On Dualistic Interpretations of Quantum Mechanics[1]

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Abstract

Dualistic interpretations attempt to solve the measurement problem of quantum mechanics by postulating the existence of non-physical minds, and by giving a suitable dynamical equation for how these minds evolve. I consider the relative merits of three extant dualistic interpretations (Albert and Loewer's single-mind and many-minds interpretations, and Squires' interpretation), and I defend Squires' interpretation as preferable to the Albert/Loewer interpretations. I also argue that, for all three of these interpretations, the minds evolve independently of the physical universe, and hence render the physical universe otiose; the interpretations are better viewed as supporting not dualism, but mental monism.

1. Introduction. The quantum-mechanical measurement problem arises because the standard quantum dynamics (the Schrödinger equation) and the standard quantum semantics (the eigenstate-eigenvalue link) make predictions about systems that seem to be incompatible with our experience. The standard dynamics and standard semantics predict that one can easily set up a system whereby a cat is neither alive nor dead, for example, and yet we always experience cats as being either alive or dead.

[1]I thank Frank Arntzenius, Jeff Barrett, and Bas van Fraassen for helpful discussion.

It is often said that, in order to solve the measurement problem, either one must modify the standard dynamics (as is done by GRW theory, for example), or one must modify the standard semantics (as is done by modal interpretations, for example). Dualistic interpretations, however, modify neither the standard dynamics nor the standard semantics.[2] Dualistic interpretations solve the measurement problem by postulating the existence of non-physical minds, and by giving a dynamics for these minds which ensures that the probabilities for experiences of measurement outcomes are given by Born's rule.

This paper has two main theses. The first is that Euan Squires' dualistic interpretation is preferable to David Albert and Barry Loewer's single-mind and many-minds interpretations. The second is that, for all three of these interpretations, the minds evolve independently of the physical universe, and hence render the physical universe otiose; the interpretations are better viewed as supporting not dualism, but mental monism.

2. The Single-Mind and Many-Minds Interpretations. I will now explain the dualistic interpretations, focussing on Albert and Loewer's (1988) single-mind and many-minds interpretations. Consider a system which starts out in the state

$$(c_1 \, |x\text{-spin='up'}\rangle_e + c_2 \, |x\text{-spin='down'}\rangle_e) \, |\text{pointer='ready'}\rangle_p \, |\text{B='ready'}\rangle_{\text{Eve}} , \qquad (1)$$

where e is an electron, P a measuring apparatus, and Eve an observer. The state $|\text{B='ready'}\rangle_{\text{Eve}}$ represents some particular state of the particles which compose Eve's brain at a time when Eve is ready to look at the measuring apparatus to see what it registers. Suppose that by the standard dynamics the system evolves to the state

[2] At least, dualistic interpretations need not make such modifications to solve the measurement problem. Proponents of a dualistic interpretation could promulgate a nonstandard semantics if they so desired.

$$c_1 \, |x\text{-spin}=\text{`up'}\rangle_e \, |\text{pointer}=\text{`up'}\rangle_p \, |\text{B}=\text{`up'}\rangle_{\text{Eve}} + c_2 \, |x\text{-spin}=\text{`down'}\rangle_e \, |\text{pointer}=\text{`down'}\rangle_p \, |\text{B}=\text{`down'}\rangle_{\text{Eve}}. \quad (2)$$

Here the state $|\text{B}=\text{`up'}\rangle_{\text{Eve}}$, for example, represents some particular state of the particles which compose Eve's brain at a time shortly after she has looked at a P measuring apparatus with its pointer pointing to 'up'.[3]

Albert and Loewer's single-mind interpretation grants that (2) is the correct state of the physical universe, but asserts that it is not a *complete* description of the universe. In addition to the physical universe, there exist non-physical *minds* which always have definite, non-superposed beliefs. A single mind exists for each conscious observer. To ensure that the predictions of standard quantum mechanics are duplicated, the dynamics for minds are such that the probabilities for what minds believe are given by Born's rule.[4] Thus, Eve starts out in a ready state, believing that she is ready to make a measurement, and the probability that she will end up believing that the *x*-spin is up is $|c_1|^2$, while the probability that she will end up believing that the *x*-spin is down is $|c_2|^2$.

