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SUNGHO CHOI

CAUSATION AND COUNTERFACTUAL DEPENDENCE

ABSTRACT. Recently Stephen Barker has raised stimulating objections to the thesis that, roughly speaking, if two events stand in a relation of counterfactual dependence, they stand in a causal relation. As Ned Hall says, however, this thesis constitutes the strongest part of the counterfactual analysis of causation. Therefore, if successful, Barker's objections will undermine the cornerstone of the counterfactual analysis of causation, and hence give us compelling reasons to reject the counterfactual analysis of causation. I will argue, however, that they do not withstand scrutiny.

1. BARKER'S EXAMPLE

The contemporary philosophers of causation have enhanced their understanding of causation by exploring the theoretical potential of the counterfactual analysis of causation. The counterfactual analysis of causation has been enjoying a great deal of popularity because, at least on the face of it, it is intuitively very attractive. However, it has been under severe and acute criticisms for years that are thought to be quite successful. It is noticeable that most of them involve cases of redundant causation targeting the claim that the counterfactual analysis of causation provides a necessary condition for causation. Therefore, they cannot really damage the following sufficiency claim:

DEPENDENCE. Necessarily, when wholly distinct events *c* and *e* occur, and *e* counterfactually depends on *c*, then *c* is thereby a cause of *e*.

Some terminology: two events are wholly distinct when they do not stand in a mereological or logical relation. The event *c* counterfactually depends on the event *e* iff, without *c, e* would not have occurred, where the counterfactual conditional should be given a forwardtracking reading. In what follows, I will assume Lewis's possible world semantics for counterfactual conditionals, according to which the would-counterfactual conditional that if it were the case

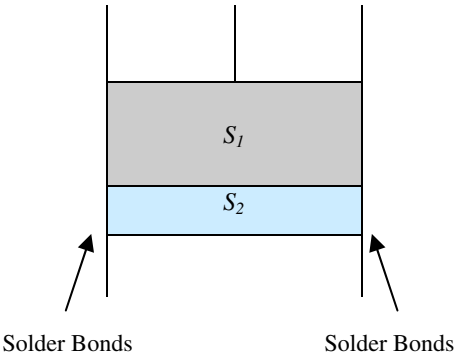
that P then it would be the case that Q is true at the actual world iff every P-world – world in which P is the case – that is closest with respect to comparative similarity to the actual world is a Q-world. To give a forwardtracking reading to this counterfactual conditional, we need to determine the closest P-worlds according to David Lewis's (1979) criteria for weighing respects of comparative similarity that, very simply, say that the first important respect is avoiding big miracles, the second important one is maximizing perfect match of particular fact, the third avoiding small miracles, the last maximizing imperfect match of particular fact. For short, call a true counterfactual conditional under the forwardtracking reading "a true forwardtracker".

Interestingly, no contemporary philosophers of causation have been making convincing criticisms of *Dependence* without simultaneously criticizing Lewis's semantics for counterfactual conditionals.[1] This is so although its indeterministic version, i.e., the thesis that counterfactual probability-raising is sufficient for causation has been seriously challenged by such philosophers as Peter Menzies (1989) and Jonathan Schaffer (2000) in a way that does not challenge Lewis's semantics. As Ned Hall (2000, 198–199; 2002, 198) says, however, *Dependence* is the lynchpin of the counterfactual analysis of causation that serves as a main source of the intuitive support for it. This suggests that, when Lewis's semantics for counterfactual conditionals is assumed, the underlying idea of the counterfactual analysis of causation still remains unscathed.

Recently, however, Stephen Barker (2003) has raised interesting objections to *Dependence* – in Barker's terminology, *Sufficiency*. Barker argues that *Dependence*, together with Lewis's semantics for counterfactual conditionals, suffers from the problem of effects and epiphenomena despite Lewis's claims to the contrary. The problem is that when e is an effect of c but not the other way around or when c and e are effects of a common cause and do not stand in a causal relation to each other, *Dependence* gives the verdict that e causes c because it is a true forwardtracker that without e c would not have occurred. Given that *Dependence* is the cornerstone of the counterfactual analysis of causation, Barker's objections, if successful, will give us conclusive reasons to repudiate the counterfactual analysis of causation.

