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# Questions about Philipp Berghofer's experience-first approach to epistemology and quantum mechanics

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It is always my pleasure to study Philipp Berghofer's work. Even when I disagree with him, I appreciate his ability to convey highly intricate subjects in phenomenology, quantum mechanics, and epistemology in easily understandable texts. I also admire his bold positions challenging conventional views, for instance, his criticisms of objectivist interpretations of quantum mechanics and his opposition to externalism in epistemology. Radical thoughts are necessary for philosophy. If they succeed, they will shape future thoughts. Otherwise, they will at least push their rivals to present their best versions. In this commentary, I ask six questions concerning the implications of Berghofer's experience-first approach for the epistemology of science, in general, and that of quantum mechanics, in particular. His responses will deepen my comprehension of his ideas. I also anticipate that these questions will aid him in further refining and strengthening his arguments.

## 1. Experience-first epistemology and the theory dependence of empirical results

I begin with the core of his epistemology. He argues that "every piece of justification can be traced back to epistemically foundational experiences" and that "justification-conferring experiences gain their justificatory force by virtue of their distinctive phenomenology" (Berghofer 2023, p. 1). While these claims primarily pertain to everyday experiences, I intend to explore their potential implications for scientific practice. I assume that "experience" in science consists of the results of experimental and observational practices, or in short: empirical results. Accordingly, the implications of Berghofer's claims for the epistemology of scientific practice will be that every piece of justification in science can be traced back to empirical results, and that the justificatory force of empirical results is grounded in the phenomenology of the respective experiences.

An initial issue that comes to mind is the theory dependence of empirical results. Berghofer has passingly discussed this topic (in his 2022, p. 296 and p. 298, footnote 16). Also, his moderate foundationalism accepts that basic beliefs such as perceptual ones are fallible, and so they can be defeated by other justified beliefs (2022, chapters 5 and 8). However, the theory dependence thesis makes a stronger assertion: the meaning, relevance, and significance of empirical results depend on theoretical concepts and interpretations. If the justificatory force of empirical results depends on the theories that interpret the results, and the justification of these theories depends on other empirical results, which themselves depend on other theories and so on and so forth, then the result will be a coherentist account of epistemic justification. According to this account, we have scientific theories that cohere with the empirical results they interpret, and thus the justificatory force of a set of empirical results comes from their coherence with other empirical results and scientific theories.

In the case of ordinary experience, and due to the cognitive penetrability of perception, a similar problem arises. In that case, however, we usually do not question the existence of observable objects. We may dispute about their descriptions, which depend on the concepts and beliefs we employ in our descriptions. On the other hand, in the case of unobservable entities such as bosons, genes, and gravitational lenses, realists and antirealists disagree even about the very existence of these entities. This deep disagreement arises because empirical results are dependent more heavily on theoretical concepts than ordinary experiences on prior beliefs. Therefore, even if one accepts a view closer to foundationalism than to coherentism regarding the relation between perceptual beliefs and other beliefs, the theory dependence of scientific observation and experimentation pushes one into accepting a view closer to coherentism regarding the relation between empirical results and theoretical beliefs. With this in mind, let me ask my first question: If we accept the theory dependence of empirical results, in what sense can empirical results be first, primary, or foundational? How can theoretical beliefs be constructed on the foundation of empirical results, whose meaning, relevance, and significance are dependent on those theoretical beliefs?

## 2. Phenomenology of instrumentally mediated empirical results

The next issue concerns the claim that the justificatory force of empirical results (in science) is grounded in their phenomenology. It is widely accepted that we do not directly experience unobservable objects. The empirical outcomes of scientific instruments are interpreted as the evidence of the detection or observation of these entities or as the measurement of their properties. In particle physics, cosmology, and many other branches of contemporary science, instruments produce large datasets that are subsequently processed to provide empirical evidence for or against a particular claim. Furthermore, data processing is mostly done automatically by computational systems, which arguably lack intentionality toward objects. In this context, not only are we unable to directly experience objects, but it is also unclear what it means to experience empirical results (is our *experience* directed to the data displayed on computer screens?). Thus, my second question can be framed in this way: what does it mean that instrumentally mediated empirical results – for instance, large datasets – have their phenomenology? More generally, how does experience-first epistemology take into account the role of instrumentation, computational systems, and automatic processes in contemporary science?