Albert and Loewer point out two problems for the single-mind interpretation. The first is that mental states do not supervene on brain states, since the quantum state of the system does not always determine what an observer believes; the same quantum state is compatible with different mental states. Because of this failure of supervenience, Albert and Loewer say

[3]I am assuming that that state is orthogonal to the state where Eve has looked at a pointer pointing to down, and to the state where Eve is ready to look at the pointer; if that turns out not to be the case then my argument still goes through, just in a slightly more complicated fashion.

[4]More precisely, the interpretation should specify not the probabilities for what beliefs minds have, but the probabilities for what phenomenal experiences minds have. A person who is convinced of the truth of the interpretation could have the phenomenal experience of the pointer pointing to 'up', but would not believe that the pointer actually points to 'up'. Instead the person would believe that the pointer neither points to 'up' nor 'down' (since the pointer is involved in the superposition, and the standard semantics holds).

that “the non-physicalism of the [single-mind interpretation] seems especially pernicious” (1988, 206).

The other problem, emphasized by Albert (1992, 130) is the *mindless hulk* problem. Suppose that some other observer, Adam, measures the *x*-spin of a different electron, also prepared in a superposition of *x*-spin eigenstates, and suppose Eve and Adam tell each other what results they got. This leads to a superposition state with four terms, corresponding to:

$$\begin{aligned}
&|\text{B=“I got ‘up’, Adam got ‘up’”}\rangle_{\text{Eve}} \otimes |\text{B*=“I got ‘up’, Eve got ‘up’”}\rangle_{\text{Adam}} , \\
&|\text{B=“I got ‘up’, Adam got ‘down’”}\rangle_{\text{Eve}} \otimes |\text{B*=“I got ‘down’, Eve got ‘up’”}\rangle_{\text{Adam}} , \\
&|\text{B=“I got ‘down’, Adam got ‘up’”}\rangle_{\text{Eve}} \otimes |\text{B*=“I got ‘up’, Eve got ‘down’”}\rangle_{\text{Adam}} , \text{ and} \\
&|\text{B=“I got ‘down’, Adam got ‘down’”}\rangle_{\text{Eve}} \otimes |\text{B*=“I got ‘down’, Eve got ‘down’”}\rangle_{\text{Adam}} .
\end{aligned} \tag{3}$$

The single-mind interpretation only specifies probabilities for individual minds evolving, and thus places no constraints on correlations between minds. It follows that it could happen that Eve’s mind is associated with the first term of the superposition, say, while Adam’s mind is associated with the last term in the superposition. Thus, Eve would believe that Adam got ‘up’, while Adam would believe that he got ‘down’. It follows when Eve hears Adam say that he got ‘up’, she is actually listening to not a conscious person but a mindless hulk.

Albert and Loewer attempt to resolve these problems by rejecting the single-mind interpretation in favor of the many-minds interpretation. On the many-minds interpretation, each conscious observer is associated with a continuous infinity of minds, where each mind evolves in accordance with the rule for mind evolution of the single-mind interpretation. Albert and Loewer claim that this solves the supervenience problem of the single-mind interpretation, since measure $|c_1|^2$ of Eve’s minds will believe ‘up’, while measure $|c_2|^2$ of Eve’s minds will believe ‘down’, and these probabilities can be read off the quantum state. Also, Albert and Loewer claim that the the many-minds interpretation solves the mindless hulk problem of the single-mind interpretation, since every term in a superposition that corresponds to a conscious

being will have minds associated with it.

3. Problems with with Albert/Loewer Interpretations. I will show that, contra Albert and Loewer, the many-minds interpretation does not solve the supervenience problem of the single-mind interpretation, and it also does not completely solve the mindless hulk problem. The reason it does not solve the supervenience problem is that, even in the many-minds interpretation, mental states do not supervene on brain states. To see this, consider again the system which starts out in state (1) and evolves to state (2). On the many-minds interpretation, when the system is in state (1) each of Eve's continuous infinity of minds is in the ready state, believing for example that she is ready to make a measurement. When the system evolves to state (2), each of Eve's minds has a $|c_1|^2$ probability of evolving in such a way that the mind comes to believe 'up', and a $|c_2|^2$ probability of evolving in such a way that the mind comes to believe 'down'. Thus, for each mind, it could happen that the mind comes to believe 'down', and as a result it could happen that *every* mind comes to believe 'down'. There is a measure zero probability of this happening, but that does not mean that it cannot happen.

