

Multiverse and Identity

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I. Introduction

The many-worlds interpretation of quantum mechanics (MWI) suggests the existence of a multiverse. It is a point of contention, however, whether an existential commitment to these extra entities is really necessary. Furthermore, the existence of a multiverse yields threats to many concepts that we can normally interpret with ease: most notably, the concept of personal identity. In this paper, I would first suggest reasons to believe in a multiverse. I will then address the problem of personal identity that is associated with the multiverse. I argue that a four-dimensional interpretation of personal identity is required to face this objection.

II. Quantum Worlds

Among the main motivations to endorse the existence of a multiverse are the measurement problem in quantum mechanics and the interpretation problem of modality.

Many-worlds interpretation (MWI) is a tentative solution to the measurement problem.¹ Very briefly, the problem lies in an inconsistency between two axioms in the orthodox quantum theory.² One axiom tells us that every system evolves according to the Schrödinger equation (SE), and the other tells us that observation causes a system to collapse into a single state. To better present the contradiction, consider, for instance, how a system associated with a wave equation would evolve according to SE:³

$$A) \quad |0\rangle_S |R\rangle_A + |1\rangle_S |R\rangle_A \rightarrow |0\rangle_S |"0"\rangle_A + |1\rangle_S |"1"\rangle_A$$

As we can see, we arrive at a superposition of states. Instead, the collapse rule gives us the following outcome, a single state:

$$B) \quad \begin{aligned} |0\rangle_S |R\rangle_A + |1\rangle_S |R\rangle_A &\rightarrow |0\rangle_S |"0"\rangle_A \text{ or} \\ |0\rangle_S |R\rangle_A + |1\rangle_S |R\rangle_A &\rightarrow |1\rangle_S |"1"\rangle_A \end{aligned}$$

There is an apparent contradiction. The many-worlds interpretation proposes that we should drop the collapse rule and take the outcome given by SE seriously. But how? Very simple, we say that the outcome describes two different worlds, both independent of each other. In one world, state $|0\rangle_S |"0"\rangle_A$ obtains, in another $|1\rangle_S |"1"\rangle_A$ obtains.

¹ Everett, H., 1957, 'Relative State Formulation of Quantum Mechanics', *Review of Modern Physics*, 29: 454–462, De Witt 1970, 'Quantum Mechanics and Reality', *Physics Today*, 23(9): 30–35.

² For a detailed discussion of the measurement problem, see Bell, J. (1990). Against 'measurement'. *Physics world*, 3(8):33.

³ Briefly speaking, S stands for system. A stand for the apparatus that is used to record the state of S. $|X\rangle$ stands for the state of a system, and $|X\rangle + |Y\rangle$ stands for a superposition of states. two sides of "→" correspond to the quantum states before and after the evolution. When the system entered the state of $|0\rangle$, the apparatus would report its state.

III. Lewisian Worlds

Much like MWI, worlds in the theory of modality are useful tools to respond to an existing philosophical problem: the interpretation of modality.⁴ Our normal speech adopts vocabularies such as “necessary” and “possibly”. But what grounds the truth values of sentences involving these vocabularies are quite unclear. The notion of possible worlds allows us to analyze facts involving modal notions in the following way:

Possibly, ϕ iff ϕ is true in some possible world.

Here remains a question: what *are* possible worlds? Philosopher David Lewis takes them as the same sort of thing as our world. Many other possible worlds are isolated, with no overlaps.⁵

Many worlds in quantum mechanics are not possible worlds in the theory of modality. For Lewis, a universe⁶ is but a single “world” among many possible “worlds”. For this paper, however, to coincide many worlds in quantum mechanics and the theory of modality would not harm our argument.⁷

IV. Everyone’s Paradise?

The virtue of the many-worlds interpretation and modal realism share is that both theories give the exact same treatment to entities that play the same roles in both theories. To illustrate this point, let us first consider the case of modal realism. A reductive theory of modality suggests that to ground the truth values of modal facts (if we believe there are such facts) requires us to believe in other possible worlds, other “containers” of objects. Suppose that our theory of the possible world is a non-reductive one, which means we do not believe there is a successful way to reduce possible worlds to something else. There is only one way out, which is to admit these other worlds are nothing so different from ours. But what makes our world special? We all must believe that our world “exists”, and those others don’t. One possibility “obtains”, and the others do not. There is this peculiar symmetry between our reality and theirs. What can be said about us are possibilities in their world, and what can be said about them are possibilities in our world. Here arises the question as to which one is the real world?

