

# *A critical look at Carlo Rovelli's views on Free Will*

In the following webpage [https://www.edge.org/conversation/carlo\\_rovelli-free-will-determinism-quantum-theory-and-statistical-fluctuations-a](https://www.edge.org/conversation/carlo_rovelli-free-will-determinism-quantum-theory-and-statistical-fluctuations-a), Carlo Rovelli argues that quantum mechanics is not necessary to explain the problem of free will. As his views contrast strongly with mine, I propose to comment on his arguments in detail thereby clarifying my own views on the issue.

Quotations from Rovelli's article will be placed in italics. Rovelli begins by asking:

*Can there be a relationship between this atomic-scale quantum indeterminism and human freedom to choose?*

*The idea has been proposed, and often reappears, but is not credible, for two reasons. The first is that the indeterminism of quantum mechanics is governed by a rigorous probabilistic dynamics. The equations of quantum mechanics do not determine what will happen, but determine strictly the probability of what will happen. In other words, they certify that the violation of determinism is strictly random. This goes in exactly the opposite direction from human freedom to choose. If human freedom to choose was reducible to quantum indeterminism, then we should conclude that human choices are strictly regulated by the chance. Which is the opposite of the idea of freedom of choice. The indeterminism of quantum mechanics is like throwing a coin to see if it falls heads or tails, and act accordingly. This is not this what we call freedom to choose.*

I entirely agree. I believe (and so, apparently) does Rovelli) that quantum events are inherently random and that if our free choices were simply random, I would not call that Free Will. My contention, however, is that, while our current understanding of the physical world does not allow any interference in the outcome of certain quantum events, our current understanding does not include a satisfactory description of consciousness. And since it would appear that only conscious beings can exhibit Free Will, my contention is that we will not understand the latter until we have understood the former. Rovelli does not use the word consciousness anywhere in his article.

*But there is a second, and more important, consideration. If an element of randomness is sufficient to account for free will, there is no need to search it into quantum uncertainty, because in a complex open system such as a human being there are already many sources of uncertainty, entirely independent of quantum mechanics. The microscopic atomic dynamic inside of a man is influenced by countless random events: just consider the fact that it occurs at room temperature, where the thermal motion of the molecules is completely random. The water that fills the molecules of our body and our brain is a source of indeterminism for the simple fact of being hot, and this indeterminism is much higher than the quantum one. If you add to this the fact that quantum indeterminism has a well-known tendency to disappear extremely fast as soon as you consider macroscopic objects (due to "decoherence"), it seems clear that trying to bind human freedom and quantum indeterminism is a very improbable hope.*

I disagree with this most strongly. There is a world of difference between true randomness and mere unpredictability. According to Newtonian mechanics, the subsequent motions of the molecules in a glass of water or the human body are, in principle, completely determined by their current state. It is totally misleading, therefore, to describe the motions of the molecules as 'random'. The motions are, in fact, completely determined in advance. In order to use the phrase 'random thermal motion of the molecules' we must admit that the randomness stems from the fact that the exact positions and

momenta of the molecules are indeterminate to the extent determined by the Uncertainty Principle and that, after a fraction of a millisecond, the velocities of the molecules in a glass of water will indeed be totally and genuinely randomised.

*This brings us back to the starting point. The problem of the apparent tension between free will and determinism is not relieved by quantum physics. The argument, however, highlights a flaw in the intuition from which the problem itself originates. If the macroscopic dynamics is subjected to the consequences of microscopic indeterminism such as the thermal one, what is the exact nature of the problem of free will?*

