Materiality, Classical Physics, Quantum Mechanics, and Symbolic Reference

(from: Becker & Hossenfelder)

I seem to have a propensity for making remote associations, seeing one thing in terms of something else (early second language acquisition (SLA) as a form of pidginization (Schumann, 1976); SLA as an aspect of acculturation (Schumann, 1978), SLA research as art (Schumann 1984, 1986), stimulus appraisal as motivation (Schumann 1997, 2001), learning as foraging (Schumann, 2001), synonymy as degeneracy (Schumann, 2016), symbolic relations as nonphysical aspects of mind (Schumann, 2018; Logan & Schumann, 2005) . This tendency may have also been the source of my thought that there might be something similar about how nonphysical symbolic entities work and what goes on in subatomic physics. It made me wonder about whether there was anything nonphysical about the quantum realm that would allow the curious behavior of particles which were being studied in quantum mechanics. Then I encountered two recent books, *What Is Real* by Adam Becker and *Lost in Math* by Sabine Hossenfelder. Both these physicists were writing about problems they saw in quantum physics.

What interested me in Becker's book was that, although quantum theory has been with us for almost 100 years, there is still no definitive interpretation of what it means for our understanding of the physical world.

Quantum physics deals with subatomic entities (quanta) which have properties that are quite unusual for physical phenomena.

1. The position and momentum of a particle cannot be simultaneously known. If you know one, you cannot determine the other.

2. An electron can behave as either a wave or a particle, but not both.
3. The principle that something that happens in one place cannot influence something taking place somewhere else seems to be violated in quantum physics.
4. When particles share an interaction, they become entangled in one wave function.
5. The process of measurement seems to influence the outcome of the experiment.
6. Even with the uncertainty and indeterminism that characterize outcomes of research in quantum physics, it predicts with great precision the behavior of many quantum phenomena.
7. Recent theories of quantum mechanics involve unobservable phenomena that resist experimental verification.

These results have generated many epistemological debates about research in quantum physics and the nature of science. Some scientists have argued that concern about unobservable entities is meaningless. They've believed that meaning only comes from empirical verification. Anything, to be considered scientific, has to come through perceptions. Anything beyond perception constitutes metaphysics. Concepts, to be scientific, must have operational definitions that yield concrete experimental procedures.

The investigation of quantum theory and research has yielded multiple interpretations of the phenomena and additional ones continue to appear. I will just list a representative sample: the Copenhagen interpretation, the pilot wave interpretation, quantum field theory, universal wave function theory, the QBism interpretation, the many worlds interpretation, spontaneous collapse theory.

QUESTIONS

Becker's book raises many questions with regard to nonphysical symbolic entities. Here I will pose some of these questions. Many of the terms used to refer to nonphysical concepts are open to multiple nuances; therefore, I will sometimes ask the same question in slightly different ways. Some of these issues have already been addressed in Schumann (2018), but the questions still remain.

1. Are there nonphysical entities?
2. Do nonphysical entities exist?
3. Is everything we encounter in the world physical?
4. Does the term, "real" mean, "physical"?
5. What is the relationship among, "real", “physical”, and “symbolic".
6. What is the relationship between, "concrete" and "physical"?
7. What is the relationship between, "abstract" and "physical"?
8. What is the relationship between "abstract" and “nonphysical”?
9. Is all mathematics physical?
10. Do any of the mathematical formulations of quantum mechanics contain symbolic (i.e. sign-sign) relationships?
11. Are the mathematical formulations of quantum mechanics physical?
12. Are there physical entities that are not directly observable even with technological support (microscopes, telescopes, fMRI) meaningful?
13. Is it appropriate to suggest that there are nonphysical entities in the symbolic realm?
14. To do legitimate research on the nature of the world should one maintain an exclusively physicalist/materialist position?
15. Is it enough to measure nonphysical entities using whatever research and statistical techniques we have or which we might borrow from the sciences and to ignore the fact that the final answers or characterizations may never result?

16. Does talk about nonphysical entities have any relevance to our understanding of the world?
17. Do unobservable nonphysical entities (i.e., concepts) have any effects on the world?
18. Is the nonphysical realm amenable to scientific investigation and verification?
19. Is symbolic reference successful in the scientific sense?
20. If nonphysical symbolic concepts cannot be seen or observed in any way that would guarantee verification, do such phenomena fall within the domain of science?
21. Are nonphysical concepts observable? All of them? Do those that are not observable fall outside the domain of science?
22. If we conclude that nonphysical concepts are outside the realm of science, what do we lose? What do we gain?
23. Are percepts and concepts the same in terms of physicality?