We must resort to Lewis’s indexical interpretation of actuality.⁸ Denizens of each world would claim proudly that their own world is the real one. It seems at this point all possibilities, if our theories told us that they are nothing so different in nature, must obtain. We must therefore distinguish between what is actual and what is real. To be actual is to exist in some of these possibilities, to enter into causal or spatiotemporal class one of the possibilities outlines.

We can see that the many-worlds interpretation borrowed this virtue. If Schrodinger’s equation is the only thing we must take seriously, we must make the same existential commitments as what the outcomes told us. The outcome told us that at one point, the universe is in a superposition of many world-states. None of these many world-states is so different in nature from others. At least that’s what math says. And we also know that we live in one of these many possibilities. What about others? What’s something beyond the theory, that makes us so special? Well, this is what denizens of other worlds think. Everyone thinks she is special.⁹

⁴ Lewis, David (1986). *On the Plurality of Worlds*. Wiley-Blackwell.

⁵ These possible worlds may be completely different, maybe even with a different law of nature and physical constants.

⁶ The universe is the entire history of the evolution of a universal state, or, the wave equation of an entire universe.

⁷ In point of fact, our understanding of modality would contribute to our interpretation of personal identity in the context of MWI.

⁸ *Ibid.*, 92-96.

⁹ The condition for giving the same existential commitments to entities (Lewisian worlds, QM worlds) that play the same roles in our theories is always that our theories do let them play the same role. If we believe, on the other hand, that other worlds do not play the same role, that is, they are fictions or some premise that is good for our theory, then the above reasoning would not apply.

V. The Problem of Identity

The existence of a multiverse would exert a huge theoretical impact. One important challenge points to our concept of identity. The common interpretation of identity will lead to an obvious contradiction, which could be explained as follows. Suppose that I existed before world-branching at time t_1 , after t_1 , I am dead in one world at t_2 and alive in one world at t_2 .

1. According to MWI (Many-Worlds Interpretation of Quantum Mechanics), at time t_2 , “I” am both alive and dead.¹⁰
2. However, no person can be both alive and dead. Therefore, the common interpretation of identity and MWI form a contradiction.

To resolve this contradiction, what we need to do first is to explain what we mean by saying “I am both alive and dead”. I will show that a proper understanding of personal identity in a multiverse would not incur assignments of logical contradictory properties to one single person.

VI. A Four-Dimensional Interpretation

When one says: “I am both alive and dead”, they are in fact talking about two entities having different statuses in different worlds. In a multiverse, we have to adopt a different definition of what it means to be a single person. Below is a brute revision of the notion of “self” to address the problem:

A person is a continuous chain of consciousness.¹¹ For x and y “to be the same person” is for x and y to be two segments in the same continuous chain of consciousness.¹²

Consider the analogy of brain splitting.¹³ Suppose that our brain can be split into two parts in surgery, and the two fragments can still operate and maintain their activities. Since the two parts can respectively perform some distinct functions of a complete person, such as calculating and simulating, it is difficult to identify which part now represents the brain before surgery. There seems to be a dilemma, but the problem can be solved if the two separate parts have respective identities, and they both have their own single continuous chain of consciousness.

Note that according to this definition, a person does not exist at any given point of time,¹⁴ but it exists across time. At any given time, only a temporal part of a person exists.¹⁵ According to this definition of personal identity, for someone to be alive at a given time t is for someone’s temporal part to occupy some space at time t . Likewise, for someone to be dead is for someone’s temporal part to be non-existent at time t . A person cannot be dead and alive at the same time.

This definition leads to two important outcomes.

First of all, after some world-branching, there are two continuous chains corresponding to one person. According to our definition, there will be two different persons. Therefore, not one single person is both dead and alive. In this case, to say something is both alive and dead is not to attribute contradictory properties to one being.