Then what are Barker's objections? Let us consider the following example. Two lead cylindrical slabs are within a metal cylinder. The upper one S_1 is suspended by a copper wire and rests barely on the

lower one S_2 that is upheld by strong solder bonds at the bottom and the cylinder itself. The situation is depicted as follows:



At a time the copper wire breaks; the solder bonds break because S_1 bears down upon S_2; finally both slabs move downward.

One clarification is in order. Barker (2003, 148 n6) supposes that friction is present between the slabs and the cylinder's wall. This raises the question of whether or not the maximum static frictional force between S_2 and the cylinder's wall is greater than S_2's gravitation. It is assumed that S_2 is upheld by the solder bonds before the copper wire breaks. But if S_2's maximum static frictional force against the cylinder's wall is greater than S_2's gravitation, we do not need the solder bonds to uphold S_2 since the frictional force is sufficient for blocking S_2's fall. I presume that Barker makes up his example such that the solder bonds are indispensable in upholding S_2. Once this is realized, it is reasonable to suppose that the maximum static frictional force between S_2 and the cylinder's wall should be understood to be smaller than S_2's gravitation. Taken this way, Barker's example is such that once the solder bonds break, S_2 will move down owing to its gravitation – without being pushed down by S_1.

Barker (2003, 135) claims that the following counterfactual conditional is a true forwardtracker:

(1) If S_2 had not descended, S_1 would not have.

On Barker's view, one candidate for the closest antecedent worlds of (1) is a possible world where neither S_1 nor S_2 falls down because in virtue of a small miracle the copper wire does not break. Another candidate is a possible world where the wire breaks, S_1 begins to move down, but S_2 does not move down because S_1 penetrates right

through it. Barker proposes that the first candidate is closer to the actual world than the second with respect to Lewis's metric of comparative similarity. This is because though the second has marginally more perfect match of particular fact than the first, it involves significantly bigger law violations than the first. Then it follows that S_1 would not descend in the closest antecedent worlds of (1), and therefore that (1) is a true forwardtracker. This means that S_2's descent comes out as a cause of S_1's descent by *Dependence*. Barker maintains, however, this is a bogus backwards causation. For him, S_1's descent causes S_2's descent but not the other way around.

Barker goes on to argue that various ways of modifying *Dependence* and/or Lewis's metric of comparative similarity between possible worlds that the advocates of *Dependence* may consider go nowhere. For instance, Barker (2003, 136–138) asserts that his objection cannot be met by imposing on *Dependence* the temporal restriction that a cause should precede its effects. He admits that this move makes it possible for *Dependence* to disqualify S_2's descent from being a cause of S_1's descent. However, it cannot solve the problem of epiphenomena that goes as follows. Suppose that an event E is both caused by S_1's descent – this is not a tricky case of causation – and preceded by S_2's descent. Let us consider the following counterfactual conditional:

(2) If S_2 had not descended, E would not have occurred.

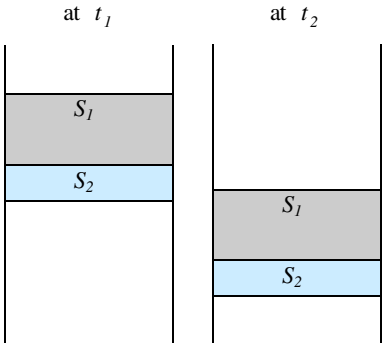
In the closest antecedent worlds of (2), Barker holds, neither S_1 nor S_2 would have fallen down because the copper wire would not have broken; thereby E would not have occurred. This means that (2) is a true forwardtracker. Moreover, S_2's descent precedes E, and therefore the new temporal restriction is satisfied. If so, the temporally restricted *Dependence* delivers the verdict that S_2's fall is a cause of E. However, Barker maintains that the two events, S_2's fall and E, are two effects of S_1's fall and do not stand in a causal relation. From this he concludes that the mere temporal restriction on *Dependence* does not help.

Then what should be blamed for this result? It is *Dependence* or Lewis's semantic framework for the forwardtracking reading or both. Barker (2003, 142) holds that it is inevitable to retain Lewis's semantic framework of determining comparative similarity between possible worlds. Hence, for him, *Dependence* should be blamed. However, the counterfactual analysis of causation cannot stand without *Dependence*. From this he reaches the conclusion that the

counterfactual analysis of causation is unlikely to provide an adequate account of causation. In what follows, however, I will contend that Lewis can meet Barker's objections without making any modifications.