### 3. Quantum mechanics and the nature of science

Let us turn our focus to Berghofer's phenomenological approach to physics. It is worth acknowledging that the "phenomenological approach to physics" is a relatively new field, with Harald Wiltsche and Philipp Berghofer being among its pioneers (see their 2020). With the forthcoming publication of Steven French's monograph, *A Phenomenological Approach to Quantum Mechanics*, I expect that this field will gain more and more recognition and esteem within the areas of philosophy of physics and philosophy of science.

In his account of physics, Berghofer (2019; 2022, chapter 15) supports a phenomenologically inspired perspectival realism, which is different from Wiltsche's (2012) antirealist interpretation of Husserl's philosophy of science (see Berghofer 2018). In the context of his phenomenological perspectivism, Berghofer relies on the formalism of quantum mechanics to reflect "the nature of science". He writes: "Science, at a fundamental level, does not represent an objective world but describes what the experiencing subject should expect to experience next" (2023, p. 5). My third question concerns his reliance on quantum mechanics to reveal the nature of science. To begin with, is quantum mechanics really fundamental in an absolute sense to show the most basic nature of science? Quantum mechanics is more fundamental than, e.g., solid-state physics or nanoscience, but less fundamental than quantum field theory and future theories unifying quantum mechanics with general relativity (see Egg 2021, section 3). Moreover, why may science not have many different faces, one of which appears in quantum mechanics? Perspectivism is more consistent with a pluralist view about scientific practice, according to which different perspectives from which reality is understood in quantum mechanics, cosmology, biology, cognitive science, computer science and other fields manifest a variety of different natures science may enjoy. In particular, in historical sciences including part of biology and cosmology, it does not make much sense to claim that scientific theories describe what the experiencing subjects should expect to experience next.

The subject of study in these sciences concerns the past and not what may be expected in the future.

## 4. The success of quantum mechanics

Berghofer's non-objectivist interpretation of quantum mechanics draws inspiration from Edmund Husserl's account that we must not "take for true being what is actually a method" (Husserl 1970, p. 51). I completely agree with Berghofer's argument against the reification of mathematical quantities of quantum mechanics. It is highly problematic to consider the wave-function to be physically real or to claim that everything allowed by the Schrödinger equation should possess physical reality. According to the criterion for reality I propose in Khalili (2023a), these entities cannot be taken as real, since they are far from displaying properties detectable in a variety of independent ways of empirical investigation. Accordingly, I do take issue with wave-function realism and the many-worlds interpretation of quantum mechanics, or with the hidden variables assumed by Bohmian mechanics. Nevertheless, the efforts of realist interpretations of quantum mechanics deserve appreciation inasmuch as they try to answer why quantum mechanics is highly successful. According to the (in)famous no-miracle argument, it is highly surprising that mathematical equations of quantum mechanics represent no aspect of reality but they can succeed in the prediction and explanation of the behavior of electrons in atoms and the interactions of particles in high-energy accelerators, and in the development of quantum computers and medical imaging. Consider the QBist claim that quantum states do "not represent an element of physical reality but an agent's personal probability assignments, reflecting his subjective degrees of belief about the future content of his experience" (Fuchs and Schack 2015, p. 1). My fourth question is raised here: how can the successful explanations and predictions of the wave function be explained if "instead of being construed as (the representation) of something physically real, the wave function is [only] considered to be a mathematical tool that encodes one's expectations about one's future experiences" (Berghofer 2023, p. 13).

## 5. QBism and realism

The fourth question is also relevant to why QBism is claimed to be a realist account. In this regard, Berghofer usually refers to Christopher Fuchs's sentence that "rather than relinquishing the idea of reality, they [namely, QBists and others who incorporate a first-person perspective at the core of physics] are saying that reality is *more* than any third-person perspective can capture" (2017, 113). But the statement that "reality is *more* than any third-person perspective can capture" is notably vague and may even lack substance. Especially if we embrace the perspectivist idea that an objective, third-person perspective is unattainable, and thus what falls within the scope of such a perspective is beyond our human first-person accesses, then the statement simply implies that "reality is more than what is unattainable", a claim that, if not devoid of meaning, fails to shed light on the realist dimension of QBism.

