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Can the Future Influence the Past? A Philosophical Analysis of Retrocausality

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ABSTRACT
Huw Price and Ken Wharton claimed recently in their paper published in The Conversation that quantum mechanics shows that the future can influence the past. According to their paper, many scientists are convinced about it. However, there is still something mystical for philosophers. The first is about the definition of retrocausality and its philosophical relation to causality. Second, it is concerned with understanding the relationship between cause and effect, not only scientifically but also logically. In this talk, I will answer the two questions by analyzing the concept of temporality and by examining the counterfactual and overdetermination. I found a tension in understanding the concept of necessity in the physical and logical sense. Finally, I will argue that the time reversal asymmetry does not imply retrocausality, and the phenomenon of retrocausality does not exist in reality but only in logic.

KEYWORDS
Causality; Retrocausality; Quantum Mechanics; Counterfactuals; Time-reversal Asymmetry

Today, I'll give a lecture about retrocausality. I want to begin my discussion with a paper published on the website The Conversation. Philosopher Huw Price and physicist Ken Wharton co-authored this paper, "Quantum Mechanics: How the Future Might Influence the Past."[1]

I read this paper and found that many people are interested in retrocausality, about how the future could influence the past. So, let's look at what happened here. Let me introduce the last Nobel Prize in physics related to quantum mechanics. The Nobel Prize in Physics 2022 was awarded jointly to three scientists, Alain Aspect, John Clauser, and Anton Zeilinger, for experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science. Before then, we couldn't find anything about quantum mechanics for the Nobel Prize. Of course, we know the Nobel Prize is usually awarded to some discoveries or achievements related to the use or utility of science and technology rather than theoretical research. It is perfect to know that last year's Nobel Prize in physics was related to quantum mechanics. From

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1 Ken Wharton & Huw Price, Quantum Mechanics: How the Future Might Influence the Past, *Conversation*, 2023, https://theconversation.com/quantum-mechanics-how-the-future-might-influence-the-past-199426 [2024-3-1].

this information, we see quantum mechanics is very close to our practice of science and technology rather than theoretical research. Their experimental work shows the quantum world must create fundamental iterations about the universe's workings. So, Alain Aspect, John Clauser, and Anton Zeilinger have each conducted a ground-breaking experiment using entangled quantum states where two particles behave like a single unit even when separated far away. Just as we learned from one place to another over a long distance, the result has cleared the way for new technology based on quantum information. This quantum information gives them an excellent insight into how two particles relate to each other from a long distance. The study of quantum mechanics is aimed at finding applications. That's why I mentioned that the Nobel Prize has been awarded to many discoveries but only to those that apply to other fields.

Now, a large field of research includes quantum computers, quantum networks, and secure quantum communication. Chinese scientist Pan Jianwei achieved some breakthroughs in his research on quantum communication. The one key factor in this development is how quantum mechanics allows two or more particles to exist in the "entangled state." So, what happens to one of the particles in an entangled pair determines what happens to the other particle, even if they are far apart. That is an extraordinary phenomenon.

And now, how could we explain this phenomenon, which we usually call "quantum entanglement"? Unlike the familiar macroscopic world we inhabit, which is governed by classical physics, the quantum realm allows for inexplicably trippy phenomena. Particles at these scales can breeze through seemingly impassable barriers, a trick called quantum tunneling, or they can simultaneously occupy many different states, known as superposition. The properties of quantum objects can also sync up even if they are light years apart. This so-called "quantum entanglement" was famously described by Albert Einstein as "spooky action at a distance," [2], and it is the experimental research that earned the 2022 Nobel Prize in Physics. So, even Einstein couldn't understand why two particles behave or relate to each other, even though they are not closely connected.