2. INTERPRETING BARKER'S EXAMPLE

As we have seen, Barker claims that S_1's descent is a cause of S_2's descent but not the other way around. But his claim is plausible only if S_1's and S_2's descents are carefully interpreted. Suppose that the copper wire breaks and then the two slabs start to move downward at a time t_1. Suppose further that, at a later time t_2, they are moving downward at lower places than before.



S_1's and S_2's downward movements from t_1 to t_2 are temporally prolonged events.

One interpretation of Barker's claim is that S_1's downward movement, taken as a whole, is a cause of S_2's downward movement, taken as a whole. However, I have some reservation about this interpretation. It should be observed that an earlier part of S_2's downward movement is temporally prior to a later part of S_1's downward movement. Therefore, it appears that when we understand S_1's and S_2's descents to be their downward movements taken as a whole, Barker's claim is obviously false because barring backwards causation a cause must be temporally prior to its effects but S_1's descent is not temporally prior to S_2's descent. Contrary to appearance, however, this is not the case. I maintain that there is a sense of "cause" in which even if a part of an event c is preceded by a part of an event e it is still true that c causes e. I watch a football match live on TV. Then there is a sense of "cause" in which my watching the

football match on TV, taken from the beginning to the end, is caused by the football match, taken from the beginning to the end, despite the fact that an earlier part of the first event is temporally prior to a later part of the second event. Hence there is a sense of "cause" in which Barker's claim is true.[2]

I suggest, however, this is not the primary sense of "cause", the sense that we have in mind when we say that, leaving exceptional cases like time travel aside, a cause is temporally prior to its effects. And it is this primary sense of "cause" that is relevant to the present context not least in the context where Barker brings a charge of bogus backwards causation against the proponents of *Dependence*. Indeed, I believe that the proponents and opponents of *Dependence* implicitly assume that *Dependence* is concerned with the primary sense of "cause".[3] Since the football match as a whole is not temporally prior to my watching the football match live on TV as a whole, the second event is not caused by the first event in the primary sense of "cause".[4] Likewise, given that S_1's descent as a whole is not temporally prior to S_2's descent as a whole, the first event is not a cause of the second event in the primary sense of "cause". In short, given the primary sense of "cause", when we understand S_1's and S_2's descents to be their downward movements taken as a whole, Barker's claim is obviously false, wherefore, it does not merit serious consideration.

Meanwhile, there is another way of looking at Barker's claim according to which it says that S_1's commencing to move down is a cause of S_2's commencing to move down but not the other way around. At least on the face of it, it is not obviously wrong to say that S_1's commencing to move down is temporally prior to S_2's commencing to move down, meaning that each part of the first event is temporally prior to every part of the second event. Then it follows that, on this interpretation, Barker's claim is not obviously false in the primary sense of "cause". This suggests that, when we focus on the primary sense of "cause", this interpretation is more natural than the one we discussed in the previous paragraph.

In fact, I believe that Barker is likely to consent to this suggestion. Barker (2003, 136) maintains that given that S_2's descent comes out a cause of S_1's descent by *Dependence* its advocates are inevitably committed to bogus backwards causation. Also, he admits that S_2's descent can be disqualified from being a cause of S_1's descent by *Dependence* by imposing on it the temporal restriction that a cause should be prior to its effects. Thus Barker makes it very explicit that S_1's descent precedes S_2's descent. However, as we have seen, it is obviously wrong to say that S_1's downward movement, taken as a

whole, is temporally prior to S_2's downward movement, taken as a whole. Meanwhile, it is not obviously wrong to say that S_1's commencing its downward movement precedes S_2's commencing its downward movement. This leads to the idea that it is likely that, by S_1's and S_2's descents, Barker means S_1's and S_2's commencing to move down.

With this in mind, I restate (1) and (2) by means of (3) and (4), respectively.

(3) If S_2 had not commenced its downward movement, S_1 would not have.

(4) If S_2 had not commenced its downward movement, E would not have occurred.

Barker will hold that both (3) and (4) are true forwardtrackers since the closest antecedent worlds of them are possible worlds where neither S_1 nor S_2 begins to fall down. On his view, this poses the problem of effects and epiphenomena for *Dependence*, since S_1's commencing its downward movement causes S_2's commencing its downward movement but not the other way around. For simplicity, let e_1 and e_2 be S_1's commencing its downward movement and S_2's commencing its downward movement, respectively.