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*Here is an example, from Daniel Dennett, to clarify this point. The Rover (the machine with wheels) sent to Mars a few months ago is programmed to move autonomously on Mars, and has a complex navigation system that analyzes its surroundings and decides where to move according to a set of assigned priorities. Say to make longer journeys, in order to explore different regions and send the images to Earth. However, the Rover can end up in a situation where it can no longer move, for example because it got stuck between two boulders. Or, scientists from the control center on Earth may decide not to leave the Rover's program to decide by itself, and to intervene and compel the Rover to go back. For example because they have independent observations of a dust storm approaching. In either case, we can say that the Rover is "no longer free" to go where it wants, because it is stuck between two rocks, or because the engineers at NASA have sent a radio control that blocks the freedom of decision of the program on board. After the sand storm is over or after being freed from the two boulders, the Rover regains its "freedom to decide" and begins to run only on its own "choices" of where to go.*

*This is a particular sense of the expression "to be free to decide." We often use this expression in this sense. For example: I am not free to decide to go for a walk if I am in prison. This sense of "being free" is the most common, and is not in conflict with physical determinism. After all, the Rover, once freed from the rocks and freed from the radio controls from NASA, becomes free to decide for itself where to go, but the program that runs it is driven by strictly deterministic physics. In this case, to "be free" only refers to the distinction between determinations of behavior that are external (the boulders, the radio controls of NASA, the prison) and determinations of behavior that are internal (the software of the Rover, my intense desire to take a walk). From this point of view, the problem of the conflict between free will and physical determinism dissolves completely, and this is the solution of the problem today proposed by many intellectuals, including, for example, Daniel Dennett.*

I find it difficult to believe that Dennett would be willing to say that the Mars |Rover was capable of exercising its Free Will, but if this is the case, then I have no respect for him at all. Rovelli is a little more deferential but clearly he disagrees with Dennett too.

*Is this a complete and satisfactory solution of the problem? Maybe not, because there are issues that remain open. The first one is that the analogy between the rover and a human being does not fully hold. A human being seems to be, and probably is, more "free" than the Rover in the following sense. Both, the Rover and the human being, can be free in the sense that the decision on the behavior is determined by factors internal and not external, but in the case of the Rover we know that there is a precise software that determines this behavior. This software was built (by engineers) in order to be as "deterministic" as possible. Sure, it can break or malfunction, but this causes the behavior of the Rover to be consider abnormal. As long as problems do not occur, and the Rover works well, its behavior is determined in a rigorous manner, by factors*

*within the Rover itself, but still factors that make a strict deterministic structure. Can we say the same of man?*

*To a certain extent, also the human behavior is determined by something similar to biological software. There is no doubt that the neuronal structure has numerous aspects similar to the software of the Rover, with subsystems that manage specific behaviors (walking) and other systems that determine complex choices arbitrating between more or less pressing competing demands from other parts of the brain ("I'm hungry, I want to go out to eat a sandwich, but I also want to write this paper").*

This is as close as Rovelli gets to identifying the true difference between the Rover and the Human. In using the word 'I' Rovelli has all but admitted that it is the conscious self which is making free decisions and since the Rover does not have a *conscious* self, it cannot exhibit its Free Will.

*But granted similarities, a key difference remains in both function and organization: the management of randomness, i.e. indeterminacy. Even the engineers who designed the Rover had to deal with hazard. Electronic equipment ages and deteriorates with time. You cannot predict when a connection will stop working well. But the engineers who designed the Rover have done everything possible to minimize this effect for the Rover. The Rover works well when the randomness of events is kept at best under control.*

*It does not appear that the functioning of living systems follows the same principle. From biochemistry, living systems are immersed in an environment of randomness. The basic biochemical processes exploit fully the highly random thermal motion of the molecules.*

This is a good point. The Rover has built in strategies to minimise randomness and cope with it when it occurs (such as having redundant critical systems) but the human brain probably has a totally different strategy and may even, as Rovelli suggests, even exploit the random thermal motion of its molecules. But even if differences do exist in the way the Rover's computer is programmed and the way the human brain operates, this may not be sufficient to explain why humans have Free Will and Rovers do not.