Sabine Hossenfelder's in Lost in Math argues that there is a problem in quantum physics. It is that traditionally quantum physicists have had an aesthetic criterion for their theories. They believe that good theories should demonstrate beauty in terms of elegance, naturalness, simplicity, symmetry, and unification. Hossenfelder also argues that these criteria which were initially applied to the theory are now applied to the mathematics in which the theory is constructed. So, she has reservations both the aesthetic criteria for evaluating theories themselves and for evaluating their mathematical formulations. The terms for the components of beauty were never strictly defined in the field, but some approximations apply. Simplicity is an assessment of the number of assumptions in a theory, with fewer being better. Naturalness maintains that an assumption which has not occurred by chance is not natural. Elegance is the criterion for the emergence of new knowledge by providing a formerly unnoticed association with something else, allowing a new perspective on a phenomenon.

How did physicists come to maintain these aesthetic criteria? The short story is, God created the world and God would create nothing that was not beautiful. Scientists came to believe that if the theory were beautiful, then it had a high chance of being correct. Hossenfelder cites Gell-Mann on this issue, "in fundamental physics a beautiful or elegant theory is more likely to be right than a theory that is inelegant" (26). She cites the physicist, Frank Wilczek, who maintains that "trying to find an exact definition is too ambitious…And over the centuries people have found patterns and what the ideas that work are. So, we've learned to see them as beautiful"(151). As physics developed the time lag between developing the theory and developing the technology that could adequately test the theory became longer and longer. The lag could outlast physicists' lifespans. Therefore, they maintained that a beautiful theory would more likely to eventually be shown to be successful even if they did not live long enough to see that justification.

Just as there are multiple interpretations of quantum mechanics, Hossenfelder points out, "postulating particles has become the theoretician's favorite pastime. We have preons, sfermions, dyons, magnetic monopoles, simps, wimps, wimpzillas, axions, flaxions, erebons, cornucipons, giant magnons, maximons, macrons, branons, skymions, cusctons, planckons, and sterile neutrinos-- just to mention the most popular ones. We have unparticles. None of these have ever been seen, but their properties have been thoroughly studied in thousands of published research articles." (190).

QUESTIONS

1. Are the entities in quantum physics physical in the same way that entities in classical physics are? If the phenomena in quantum physics that are not physical or not physical in the classical sense, could the mathematics used to describe quantum phenomena be too precise to be appropriate in all cases?

2. Is the mathematics used in quantum physics itself physical? Or is it simply a representation of quantum entities? Is it a map of the quantum phenomena, or is it the actual territory?
3. Hossenfelder states that the mathematics used in physics is "what we invented to quantify the observed behavior of particles, a mathematical tool that helps us make predictions".
4. Is the mathematics real? Hossenfelder prefers to view the mathematics as a description of reality, and she avoids trying to decide whether it is real. She says, "how math connects to reality is a mystery that plagued philosophers long before there were scientists, and we aren't any wiser" (52).
5. If it is the case that mathematical formulations and quantum mechanics are symbolic entities, and if it is the case that symbolic entities are inherently ambiguous, vague, and have no defined teleology (as suggested by Schumann, 2018), then the lack of a final solution or formulation may not be possible, and it may be a mistake to expect such an outcome.

Quantum mechanics and nonphysical entities

Interpreting the term which makes symbolic reference to a nonphysical entity means engaging in a web of words from which the term derives its meaning. Initially, many interpretations are possible. But when `one is settled upon, reference is established. This process may be in some ways analogous to the collapse of the wave function in quantum mechanics. However, when that occurs in the quantum world via the measurement of the location of a particle, it does so immediately and violently. In the nonphysical semiotic world, the collapse may be temporary and tentative while determination of the referent continues to be made. Interpretation may be made and entertained to see whether it actually works.

A researcher who, for example, wants to define the meaning of an abstract nonphysical entity like emotion, feeling, motivation, or mind is intentionally trying to collapse the wave. That collapse may be accepted by his interlocutors, rejected, or only tentatively considered. Since nonphysical entities and the terms that refer to them are always somewhat vague, under determined, and open to alternate interpretations based on context, ultimate collapse may never happen. New interpretations are possible as context changes, and therefore, may resist a designation of an ultimate interpretant.

Symbolic reference in the mathematics of quantum mechanics

Is it possible that quantum physicists in their mathematics are actually using symbolic reference in which the mathematical signs get their meaning from other signs, and under these conditions certainty becomes difficult because reference is not being made to the physical world outside of mathematics. If structurally different mathematical solutions can come to the same conclusion, do we not have a situation of degeneracy which is like synonymy in words. If one word can be substituted for another because the two words are synonymous (i.e. both words have similar meanings but not necessarily exactly the same meaning), and neither refers to a physical entity in the world, but nevertheless refers to a nonmaterial concept (e.g., democracy, mediocrity), then ambiguity, uncertainty, and impreciseness can result. In other words, are the mathematical depictions in quantum mechanics actually depicting not a material thing, but rather an abstract nonmaterial symbolic concept. The symbolic nature of the mathematical constructs used in quantum research may be what is keeping that field from a final solution, a theory of everything, a grand theory of the physical.