It should be noted that Barker tacitly assumes that both S_1 and S_2 are ideally incompressible. Suppose that one of them, say, S_2 is not ideally incompressible. In this case, when the copper wire breaks, S_1 moves down compressing S_2 until the solder bonds break; once the solder bonds break, both S_1 and S_2 fall down. Then what is the truth value of (3)? In a possible world where the wire breaks but S_2 does not move down, S_1 would move down compressing S_2. This possible world is closer to the actual world than one where neither S_1 nor S_2 begins to fall down because the copper wire does not break. The first has more perfect match than the second but it does not involve more or bigger law violations than the second. If so, S_1 would commence its downward movement in the closest antecedent worlds of (3).[5] This means that (3) is false.[6] We can get the same result for the case where S_1 is not ideally incompressible or where neither S_1 nor S_2 is ideally incompressible.

Meanwhile, Barker will say, on the assumption that S_1 and S_2 are ideally incompressible, (3) is true. The possible world where S_1 descends compressing S_2 is less close to the actual world than the one where neither S_1 nor S_2 begins to descend. The reason is that, on the

assumption that S_1 and S_2 are ideally incompressible, though the first has marginally more perfect match than the second, it involves much bigger miracles than the second, Therefore, for Barker, the closest antecedent worlds of (3) are the possible worlds where neither S_1 nor S_2 begins to descend, and therefore (3) is true. Keeping this in mind, I suggest that Barker assumes that both S_1 and S_2 are ideally incompressible.

3. CAUSAL RELATION

I agree with Barker that e_2 comes out as a cause of e_1 by *Dependence* since (3) is a true forwardtracker. But I disagree with his claim that this is a bogus backwards causation. In fact, he explicitly offers no supporting arguments for the claim that e_1 is a cause of e_2 but not the other way around. Let us first examine his claim that e_1 causes e_2. It is undeniable that S_1 makes some causal contribution to e_2. When the copper wire does not break, the gravitational force on S_1 is balanced by the tension in the wire. Thereby, S_1 exerts no downward force on S_2. Thereby, the solder bonds do not break. When the wire breaks, however, the gravitational force on S_1 is not balanced by the tension in the wire, and therefore S_1 exerts a non-vanishing downward force on S_2 at a time t. As a result, S_2, in turn, exerts a greater downward force on the solder bonds than before. This greater downward force does cause the breaking of the solder bonds that supported S_2, which in turn causes S_2's commencing its descent. By the transitivity of causation, S_1's exerting the non-vanishing downward force on S_2 at t causes S_2 to descend. In this sense, S_1 causally contributes to e_2.

Here it is important to realize that what I think causes e_2 is not e_1 but S_1's exerting the non-vanishing downward force on S_2 at t. And, e_1 is a different event from S_1's exerting the non-vanishing downward force on S_2 at t. Indeed, I take it that, on the assumption that both S_1 and S_2 are ideally incompressible, e_1 is temporally preceded by S_1's exerting the non-vanishing downward force on S_2 at t. This is because S_1 begins to fall down only after the solder bonds break as a result of S_1's exerting the non-vanishing downward force on S_2. Then is e_1 a cause of e_2? I think not. We have found above that it is natural to assume that the maximum static frictional force between S_2 and the cylinder's wall is smaller than S_2's gravitation. Under this assumption, when the solder bonds break as a result of S_1's exerting the non-vanishing downward force on S_2, S_2 begins to move down because of its gravitation. This means that, once the solder bonds break, S_2

commences its descent regardless of whether S_1 descends or not. Therefore, it is reasonable to suppose that the explanation of why S_2 begins to fall down would include no reference to e_1. In addition, when a person has control over S_1's movement, she will not be held morally responsible for the consequences of e_2. This is because she could not prevent S_2 from falling. Finally, without e_1, we could still bring about e_2 by exerting the non-vanishing downward force on S_2 at t. This means that e_1 in the circumstances under consideration does not constitute an effective strategy for bringing about e_2. Thus, e_1 has no distinctive connotations of being a cause of e_2. Then we come to the conclusion that Barker is wrong that e_1 causes e_2.[7]

I will now examine Barker's (2003, 135) claim that e_2 does not cause e_1. Before delving into this matter, let me first point out that Barker is wrong that e_1 temporally precedes e_2. As long as there exists no empty gap between S_1 and S_2, S_1 commences to move down only after S_2 moves down with the result that it evacuates the spatial region occupied by it.[8] Then e_1 is later than or at least simultaneous with e_2. Hence I take it that Barker is wrong that e_1 is temporally prior to e_2.