Now, what is the result of this research? There are some challenges to locality and realism. Let's look at the first challenge, which is locality. Many people look at those experiments and conclude that they challenge "locality" — the intuition that distant objects need a physical mediator to interact. We couldn't explain why the two objects are connected if we couldn't find any interactor. However, in quantum mechanics, two particles could be connected without mediation. So that is a big challenge to the locality. Indeed, a mysterious connection between distant particles would be one way to explain these experimental results. If we want to explain one fact or object in place to another, we should know, or we should find, or we should discover what happened or what there is between the two objects. For example, when we hold a cup, if we drop it on the ground, we can see what causes it and what results in such consequences – gravity. You can't see the gravity in our ordinary life. Still, we usually get information about why some objects with quantity when they are falling from the ground behave just as if they are attracted to another object. For the quantum entanglement, we couldn't find anything existing between the two objects or two particles' behavior or similarities. So that's why philosophers say this phenomenon, quantum entanglement, challenges gravity.

The second challenge comes from realism. Others think the experiments challenge "realism" — the intuition that there's an objective state of affairs underlying our experience, not only locality. The world is real, so we can understand what's real. So, a realistic attitude or position in philosophy could be easily acceptable. But in quantum mechanics, we couldn't find realism as a reality in our

2 Albert Einstein, Max Born, Hedwig Born, *The Born–Einstein Letters: Correspondence Between Albert Einstein and Max and Hedwig Born from 1916–1955*, with commentaries by Max Born, New York: Macmillan, 1971, p. 158.

belief in the world. Yet, the experiments are only difficult to explain if our measurements are thought to correspond to something real. Something real should be our base or fundamental ideas about defining something object. Either way, many physicists agree about what's been called "the death by experiment" of local realism. We find that realism could be denied. That's because it couldn't explain why we couldn't experience what happened in the quantum universe compared to our physical world.

Given these two challenges, some physicists want to find a third way to fill the gap between them. Some philosophers and physicists thought that the third way might solve or explain the challenges to locality and realism. Quantum entanglement defies many of our assumptions about the universe, prompting scientists to wonder which of our treasured darlings in physics must be killed to account for it. For some, it's the idea of "locality," which essentially means that objects should not be able to interact at great distances without some physical mediator. Other researchers think that "realism"—the idea that there is some objective bedrock to our existence—should be sacrificed at the altar of entanglement. More and more scientists and philosophers of science believe we should abandon the assumption that present actions can't affect past events. Called "Retrocausality," this option claims to rescue both locality and realism if we want to answer or respond to the challenge from quantum mechanics to realism. So that's the problem for us now: how do we reply to the challenge of realism in the quantum mechanics world? Now, we can see that the new way to respond to or answer the two challenges is retrocausality, also called backward causation. So, this option aims to rescue both locality and realism. That means if we accept such a position, the third position, as it is here, we can rescue both realism and locality.

Let's look at this third way to address the two challenges. Who is engaged thirdly? Among many others, Kenneth Wharton and Huw Price embrace a third option: Retrocausality.[3] In addition to potentially rescuing concepts like locality and realism, retrocausal models also open avenues of exploring a "time-symmetric" view of our universe, in which the laws of physics are the same regardless of whether time runs forward or backward. This is a point for us to understand the "time symmetric" view of our universe. Causality may relate to our conception of time, so how we understand causality depends on how well we explain the concept of time. In this lecture, my focus is not on the idea of time but instead on the position. If we want to know how to explain the conception of retrocausality or backward causation, we need to understand the conception of time differently. Tonight, I will explain what happened between the two fields or two conceptions.

Kenneth Wharton states, "In any model where you had an event in the past correlated with your future choice of setting, that would be retrocausal."[4] This is an explanation from him about the concept of retrocausality.

Now, let's look further. How could we understand causality and retrocausality? We can find two different ways and two different conceptions of causation. Usually, in science, we can find different understandings of causality or causation in different ways. Here I list some of them:

・Causation and Causality in Sciences

・Causation is a process that connects causes to their effects.

・Causality is a general concept that there is such a thing as a cause–effect relationship between entities in which the cause makes a difference in the occurrence of the effect.

