Reality. Paraview Pocket Books

[16] Rao, Ramakrishna (2001). Basic Research in Parapsychology. McFarland. New York

[17] Peirce, Charles (1988). Philosophical Writings of Peirce, ed. Justus Buchler. Dover

[18] Schmidhuber, J. (2002). The Speed Prior: A New Simplicity Measure Yielding Near-Optimal Computable Predictions. In J. Kivinen and R. H. Sloan, editors, Proceedings of the 15th Annual Conference on Computational Learning Theory (COLT 2002), Sydney, Australia, Lecture Notes in Artificial Intelligence, pages 216–228. Springer, 2002

[19] Sheldrake, Rupert (1988). The Presence of the Past: morphic resonance and the habits of nature, New York, NY: Times Books, 1988

[20] Spottiswoode, James and Ed May (2010). Anomalous Cognition Effect Size: Dependence on Sidereal Time and Solar Wind Parameters, http://www.jsasoc.com/library.html

[21] Sun, Yi, Tobias Glasmachers, Tom Schaul, Juergen Schmidhuber (2010). Frontier Search. Proceedings of AGI-10, Atlantis Press.

[22] Valentini, A. (1991). "Signal-Locality, Uncertainty and the Subquantum H-Theorem. II," Physics Letters A 158: 18.