In my opinion, Barker's tacit argument for the claim that e_2 does not cause e_1 is based on the assumption that e_1 precedes e_2: "Given that e_1 precedes e_2, if it is true that e_2 causes e_1, it should be a case of backwards causation. However, nobody would think that backwards causation is such a commonplace affair. Therefore, e_2 does not cause e_1." But we have seen that Barker's assumption that e_1 is temporally prior to e_2 is mistaken. This means that Barker's argument does not work.[9] To be sure, if we suppose that there exists an empty gap between S_1 and S_2, then S_1 will start to fall down earlier than S_2 does, and therefore e_1 will indeed precede e_2. In this case, however, the counterfactual conditional (3) is not a true forwardtracker. When there exists such an empty gap, S_1 descends but S_2 does not for a while. Therefore, even if S_2 had not started to move down, S_1 would still have moved down for a while. This means that *Dependence* does not deliver the verdict that e_2 is a cause of e_1. Consequently, even if we suppose that there exists a gap between S_1 and S_2, still we do not have any bogus backwards causation.

So far I have argued that Barker's reason for the claim that e_2 is not a cause of e_1 is a bad reason. Obviously, this does not immediately mean that e_2 is a cause of e_1. So I will now attempt to show that e_2 is a cause of e_1. The thought is that e_2 has every distinctive connotation of being a cause of e_1. Suppose that we try to explain why S_1 falls down in the circumstances under consideration. S_1 falls down only if the downward gravitational force on S_1 is not counterbalanced by some

upward resistance. But if S_2 had not fallen down, the downward gravitational force on S_1 would have been counterbalanced by S_2's resistance; thereby S_2 would have blocked S_1's descent; thereby S_1 would not have fallen down. This suggests that a person cannot fully understand why S_1 falls down unless she is informed that S_2 falls down and hence does not block S_1's descent. If so, the explanation of why e_1 occurs should include a reference to e_2. In addition, when a person has control over S_2's movement, she will be held morally responsible for the consequences of e_1 because she could make S_2 block S_1's descent by maintaining S_2's position. Finally, e_2 in the circumstances under consideration constitutes an effective strategy for bringing about e_1 since, without e_2, we could not bring about e_1. Then, I think, it is fair enough to say that e_2 is a cause of e_1.[10]

From the above considerations, it emerges that e_2 is a double preventer of e_1. This is due to the fact that e_2 prevents an event – namely, S_2's counterbalancing the downward gravitational force on S_1 – that would have prevented e_1 if it had occurred. Here one might object[11]: "The statement P_a that S_2 starts its downward movement logically entails the statement P_b that S_2 does not counterbalance the downward gravitational force on S_1. Then it is wrong to say that e_2 causes S_2's not counterbalancing the downward gravitational force on S_1 because the two events are not wholly distinct. This means that it is wrong to say that e_2 prevents S_2's counterbalancing the downward gravitational force on S_1." In my opinion, however, it is logically possible that S_2 commences its downward movement but counterbalances the downward gravitational force on S_1. For instance, it is easy to imagine a possible world where S_2 moves down but counterbalances the downward gravitational force on S_1 by action at a distance. Therefore, the statement P_a does not logically entail the statement P_b. Moreover, it is clear that e_2 stands in no mereological relation to the event of S_2's not counterbalancing the downward gravitational force on S_1. Then e_2 is a wholly distinct event from S_2's not counterbalancing the downward gravitational force on S_1. Consequently, it is safe to say that e_2 prevents S_2's counterbalancing the downward gravitational force on S_1, and therefore that e_2 is a double preventer of e_1.

4. COUNTERFACTUAL DEPENDENCE

We have seen above that e_2 causes e_1 but not the other way around. This result accords quite well with *Dependence*. As Barker states, (3)

is a true forwardtracker, which entails that, according to *Dependence*, e_2 comes out as a cause of e_1. Further, I take it that *Dependence* does not deliver the verdict that e_1 is a cause of e_2. To see this, consider the following counterfactual conditional:

(5) If S_1 had not commenced its downward movement, then S_2 would not have.

