Does Quantum Mechanics Rule Out Free Will?

By John Horgan

Superdeterminism, a radical quantum hypothesis, says our "choices" are illusory.

A conjecture called superdeterminism, outlined decades ago, is a response to several peculiarities of quantum mechanics: the apparent randomness of quantum events; their apparent dependence on human observation, or measurement; and the apparent ability of a measurement in one place to determine, instantly, the outcome of a measurement elsewhere, an effect called nonlocality.

Einstein, who derided nonlocality as "spooky action at a distance," insisted that quantum mechanics must be incomplete; there must be hidden variables that the theory overlooks. Superdeterminism is a radical hidden-variables theory proposed by physicist John Bell. He is renowned for a 1964 theorem, now named after him, that dramatically exposes the nonlocality of quantum mechanics.

Bell said in a BBC interview in 1985 that the puzzle of nonlocality vanishes if you assume that "the world is superdeterministic, with not just inanimate nature running on behind-the-scenes clockwork, but with our behavior, including our belief that we are free to choose to do one experiment rather than another, absolutely predetermined."

In a recent video, physicist Sabine Hossenfelder, whose work I admire, notes that superdeterminism eliminates the apparent randomness of quantum mechanics. "In quantum mechanics," she explains, "we can only predict probabilities for measurement outcomes, rather than the measurement outcomes themselves. The outcomes are not determined, so quantum mechanics is indeterministic. Superdeterminism returns us to determinism."

"The reason we can't predict the outcome of a quantum measurement," she explains, "is that we are missing information," that is, hidden variables. Superdeterminism, she notes, gets rid of the measurement problem and nonlocality as well as randomness. Hidden variables determine in advance how physicists carry out the experiments; physicists might think they are choosing one option over another, but they aren't. Hossenfelder calls free will "logically incoherent nonsense."

Hossenfelder predicts that physicists might be able to confirm superdeterminism experimentally. "At some point," she says, "it'll just become obvious that measurement

outcomes are actually much more predictable than quantum mechanics says. Indeed, maybe someone already has the data, they just haven't analyzed it the right way." Hossenfelder defends superdeterminism in more detail in a technical paper written with physicist Tim Palmer.

Hossenfelder's commitment to determinism puts her in good company. Einstein, too, believed that specific causes must have specific, nonrandom effects, and he doubted the existence of free will. He once wrote, "If the moon, in the act of completing its eternal way around the earth, were gifted with self-consciousness, it would feel thoroughly convinced that it was traveling its way of its own accord."

I'm nonetheless baffled by superdeterminism, whether explicated by Hossenfelder or another prominent proponent, Nobel laureate Gerard t'Hooft. When I read their arguments, I feel like I'm missing something. The arguments seem circular: the world is deterministic, hence quantum mechanics must be deterministic. Superdeterminism doesn't specify what the hidden variables of quantum mechanics are; it just decrees that they exist, and that they specify everything that happens, including my decision to write these words and your decision to read them.

Hossenfelder and I argued about free will in a conversation last summer. I pointed out that we both made the choice to speak to each other; our choices stem from "higher-level" psychological factors, such as our values and desires, which are underpinned by but not reducible to physics. Physics can't account for choices and hence free will. So I said.

Invoking psychological causes "doesn't make the laws of physics go away," Hossenfelder sternly informed me. "Everything is physics. You're made of particles." I felt like we were talking past each other. To her, a nondeterministic world makes no sense. To me, a world without choice makes no sense.

Other physicists insist that physics provides ample room for free will. George Ellis argues for "downward causation," which means that physical processes can lead to "emergent" phenomena, notably human desires and intentions, that can in turn exert an influence over our physical selves. Mathematicians John Conway and Simon Kochen go even further in their 2009 paper "The Strong Free Will Theorem." They present a mathematical argument, which resembles John Bell's theorem on quantum nonlocality, that we have free will because particles have free will.

To my mind, the debate over whether physics rules out or enables free will is moot. It's like citing quantum theory in a debate over whether the Beatles are the best rock band ever (which they clearly are). Philosophers speak of an "explanatory gap" between physical theories about consciousness and consciousness itself. First of all, the gap is so vast that you might call it a chasm. Second, the chasm applies not just to consciousness but to the entire realm of human affairs.

Physics, which tracks changes in matter and energy, has nothing to say about love, desire, fear, hatred, justice, beauty, morality, meaning. All these things, viewed in the light of physics, could be described as "logically incoherent nonsense," as Hossenfelder puts it. But they have consequences; they alter the world.

Physics as a whole, not just quantum mechanics, is obviously incomplete. As philosopher Christian List told me recently, humans are "not just heaps of interacting particles." We are "intentional agents, with psychological features and mental states" and the capacity to make choices. Physicists have acknowledged the limits of their discipline. Philip Anderson, a Nobel laureate, contends in his 1972 essay "More Is Different" that as phenomena become more complicated, they require new modes of explanation; not even chemistry is reducible to physics, let alone psychology.

Bell, the inventor of superdeterminism, apparently didn't like it. He seems to have viewed superdeterminism as a reductio ad absurdum proposition, which highlights the strangeness of quantum mechanics. He wasn't crazy about any interpretations of quantum mechanics, once describing them as "like literary fiction."

Why does the debate over free will and superdeterminism matter? Because ideas matter. At this time in human history, many of us already feel helpless, at the mercy of forces beyond our control. The last thing we need is a theory that reinforces our fatalism.

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