A related issue concerns the claim that the wave function encodes one's expectations about one's future experiences. This claim could entail that the wave function represents only degrees of belief but no aspects of reality. This reading lacks any descriptive, representational elements, and is in line with David Glick's (2021) interpretation of QBism, according to which quantum theory is as normative as an ethical theory is. Glick suggests that "realism about quantum theory is a form of normative realism" (2021, p. 12). A rule-based ethical theory advises us to follow specific ethical rules; similarly, quantum theory gives guidance that we "should strive to satisfy the Born Rule for all probabilities" (Fuchs 2017, p.13). Since the Born rule yields *correct* guidance for navigating the quantum realm, according to Glick, it reflects a kind of normative *realism*: "quantum theory provides correct answers to questions about what we should do, and provides us with reasons to do as it prescribes. Thus, it would seem that QBism can meet the demands of a conception of realism appropriate for a normative theory" (2021, p. 18). This take on QBism is stimulating, yet it does not address my fourth question. If realism concerning quantum theory is exclusively concerned with normative aspects and lacks any descriptive components, it can, at most, explain why rational agents find it reasonable to adhere to quantum mechanics. However, it cannot elucidate how those who adhere to quantum mechanics can enjoy predictive and explanatory power, embodied in technologies that function effectively without caring about guiding our beliefs and actions.

The second way of understanding QBism is closer to Maurice Merleau-Ponty's partial realism (see Berghofer 2019) and to Karen Barad's (2007) agential realism. Both highlight the inseparability of the observer and the observed and emphasize the role of human participation in the constitution of quantum reality. This view can suitably be labeled *participatory realism* (Fuchs 2017). It may imply that quantum measurement *represents* some features of quantum reality, but this representation takes place only after human *participation*. From the ontology of potentialities viewpoint, I support a similar account (as outlined in Khalili 2023c): Human participation is the constitutive part of realizing real potentialities ('realizing' in both senses: 'actualizing' and 'knowing'), and this account completely agrees with perspectivism because real potentialities may be realized differently in different perspectives. As a result of this participatory perspectivism, the representation of quantum reality is always offered from a human *perspective*, the participation of which is necessary for the measurement of quantum states. And as I argue in Khalili (2022; 2023b), this perspectivism is compatible with a modest version of realism, in which the notion of robustness or perspectival objectivity plays a central role: the most objective aspects of our scientific knowledge concern those that persist in appearing in different perspectives. But what are those aspects of quantum reality, if any, that persist in the perspectives of different observers? This is my fifth question.

## 6. Underdetermination in quantum physics

Berghofer's broader project in quantum mechanics is to develop an account that "actively incorporates the cognizing subject and thus accounts for the fact that the life-world predates all scientific endeavors" (2023, p. 12). He has already made several attractive connections between phenomenology and non-objectivist interpretations of quantum mechanics such as QBism and the one presented by Fritz London and Edmond Bauer, supported by Steven French (Berghofer 2022, sections 15.3.2 and 15.5.1). Berghofer also plans to address the fundamental question of whether "the quantum formalism could be *reconstructed* from phenomenological-epistemological principles" (2023, p. 20; see also Berghofer, Goyal, and Wiltsche 2021). His future work would elaborate on how ideas from phenomenology, non-objectivist interpretations of quantum mechanics, and the reconstruction program can collaborate in offering a fresh interpretation of quantum mechanics. However, we should note that there are already several rival interpretations on the table, which has raised the problem of underdetermination in quantum mechanics (Egg and Saatsi 2021). Barzegar and Oriti (2022, section 3.3) suggest that successful reconstructions of quantum mechanics, along with present and future no-go theorems, will probably provide us with reasons to favor one interpretation over others in the future, thus addressing the current underdetermination of interpretations. However, one might question this optimism, claiming that different reconstructions based on different axioms may themselves lead to a variety of new interpretations. My sixth and final question in this commentary is about this underdetermination: will the reconstruction of quantum mechanics from phenomenological-epistemological principles, and its potential to result in a new interpretation of quantum mechanics, not exacerbate the underdetermination problem?

This commentary will achieve its goal if my questions will be useful in realizing the unfulfilled potential of Berghofer's promising project on the epistemology of scientific practice and quantum mechanics.

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