One candidate for the closest antecedent worlds of (5) is a possible world where neither S_1 nor S_2 falls down because in virtue of a small miracle the copper wire does not break. Another candidate is a possible world where the wire breaks, the gravitational force on S_1 is not balanced by the tension in the wire, S_1 exerts a non-vanishing downward force on S_2, the solder bonds break, S_2 begins to move down, but S_1 does not move down because of a small miracle. It is clear that the second candidate has more perfect match than the first, while it does not involve more or bigger law violations than the first. Therefore, the second candidate is closer to the actual world than the first with respect to Lewis's metric of comparative similarity. Then it follows that S_2 would have descended in the closest antecedent worlds of (5), and therefore that (5) is a false forwardtracker. Consequently, *Dependence* does not deliver the verdict that e_1 is a cause of e_2.[12]

As noted above, one of the causes of e_2 is S_1's exerting the non-vanishing downward force on S_2. This is in conformity with *Dependence*. In a counterfactual situation where S_1 does not exert the non-vanishing downward force on S_2, S_2 would exert the same amount of force on the solder bonds as it does when the copper wire does not break; thereby the solder bonds would not break; thereby S_2 would not commence its descent. Therefore, it is a true forwardtracker that if S_1 had not exerted the non-vanishing downward force on S_2, S_2 would not have descended. It follows that S_1's exerting the non-vanishing downward force on S_2 qualifies as a cause of e_2 by *Dependence*.

It is remarkable that, though Barker is right that (3) is a true forwardtracker, he is mistaken in identifying the closest antecedent worlds of (3). Barker proposes that the closest antecedent worlds of (3) are possible worlds where neither S_1 nor S_2 falls down because in virtue of a small miracle the copper wire does not break. On the other hand, the possible worlds I have in mind are ones where the wire breaks, the gravitational force on S_1 is not balanced by the tension in the wire, S_1 exerts a non-vanishing downward force on S_2, the solder bonds break, but S_2 does not move down because of a small miracle,

wherefore, S_1 does not move down, either. My possible worlds have more perfect match with the actual world than Barker's, whereas my possible worlds do not involve more or bigger law violations than Barker's. Therefore, my possible worlds are closer to the actual world than Barker's with respect to Lewis's metric of comparative similarity. Fortunately, however, this makes no difference to the truth of (3) because, in my possible worlds, S_1 would not have descended.

To wrap up, *Dependence* gets Barker's example right, and therefore Barker's example does not pose the problem of effects for *Dependence*. Further, it is an easy job to see that the alleged problem of epiphenomena is not a real problem, either. Now that it is realized that e_2 is a cause of e_1, the truth of (4) spells no troubles for *Dependence* because e_2 is indeed a cause of E: e_2 is a cause of e_1 that in turn is a cause of E, and therefore, by the transitivity of causation, e_2 is a cause of E. So I conclude that Barker's criticisms of *Dependence* fail.

In Section 1, I supposed that the maximum static frictional force between S_2 and the cylinder's wall is smaller than S_2's gravitation. Barker might modify his example such that it is greater than S_2's gravitation.[13] As already noted, when it is greater than S_2's gravitation, we do not need the solder bonds to uphold S_2 since the frictional force is sufficient for blocking S_2's fall. For simplicity, let us take the solder bonds out of the picture and suppose that, before the copper wire breaks, S_2's position is maintained only by the friction between S_2 and the cylinder's wall. The copper wire breaks at a time, the gravitational force on S_1 is not balanced by the tension in the wire, S_1 exerts a non-vanishing downward force on S_2 at a time t, S_2 undergoes a greater downward force than the maximum static frictional force between S_2 and the cylinder's wall, S_2 begins to move down.

On the one hand, it is clear to me that this modification makes no difference to the plausibility of my claims that e_2 is a cause of e_1 and that (3) is a true forwardtracker: without e_2, S_1 would not have commenced its downward movement because S_2 would have blocked S_1's descent, regardless of whether S_2 is actually sustained by solder bonds or by friction. On the other hand, one might suspect that, in the modified example, e_1 is a cause of e_2. In fact, it appears that (5) is a true forwardtracker. But I maintain that this is not the case.