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3 Ken Wharton & Huw Price, To Understand Your Past, Look to Your Future, *Nautilus*, 2016, https://nautil. us/to-understand-your-past-look-to-your-future-235937/? _sp=d4c87da5-312a-4915-a656-619163d55dfd. 1710101154421. [2024-3-1]; Kenneth Wharton, A New Class of Retrocausal Models, *Quantum Physics*, 2018, https://doi. org/10.48550/arXiv.1805.09731 [2024-3-1].

4 Kenneth Wharton, A New Class of Retrocausal Models, *Quantum Physics*, 2018, https://doi. org/10.48550/arXiv.1805.09731 [2024-3-1].

So why stress the two concepts, causation, and causality? The second one, causality, focuses on the property of the condition. Causation is a process, while causality is a concept. They are different. Of course, we can see causality should be included in causation, and that causation comes from our intuition. When I was a child, I always asked why. Why the earth moves like this? Why the sun rises from the east of the city? Usually, others or your parents explain the reason to you using "because." We had some intention or disposition to ask, "Why." That's because we want to find the cause. So, the cause should result from the "why" question. That's metaphysically significant for us in understanding our ordinary sense of causation. So, suppose we can find causality and causation differently, just like this paper, "The Representation of Causality and Causation with Ontologies: A Systematic Literature Review."[5] In that case, it's essential to understand the difference between causation and causality.

Now, how could we explain causality apart from causation? Causation is a process, and we need to explain it much more. The causation is apparent. That's because we can answer the question with "why." That is a process, from questions to answers. But causality is complicated. That's because when we talk about the concept of causality, actually we have to explain it. We have to interpret the idea in many ways. So, that's why we should focus on the causality representations. Here, I find seven types of representations from the paper that I just showed:

1) Association. 12% represented causality in the form of "A is associated with B." For example, some used the relation "associated-with" between genetic factors and disease to identify genetic susceptibility to human disease. Causal terminology is avoided and replaced by statistical terms (association as in correlation). Another interpretation of "association" would be simple co-occurrence without statistical connotation.

2) Determinism. 60% used an assertion of the form "if A, then B." For example, "radiation causes cancer," "treatment causes side effects," and "herbs treat disease." The assumption is that causation is like a natural law: whenever the cause occurs, it is safe to infer that the effect will occur.

3) Temporal order. 10% used the form "A causes B if A precedes B." Temporality is a necessary criterion for a causal association between an exposure and an outcome, in which a cause should precede its effect.

4) Disposition. 14% assumed that causal relations are not dependent on entities (objects or events). Instead, causation is reflected in the circumstances in which objects express and generate their powers. For example, adverse effects can be conceived as a patient's disposition to respond to exposure to a drug adversely.

5) Causal chain. 4% structured causality as a series of events, each caused by the immediately previous event, e.g., an adverse series of events or a pathogenetic process. This view is reminiscent of the way causes of death are listed on death certificates and how causality is conceived in some legal contexts.

6) Influence. 4% conceptualized causality as "process A influences (positively, negatively) the occurrence of B," such as in which the "nicotine_withdrawal positively_influences smoking_relapse" refers to a scenario in which an increase in withdrawal severity would tend to increase smoking relapse.

7) Production. 6% used a representation: "A causes B if A produces B." For example, "produces" and "triggers" represent the concept of causality.