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*Rovelli inserts here an explanation of what he means by 'supervenience' and uses the example of a balloon released into flight to illustrate the difference between the macroscopic and microscopic explanations of the same events.*

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*At this point I think that some aspects of the problem are clearing up, and I can go back to the original question: let's say that a human being is free to choose. What does this mean? If we mean that two human beings can behave differently if they are placed in the same "external" conditions and also have the same "internal" state, then we must also specify what do we mean, here, by internal state. If we understand the set of memories, education, emotions, thoughts, and so on, we are still giving a description of the system that is not the positions of the individual atoms, and therefore also with these factors equal, the fact that the same two human beings can decide differently is not in contradiction with the existence of an underlying physical determinism. It is no more surprising than the fact than two balloons that appear identical, with the same pressure, the same radius, the same color, the same plastic ... move in a completely different way when let loose with loose knots.*

The crucial point here is the extent to which two human beings can actually have “the same external conditions and also have the same internal state”. It is possible to put two Rovers into this

condition and we would expect both Rovers to make the same decisions in accordance with their stored programs. Now if the human brain was just a classical computer made out of protein instead of silicon, then two identical human brains would also make the same decisions. If, however, you truly believe in the existence of Free Will, then you must draw at least one of two possible conclusions: a) it is impossible even in principle to create two identical human brains (if only because they must be in a different places in spacetime) or b) the human brain is not a classical computer. My preference is for the latter alternative but I suspect that the former is also true.

Since Rovelli rejects any role for quantum effects in the human brain, he has to adopt the first alternative but he does not put it quite as bluntly. He says:

*... mental states, whatever we mean by that and whatever the amount of information they imply, contain immensely less information than the information necessary to determine the full physical state of the brain, which, let us not forget, has about a million billion synapses, but is composed of a number of molecules still much larger. So the fact remains that, however you look at it, to the same mental state correspond a large number of molecular states. And in any case, the relationship between the former and the latter is statistics. There is therefore no reason a physical determinism should determine psychic determinism. Physical determinism is perfectly consistent with psychic indeterminism.*

In other words, two brains which are in the same mental state are not necessarily identical physically. As it happens I might be prepared to agree with this. But then, instead of pursuing this line of argument, Rovelli makes a serious mistake. He says that the same mental state can correspond to a large number of molecular states and just as two balloons under the same macroscopic starting position can fly off in completely different directions, so two human brain with the same initial mental states can make different decisions. This is not what we mean when we are talking about 'two identical brains'. What we are interested to know is whether two brains which are identical *right down to the molecular level* would behave in the same way just as two balloons with identical molecular descriptions would (in a deterministic universe) behave identically. If you allow that two brains in the same mental state can have different molecular configurations, then the fact that they may subsequently behave differently is no surprise at all.

No. Free Will is the ability for microscopically identical brains to make different decisions. For this to be the case, the processes which go on in the brain cannot be deterministic. Since quantum effects are known not to be deterministic it is perverse not to allow that quantum effects have a role to play in the operation of the brain.

It is my contention that Rovelli has got things the wrong way round. It is not just that two brains which are in the same mental state are not necessarily identical physically, two *conscious* brains which are in the identical physical state are not necessarily in the same mental state. Yes, this means that there must something else in the universe besides molecules and the rules of quantum mechanics. No, I am not a spiritualist and I do not believe in magic – all I am saying is that when it comes to explaining how *conscious* brains work, I do not believe we know all the answers. Rovelli, however, seems to think that we do know all the answers and this causes him to have to decide between a rock and a hard place either our decisions are determined by our mental state or they are random. Free Will either does not exist or Rovers have it.