(At this stage one might hold that, instead of the Albert/Loewer many-minds interpretation, it would be better to consider a many-minds interpretation where it is *guaranteed* that measure $|c_1|^2$ of Eve's minds come to believe 'up' and measure $|c_2|^2$ 'down'. The problem with such an interpretation (as explained by Loewer 1996) is that there is no way to make sense of that measure as a *probability* measure, and hence the fact that the probabilities for measurement outcomes are in accordance with Born's rule gives evidence for the Albert/Loewer many-minds interpretation and not for this alternative many-minds interpretation.)

It follows that the Albert/Loewer many-minds interpretation is no different than the

single-mind interpretation with regard to supervenience. On the Albert/Loewer many-minds interpretation, mental states do not supervene on brain states, since a given brain state is compatible with different configurations of mental states. Jeff Barrett (1995), citing Marc Albert, has made a version of this point, but Barrett does not draw the correct conclusion. Barrett writes that

> The mental state of each of the observer's minds is a random function of his physical state and independent of the states of his other minds. This means that the observer's global mental state ... *almost always* supervenes on his physical state. (Barrett 1995, 98)

Barrett concludes that, because the supervenience relation almost always holds, "This lack of strict supervenience does not seem to be a very serious problem" (1995, 98).

Barrett misunderstands the notion of supervenience, though. Supervenience is a modal notion, and does not admit of degree. If property B supervenes on property A, then all accessible possible worlds which have the same A-properties must also have the same B-properties. In our situation, though, there can exist two worlds with the same physical state, but with different mental states. Consider two worlds in the physical state (2), but where in one world measure $|c_1|^2$ of Eve's minds believe 'up', where in the other world all of Eve's minds believe 'down'. Thus, on the many-minds interpretation, mental states do not supervene on physical states. It doesn't make any sense to say that they "almost always" supervene.

It follows that the non-physicalism of the many-minds interpretation is just as pernicious as the non-physicalism of the single-mind interpretation, so supervenience considerations do not give one a reason to favor the many-minds interpretation over the single-mind interpretation. What about mindless hulk considerations? Here we can say that the the many-minds interpretation almost always solves the mindless hulk problem, since there is

only a measure zero probability that mindless hulks will exist on the many-minds interpretation.

Nevertheless, the mindless hulk issue does not give strong support to the many-minds interpretation as compared to the single-mind interpretation, because one can formulate a version of the single-mind interpretation which does not face the mindless hulk problem. We can add an additional postulate to the Albert/Loewer single-mind interpretation, which specifies that the minds which exist in some system pick out a preferred branch of the superposition state of the system, and any new minds which come to exist in that system, or any minds which are part of a system which comes to interact with the original system, must also be associated with that preferred branch. For example, suppose that Eve's mind believes 'up' when the system is in state (3). When Adam interacts with Eve, since the superposition term with $|\text{believes 'up'}\rangle_{\text{Eve}}$ is the preferred branch of the superposition, Adam's mind will come to believe that Eve got 'up'.

This proposal captures the essence of the dualistic interpretation proposed by Euan Squires (1990). Squires gives a version of the single-mind interpretation, where each observer's non-physical mind is associated with one branch of the universal superposition state (where the minds pick out a preferred basis). He considers an EPR-style experiment with perfect anti-correlation, and asks the question: supposing that I get the result 'up', how is it guaranteed that you get the result 'down'? Squires does not consider the possibility that, when I later appear to tell you about my 'up' result, the thing telling you that is really just a mindless hulk. Instead, Squires postulates a "universal consciousness" (1990, 216) which ensures the desired correlations between minds. Squires considers various possibilities for what this consciousness might amount to, but the picture he seems to endorse is one where each person's consciousness is a *part* of the universal consciousness. I believe that it is not

necessary to get bogged down in the metaphysics of a particular model of universal consciousness; it is enough just to specify that, somehow, the appropriate correlations between individual minds obtain.