Physics = Laws; Life = Operations (Kull,2015)

1.Physical systems operate on laws which do not have inconsistencies, contradictions or options (Kull, 2015)

2.Biological systems can (through sign relations) operate on alternatives, options, and "in terms of". They can perform operations on alternatives and on inconsistencies and contradictions. (Kull, 2015)

3.But quantum physics seems to engage contradictions and inconsistencies. An entity can be in two different places at the same time. An electron can be either a wave or particle. Something happening in one place can influence something taking place somewhere else. Measurement can affect an experiment in the quantum realm. (Kull, 2015)

If the above three statements are roughly accurate, then symbolic relationships (sign-sign) and subatomic entities are not physical and do not operate according to classical physical laws.

Kull (2015) notes that meaning is not relevant to physics. The classical physical world, i.e. the inorganic world, is governed by non-contradictory laws. "By definition, the physical laws… cannot contradict each other, nor can they have exceptions (this is a fundamental assumption for physical theories)." (2015, 618) These laws do not permit situations in which there are simultaneous options, inconsistencies, incompatibilities, choices, decisions, multiple interpretations. Biological systems (the organic world, life) can deal with options not via laws but via operations which are rules that are local, not universal, that have exceptions, and that can contradict each other, and that can be implemented simultaneously. They can operate on simultaneously presented choices, possibilities, decisions and interpretations. In physics there can be alternatives, but they must be considered sequentially, for example if A do B, and if A do Z, but physical laws do not allow both conditions of to be considered or implemented simultaneously.

However, quantum physics seems to engage contradictions and inconsistencies. An entity can be in two different places at the same time. An electron can be either a wave or a particle. Something happening in one place can influence something that is not present. Measurement can affect the outcome of an experiment. If this is the case, then quanta may be either nonphysical or not physical in the same way as in classical physics.

Thus, at the quantum level, there is uncertainty and at the symbolic level there is great uncertainty. These uncertainties may both relate to the issue of non-physicality or simply size.

The scientific revolution had its focus on the physical world, inorganic and organic. It valued observability, experimentation, and the replicability of experimental results. But the notion of science got extended to where physicality, observability, the isolation of variables, and laboratory experimentation were not really possible or possible but not convincing. If science, as we imagine it and currently believe in it, pertains to the physical world then it has a restricted range of applicability. Maybe we have overextended that range.

Perkins (2011) takes up the issue of similarities between triadic relation (symbolic reference) in quantum mechanics. She notes that classical physics is not adequate to describe quantum physics and neither does it account for the nonphysical/nonmaterial triadic world of symbolic reference. Thus, the quantum order and the symbolic order deviate from the physical order (and vice versa). They may differ in some similar ways, but we should probably not expect that they would match up in any way that we could use one as a precise guide to the other.

The quantum world (subatomic entities from atoms two larger physical entities) may somehow scale up to the classical physical world. With life came the physical biological world and humanity developed the ability to create nonphysical symbolic entities (ideas, concepts, categories, fictions etc.), and this made it possible to leave the material worlds of classical physics and biology, but without losing physical grounding. Physicists have been looking for a grand unifying theory that would unite the quantum and classical perspectives. But that desire for everything to conform to the classical view might simply distort the actual nature of things. An ideological physicalist position may simply prevent an understanding of our quantum and symbolic modes of existence. On the other hand, Perkins (2011) notes that there may be a continuity across all three levels such that the quantum, physical, and symbolic worlds, while operating with different processes and constraints, may have emerged from each other but are not reducible to each other.

The term "science" has an interesting status in the current symbolosphere. It seems to have become an honorific, a term of deference. Because of the great strides that have taken place in what we call science, both fields of inquiry and individuals have appropriated the term because of the status it brings. This is perhaps exemplified in the current reverence with which we regard STEM (science, technology, engineering, and mathematics) studies. Because of the increased cost of college education and the concerns regarding employment after graduation, studies outside these areas are regarded by some as a financial extravagance. Science, technology, engineering, and mathematics are concerned with the material world. And although the term "science" has accrued a reverential aura, I strongly suspect that it is mainly technology that impresses the world. Technology brings us things like computers, toaster ovens, robotics, microwave ovens, retinal implants, functional magnetic residence imaging, air conditioning, and ATMs. A lot of science stands behind this technology, but what most of us see is simply a technological product, and having the education to work for manufacturers of this technology is believed to be the avenue to financial well-being. There may be a downside to the diminutation in the study of the arts, the humanities, in the social sciences because it is here that we often have to deal with the nonmaterial/nonphysical symbolic world. But there are scientists who themselves have backgrounds in the arts and humanities and also thus have training in the value and the use of intuition, inspiration, and every if great Bobby sure conceptual association (see the discussions of Eric Kandel, Edward O Wilson, and of Michael Anderson in Schumann, 2018).

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