Now, let's talk about quantum retrocausality. As I said, the quantum threat to locality (that distant objects need a physical mediator to interact) stems from an argument by the Northern Ireland physicist John Bell in the 1960s. Bell considered experiments in which two hypothetical

5 S. Sawesi, M. Rashrash, O. Dammann, The Representation of Causality and Causation with Ontologies: A Systematic Literature Review, *Online J Public Health Inform*, 2022, https://doi.org/10.5210/ojphi.v14i1.12577 [2024-3-1].

physicists, Alice and Bob, each receive particles from a common source. Each chooses one of several measurement settings and then records a measurement outcome. Repeated many times, the experiment generates a list of results. Bell realized that quantum mechanics predicts that there will be strange correlations (now confirmed) in this data. They seemed to imply that Alice's setting has a subtle "nonlocal" influence on Bob's outcome, and vice versa – even though Alice and Bob might be light years apart. [6] Bell's argument is said to threaten Albert Einstein's theory of special relativity, which is an essential part of modern physics. But that's because Bell assumed that quantum particles don't know what measurements they will encounter in the future. Retrocausal models propose that Alice's and Bob's measurement choices affect the particles back at the source. This can explain the strange correlations without breaking special relativity. So, he thought retrocausality could save Einstein's theory of spatial relativity.

Ok, that's all about physics. We haven't mentioned anything about philosophy so far. Let's now look at retrocausality in philosophy. Here, I use the explanation from the Stanford Encyclopedia of Philosophy about backward causation:

> Backward causality is also called retrocauality. A common feature of our world is that in all cases of causation, the cause and the effect are placed in time so that the cause precedes its effect temporally. Our usual understanding of causation assumes this feature to such a degree that we intuitively have difficulty imagining things differently. The notion of backward causation, however, stands for the idea that the temporal order of cause and effect is a mere contingent feature and that there may be cases where the cause is causally before its effect but where the temporal order of the cause and effect is reversed concerning ordinary causation, i.e., there may be cases where the effect temporally, but not causally, precedes its cause.[7]

We see the two concepts needing clarification here: causation and causality. They are different, but they could be interchanged. That's the source of our confusion about causality. According to the other fact, our ordinary understanding of causation assumes this feature to such an extent that we may intuitively have difficulty imagining things differently. By our intuition, we couldn't understand or guess what happened differently from our usual understanding of causality or causation, as he said. However, the notion of backward causation stands for the idea that – he wants to say – okay, we can find other ideas about causality just because they are called backward causation or backward causality. He replaced the two. This idea "explains the temporal order of cause and effect as a mere contingent feature. And there may be cases where the cause is causally before its effect, but where the temporal order of cause and effect is reversed concerning normal causation." But it is not accessible if we imagine or if our ordinary understanding of the causation convinces us. Of course, causation means the cause precedes the effect; the cause precedes the effect in time. How do we say the event in the future could influence its cause before? This is the contradiction. That's why we couldn't see time traveling. We couldn't see the grandchildren kill his grandfather. We say, just because time could be reversed from the future to the past so that the grandchildren could kill their grandfather. But where and how would they do that if they could do that? Grandchildren mean they have grandparents. If they could go back to the past to kill his grandparents, where are they from? That's the contradiction. That's why, theoretically speaking, we could explain retrocausality just in part by time order.

Here, I want you to consider the term "contingent." Contingent means unnecessary. Unnecessary means there is no necessity in our understanding of causality. If there is no necessity as we understand in ordinary life or the physical world, why do we say something happens

6 J. S. Bell, On the Einstein–Podolsky–Rosen Paradox, *Physics*, vol. 1, no 3 (1964), pp. 195–200.

7 Jan Faye, Backward Causation, *The Stanford Encyclopedia of Philosophy* (Spring 2021 Edition), Edward N. Zalta (ed.), 2021, https://plato.stanford.edu/archives/spr2021/entries/causation-backwards [2024-3-1].