4. Dualism versus Mental Monism. There are two reasons Albert and Loewer moved from the single-mind to the many-minds interpretation, and it turns out that neither reason is a good one. The many-minds interpretation does not, after all, allow for mental states to supervene on physical states, and one can give a version of the single-mind interpretation which does not face the mindless hulk problem. We should not be sanguine about the single-mind interpretation, however; I will now present a problem for all the dualistic interpretations.

The problem is that the most natural ontology for these interpretations turns out to be not dualism, but mental monism. Any physical state of the universe does no work in the dualistic interpretations. Mental states do not supervene on, or emerge from, physical states. Interactionist dualism is false, because there is no interaction between the physical and the mental: the quantum state evolves in accordance with Schrödinger's equation, while minds evolve in accordance with some incompletely specified mental dynamical equation. One can obtain evidence that the physical state of the universe is irrelevant to dualistic interpretations by noting that proponents of dualistic interpretations do not bother to specify a semantics for the quantum state; they do not say what the physical ontology of their interpretation is. Because of this I have taken them to endorse the standard semantics of quantum mechanics,

the eigenstate-eigenvalue link.[5]

Intuitively, we believe that the physical state of the universe is relevant to what mental states people have: we think that the reason a competent observer like Eve believes that a particle is *x*-spin up is that the particle really is *x*-spin up, or at least that the pointer on a good measuring apparatus points to 'up'. On the single-mind and many-minds interpretations with the standard semantics, though, that is not the case: Eve believes that the particle is *x*-spin up and that the pointer points to 'up', but those beliefs are false.

It is true that the quantum state is relevant to the evolution of mental states; the probabilities for the evolution of mental states supervene on the quantum state. But I maintain that this does not give sufficient evidence that the quantum state corresponds to something physically real. One can instead take the quantum state to be part of the dynamical equation for minds. The dynamical equation for minds would then establish the probabilities for the evolution of mental states.

I will now consider an objection to that proposal. The objection begins by stating that, according to the proposal, the dynamical equation for minds would constitute the fundamental law of nature, but that law of nature would change with time, corresponding to the change of the quantum state with time. The objection maintains that laws of nature are meant to hold for

[5]One caveat: if belief observables exist, then the standard semantics would have to be modified at least slightly. Taking B as a belief observable, then when the system is in state (2), the standard semantics entail that Eve neither believes the pointer points to 'up' nor that it points to 'down'. This contradicts the prediction of for example Squires' interpretation, that Eve will have a definite belief. For a discussion of whether belief observables exist, see Ruetsche 1998 and Arntzenius 1998.

all time, not to change over time.

My first reply is that this objection assumes that there are laws of nature, but this position has been cogently if controversially argued against by Bas van Fraassen (1989). My second reply is that, perhaps laws of nature do exist, but it turns out that laws of nature do after all change with time. If that is what our best physics tells us about laws of nature, then that is the philosophical view we should accept.

For those who reject the first and second replies, then my third reply is that it need not be the law itself which changes over time. The law can simply incorporate a free parameter corresponding to the quantum state, and the value of that parameter can change with time.

One may object to the proposal in the third reply by pointing out that it is meaningless to talk about this free parameter changing if nothing in the world corresponds to the change in parameter. In reply, one can postulate the existence of a property of the mental world as a whole, or of some part of the world, such that the value of that property corresponds to the value of the parameter in the dynamical equation for minds.

I conclude that, on the dualistic interpretations, the physical world is otiose. Thus, there is not sufficient reason for proponents of these interpretations to postulate the existence of the physical world; the most reasonable ontology of these interpretations is not dualism, but mental monism. This conclusion does not entail that these interpretations are false, but it does show that proponents of these interpretations, who present their ideas in a dualistic framework, need to get more clear on what ontology they are promulgating, and why they are promulgating it.

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