*There remains one last question, the crucial one, and the main reason for me for writing this piece. Trying to force the meaning of "free will" beyond the simple meaning of freedom from "exterior" constraints, is an enterprise doomed to failure anyway. Is our "free" decision completely determined by internal factors? Let's assume for moment that it is not, and we see that we are in trouble. Suppose to be able to do an experiment where we can put a person in exactly the same mental situation (with the same memories, values, character, mood ...) and suppose we repeat the experiment many times, always with the same initial conditions. What would observe? There are two*

*extreme possibilities: the first is that we see that the person will decide entirely at random. In this case the results will be just governed by chance. Half the time he will make a choice, the other half he will make the other choice. The second extreme possibility is that instead the person will always make the same choice.*

*In which of these two cases, is there free will?*

*Both answers are meaningless. If we answer in the first case, we are saying that free will is manifested when we decide completely at random, throwing a coin. I do not think that this is what people believing in free will mean. If so, we must conclude that we go to heaven or hell by pure chance. But the second answer is even worse: in this case free will is to be determined by our own internal mental states! That is, it means the absence of free will! In either case, we are in trouble, and this shows that the idea that free will may have to do with the ability to make different choices on equal internal states is an absurdity.*

My solution to this dilemma is as follows: when the conscious brain is faced with making a decision, a quantum process is involved of which we currently have no knowledge. I suspect that it may have something to do with entanglement on a massive scale. In any event, a large part of the brain is involved and the motor neurons which carry out the brain's decision are influenced not just by those neurons to which it is directly connected but to others which encode all sorts of information relevant to the decision. The outcome is not pre-determined because it is a quantum process but neither is it random because the whole conscious brain is somehow involved in making the decision. I can see why this sort of thinking is rejected by die-hard physicists like Rovelli but if we are to believe in our ability to change the future of the world, I see no alternative.

Rovelli summarises his arguments as follows:

*All this brings us back to the only possible solution of the problem of free will, which is a classical solution, the one that was put forward in the Ethics by Spinoza. We humans are complex systems and develop a picture of the world and of ourselves. (True) We look for causal connections in the world and then construct a number of interpretative representations, which allow us to predict to some extent the behavior of the world. (true) We do this also in reference to ourselves. (True) We have a representation of ourselves (Only conscious creatures have this) and this allows us to know how we will act, or how another person will act in this or that situation. But this representation we have of ourselves is extremely crude and approximate compared to the complex details of our own real being, and thus we find ourselves acting continuously in manners that we are not able to predict, neither for others nor for ourselves. (Probably true) When we observe behavior unpredictable in us or in others, we call this "free choice" and "free will". There is nothing wrong or illusory in this use of the term; it is a reasonable name, suitable for an approximate description. (This is handwaving) There is no contradiction between the use of this concept and the fact that our behavior arises from the movement of the molecules of our body, and that this can be, at the molecular level, perfectly deterministic. (There is a glaring contradiction) This is the only reasonable solution of the apparent tension between determinism and free will. Quantum theory, statistical physics, neural biology, cognitive sciences, and the rest of the knowledge that we have. (No. it isn't)*

*Any attempt to link this discussion to moral, ethical or legal issues, as is often been done, is pure nonsense. (It is not nonsense. If our actions are either random or predetermined then there would be no room for moral responsibility and humans, like most if not all animals, would not display any moral responsibility)*

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*Free will has nothing to do with quantum mechanics. (False) We are deeply*

*unpredictable beings, like most macroscopic systems. (True, but the unpredictability is fundamentally due to quantum uncertainty.) There is no incompatibility between free will and microscopic determinism. (False) The significance of free will is that behavior is not determined by external constraints, nor by the psychological description of our neural states to which we access. The idea that free will may have to do with the ability to make different choices on equal internal states is an absurdity, as the ideal experiment I have described above shows. (I do not think the idea is at all absurd. There was a time when respected thinking regarded the possibility that the Earth revolved round the Sun as absurd.) The issue has no bearing on questions of a moral or legal nature. Our idea of being free is correct, but it is just a way to say that we are ignorant on why we make choices. (I think it is self-evident that a) if we do not have free will then we cannot be held responsible for our actions, b) all conscious creatures have free will and c) we will only understand how the human brain can exercise its free will when we understand what makes us conscious.)*

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