"necessarily"? If there is no such necessity in our physical world, how could we tell if time could be reversed from the future to the past? Theoretically speaking, it is possible. Philosopher Max Black built his equation on this. He used his Bilking argument to go against retrocausality. He didn't accept such ideas that there is a possibility of a backward effect from the future to the past. He said:

> Imagine B to be earlier than A, and let B be the alleged effect of A. Thus, we assume that A causes B, even though A is later than B. The idea behind the bilking argument is that whenever B has occurred, it is possible, in principle, to intervene in the course of events and prohibit A from occurring. But if this is the case, A cannot cause B; hence, we cannot have backward causation. [8]

This is his argument. Since then, philosophers have debated the effectiveness of the bilking argument in particular and, in general, the validity and soundness of the concept of backward causation. Of course, I agree with his opinion about backward causation. But his argument is about something other than causality. It defines the contradiction from the cause, from the collection of cause and effect. But it is not about causality. Why? The reason is simple. Let's look at some influential theories of time in the history of philosophy:

One is Presentism. This view claims that only events that exist now really exist. Past or future events do not exist. Past events have ceased to exist, whereas future events are yet to become real. So, only statements about the present or related to the present have a definite truth value. This theory is always called the A-theory of time in the sense of tenseness.

The second one is Possibility. According to this theory, past and present events exist, but future events are only possible or non-existent. This view is sometimes called the growing block universe. Consequently, the view holds that only statements about past and present events have a definite truth value. Still, statements about the future are either probably factual or may completely lack any truth value. So that one can find out the truth about future events.

The third one is Eternalism. This is also called the Block Universe. This position maintains that every past, present, and future event tenseless exists at a specific time and that statements about these events have a definite truth value at every other time. This theory is always called the B-theory of time in the sense of tenselessness.

Following the three theories of time, let's answer some questions about temporality.

The first question is, can metaphysics provide the notion of time that allows the effort to precede its course? How could we explain it? Metaphysics is related to the B Theory of Time. Our following lecture will be given by another professor, talking about the three theories of time. Eternalism is the best choice. We can use eternalism to explain the metaphysics of time. We usually say that you use time in physics or epistemology, so we could say anything about time because time changes our explanations in physics or epistemology. However, in metaphysics, the case is different. In metaphysics, time does not change. It's eternal. That's why Eternalism may be the best choice for the first question.

The next question is, does backward causation mean that a future cause changes something in the past? According to Max Black's argument, the answer is No. I'm afraid I have to disagree with him. That's because we can find causation here. Because we couldn't find anything happening in the future that could influence something that occurred in the past. We couldn't explain what happened in the future just because the future event occurred in the case of the past event that happened before. We can't explain what happens in the future. Only in physics or the physical world could we say anything that happens in the future would influence something in the past. Remember, it occurs only in the physical world, not the metaphysical one.

8 Max Black, Why Cannot an Effect Precede its Cause? *Analysis*, vol. 16, no. 3 (1956), pp. 49–58.

The third question would be, can the cause be distinguished from its effect so that the distinction does not depend on a temporal ordering of the events? According to my explanation before, I say yes, but only contingently. The answer should be "Yes, but contingent". I told you that temporal ordering is unnecessary for understanding or explaining causality. Of course, in the explanation of causation, it's our common sense that the first comes from the earliest to the later. Causation means "something because of others".

Fourth, can Max Black's bilking argument be challenged so that the mere possibility of intervention does not generate any severe paradoxes? If we accept his argument against retrocausality, we would say, "Ok, we couldn't generate any paradox." Yes, definitely. If we want to use his argument to challenge the causation by his understanding, then there's no problem here. He's right.

Finally, the fifth question is, does backward causation imply fatalism? I would say no. First of all, that's because backward causation is invalid. It doesn't mean fatalism. Second, even if we follow backward causation, we couldn't say there's something counterfactual in our understanding of time. For example, let's review the argument about a grandchild who kills their grandparent. But when we say that, could we say that there's something factual because he would kill his grandparents in the future? No, we couldn't know that because he didn't do that in the future, but he did it in the past, not in the future. So logically, we couldn't conclude fatalism because there's not anything decisive. So, for now, I want to reply, "No, not at all."

Following David Lewis' explanation of counterfactuals,[9] we see something different between physical and logical necessities. I think that gives us an obvious explanation of the two necessities from various points of view, as depicted in this graph (see Figure 1). He gave us what is called "strict conditioners." This is another piece of information about necessity.