Secondly, since we believe that a person is a continuous chain of consciousness, she cannot exist at any specific time. Instead, she will exist across different times. Therefore, what we actually mean by “is dead” or “is alive” is not attributing properties to any person at all. Rather, we are attributing properties to some “parts” of a person.

¹⁰ According to people’s common sense, at any time, there is one, and only one, person.

¹¹ It is always a complex problem to define consciousness. Here I would take for granted that consciousness is someone’s sense experience. A clear definition of consciousness is not the paper’s main goal.

¹² There is an extra advantage of this treatment of personal identity. In many-world interpretations, decoherence is responsible for the branching (and thus the isolation) of different worlds. Yet it is hard to have “perfect” decoherence, and hence perfectly isolated persons. To equate a person to a continuous chain of consciousness, we avoid the problem of locating specific persons.

¹³ Parfit, Derek. 1987. *Reasons and persons*. Oxford [Oxfordshire]: Clarendon Press. P. 255.

¹⁴ Strictly speaking, for x and y to be the same person is for x and y to be identical. But we need to give an account for “to be the same person” in ordinary sentences such as “I am whom I used to be”. This sentence ought to be interpreted according to our definition as saying the past me and the present me occupy two parts of a continuous chain of consciousness.

¹⁵ Sider, Theodore (2007). *Temporal Parts*. In Theodore Sider, John Hawthorne & Dean W. Zimmerman (eds.), *Contemporary Debates in Metaphysics*. Blackwell. pp. 241--262.

VII. Shared Parts in Identity

There is, however, a further objection. Suppose there is a traveler at the airport, who wants to decide whether to go to Paris or New York for his whole summer vacation by consulting a laboratory if a specific particle decays during half-life¹⁶. There are equal possibilities for the particle to decay or remain during half-life, so the traveler has equal chances to go to Paris or New York. The particle will be both alive and dead, in a superposition. Therefore, the following statement would be true:

The traveler “will be” in Paris and New York at the same time.

Yet no one “will be” in two places at the same time, so a contradiction exists. Here is the problem: During the summer, there are two persons, one is in Paris and the other is in New York. In this way, dating back to the time when the traveler was at the airport, the two persons should be in the body of the traveler, so the traveler had at least two identities at the same time. It sounds peculiar to say that many identities coincide at the same time.

As noted before, a person is a continuous chain of consciousness stretching throughout time, rather than an object that exists at different time points. In this respect, we say many people share their “parts” at one point.¹⁷ Of course, there are two persons in this scenario! One of them has temporal parts in Paris yet the other does not. The persons that are present in Paris and New York share the same temporal parts at a time when the traveler is at the airport.

To consider a spatial analogy of the above scenario, let’s say Siamese twins share two heads but one body. We would not consider there are two babies in the body below the heads, but we would describe the body as “a part” that is “shared” by two babies. A baby is a body plus a head, so no baby is fully present in the body without a head.

In the same way, no person is fully present at any one point in the past. So, if we look back from a certain point of time, such as the coming summer vacation, the person before the vacation is only a temporal part of different people, not their entirety. We cannot say there are many people inside the traveler before the vacation. Instead, there is only one person there, but the persons in Paris and New York share a part at that point.

VIII. Conclusion

I have argued in this paper that there are good reasons to believe there is a multiverse, and to postulate entities such as worlds in MWI and possible worlds in modal theory for theoretical harmony. These reasons are not decisive ones. There are alternatives for both multiverse theories to solve the same problems.¹⁸ It is always a matter of art as to how much certain theoretical benefits should be counted towards our eventual acceptance of a theory. I also argued that our common understanding of personal identity is challenged by the existence of a multiverse. Personal identity can be made sense far better by the idea of temporal parts.

¹⁶ Among an immense number of particles, half of them would die during the half life, according to experiments.

¹⁷ Paul, L. A. (2006). Coincidence as overlap. *Noûs* 40 (4):623–659.

¹⁸ For instance, Bohm, David, 1952, “A Suggested Interpretation of the Quantum Theory in Terms of ‘Hidden’ Variables, I and II”, *Physical Review*, 85(2): 166–193. doi:10.1103/PhysRev.85.166, Rosen, Gideon (1990). “Modal Fictionalism.” *Mind* 99: 327–354.

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