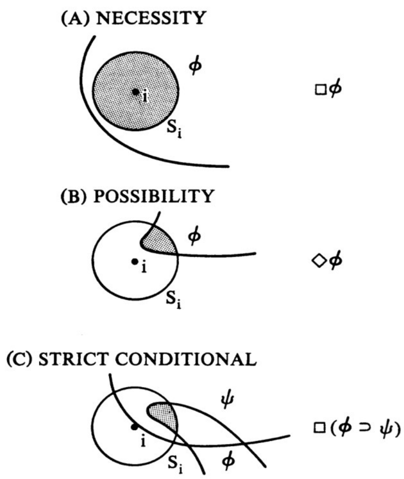

Figure 1 Source: David Lewis, *Counterfactuals*, Oxford: Blackwell, 1973, p. 6

Now, another idea about time. We are going to the center of the argument of my lecture about time. My lecture is divided into two parts. The first part concerns causality or retrocausality, and the other is time. But when we talk about time, we can find that the time argument is specific for causality. In Price's 2011 paper, "Does Time-Symmetry Imply Retrocausality? How the Quantum World Says 'Maybe,' " Huw Price claimed that the combination of time-symmetry without

9 David Lewis, *Counterfactuals*, Oxford: Blackwell, 1973, p. 1.

retrocausality is unavailable in quantum mechanics for reasons intimately connected with the differences between classical and quantum physics. [10]His thesis for this claim is SRRT, Symmetry-Requires-Retrocausality Thesis. It establishes that a time-symmetric ontology of photon polarization is necessarily retrocausal. Hence, if the quantum world is time-symmetric, it must be retrocausal. He gives a final form of the thesis as TSAR, a Time-Symmetry Argument for Retrocausality: Realism + Time-symmetry + Discreteness ⇒ Retrocausality.

But does time symmetry truly imply retrocausality? In one of his forthcoming papers, Sun Sheng argues that temporality is not a necessary universe feature. Time symmetry does not occur in a system but only in some specific cases. It is only a holistic feature in a system. This means that time symmetry does not imply retrocausality that is not relative to temporality but to the order of causes and effects that occurred. So, a world with time-reversal asymmetry does not necessarily originate from the laws of time-reversal asymmetry.

Moreover, for the physical laws themselves, discussing whether they have time-reversal symmetry isn't very sensible. The only meaningful discussion is whether the sequence of events determined by physical laws is symmetric in time reversal. A time-reversed world does not need to assume any new laws of physics.

Lastly, I want to talk about how the future affects the past but in different ways. This is my conclusion. The future could influence the past in various ways. First, it's the difference between the microscopic and macroscopic demission of the physical world: Retrocausality may appear in the microscopic world but cannot appear in the macroscopic world. That's why I said we couldn't find any phenomena as reversed timing that happens in our physical world. That's because, in the physical world, the world is observable. All objects existing in the world could be explained physically. But if we talk about something in the microscopic world, we can't explain it just by sensible data. The data could be used on the macroscopic surface. The microscopic and the macroscopic are different worlds. Therefore, the impact of future events on past events is only possible in the microscopic world of quantum mechanics.

Then, there is a psychological association of psychological effects: Our psychological expectations for the future will directly affect current behavior and judgments of past events. This psychological association is why we question how the future affects the past. However, it will not change past events, let alone cause future events to affect past events. Psychological expectations for the future mainly come from psychological associations and are our plans for past events. This plan is in the future but will directly impact current behavioral choices.

Finally, it is about the metaphysics of time and causality: To understand the nature of philosophy with the future is to explain the task of philosophy with uncertainty, unpredictability, and openness, thereby realizing the integrity, transcendence, and prophetic characteristics of philosophy. In a metaphilosophical sense, philosophy is a future-oriented wisdom ultimately embodied in a philosophical methodology. In this sense, the future must affect the past because, in metaphilosophy, the future and the past are not temporal but spatial concepts.

Thank you for your listening.

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