In a counterfactual situation where S_1 does not begin to move down, the wire would break, the gravitational force on S_1 would not be balanced by the tension in the wire, S_1 would exert a non-vanishing downward force on S_2 at t, S_2 would undergo a greater downward force than the maximum static frictional force between S_2

and the cylinder's wall, S_2 would move down, but S_1 would not move down as a result of a small miracle. Here it is important to note that S_1 does not need to move down in order to cause S_2 to commence its downward movement. S_1 has only to exert the non-vanishing downward force on S_2 at t, which does not require S_1 to move down. Therefore, even if S_1 had not commenced to move down, S_2 would still have commenced to move down. This means that (5) is not a true forwardtracker. This being the case, *Dependence* rules that, in the modified example, e_1 is not a cause of e_2.

To be sure, in the counterfactual situation described above, S_1 would not continue putting pressure on S_2 because S_1 would not but S_2 would move down. Therefore, on the assumption that the kinetic frictional force between S_2 and the cylinder's wall is greater than S_2's gravitation, S_2 would not continue undergoing a greater downward force than the kinetic frictional force against the cylinder's wall; thereby, S_2 would stop shortly after starting to move down. In short, if S_1 had not commenced to fall down, S_2 would still have commenced to fall down but it would have stopped soon thereafter. This suggests that, according to *Dependence*, e_1 is a cause of a later part of S_2's descent although e_1 is not a cause of e_2. This result is in keeping with our intuition that, in the modified example, it is because S_1 descends and continues pushing down S_2 that, despite the frictional force between S_2 and the cylinder's wall, S_2 moves all the way down.

The reason for believing that, in Barker's original example, e_1 is not a cause of e_2 equally applies to the modified example described above. For instance, given that, as a result of S_1's exerting the non-vanishing downward force on S_2 at t, S_2 undergoes a greater downward force than the maximum static frictional force against the cylinder's wall, S_2 begins to fall down, regardless of whether S_1 begins to fall down or not. Therefore, one does not need to know if S_1 begins to fall down or not in order to understand why S_2 begins to fall down. This means that the explanation of why S_2 begins to fall down would include no reference to e_1. In general, it is easy to see that e_1 has no distinctive connotations of being a cause of e_2. As in Barker's original example, S_1 makes a causal contribution to e_2 not by commencing a downward movement but by exerting a non-vanishing downward force on S_2 at t. Then we are led to the conclusion that, in the modified example, e_1 is not a cause of e_2. As a result, *Dependence* gets right the modified example as well as Barker's original example.

So far I have been arguing that Barker's criticisms of *Dependence* fail. As usual in the contemporary philosophy of causation, Barker's criticisms rely on his intuitive judgment that e_1 causes e_2 but not the

other way around. As we have seen, however, it takes a very careful analysis to get the causal structure of Barker's example right. Specifically, we need to take into account various factors such as gravitation, friction, and incompressibility and use our scientific knowledge of how those factors mechanically interact one another. Having examined the causal structure of Barker's example, it turned out that Barker's intuition is mistaken. This teaches us one methodological lesson about the philosophy of causation: in order to draw the right conclusions for individual cases, we need to go over each of them very carefully without blindly trusting our off-the-cuff intuitions about it.

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5. NOTES

[1] It is worth noting that *Dependence* has been subject to plenty of serious criticisms that are based on the idea that Lewis's semantics is mistaken (Bennett 1984; Horwich 1987, Chapter 10). For instance, Jonathan Bennett (1984, 68) attacks *Dependence* by discrediting Lewis's semantics for counterfactual conditionals. Suppose that a die was thrown in a specific way and then fell three uppermost. Bennett argues that it is a true counterfactual conditional that if the die had not fallen three uppermost it would not have been thrown in that specific way. This joins with *Dependence* to imply that the die's falling three uppermost caused it to be thrown in that specific way, which is a disastrous result. For Bennett, it is *Dependence* that should be blamed for this disaster. Here it should be observed that, on Lewis's (1979, 34) view, the counterfactual conditional I just mentioned is a backtracking counterfactual conditional which is false under the standard resolution of vagueness. This means that Bennett's attack on *Dependence* is based on his rejection of Lewis's semantics for counterfactual conditionals. I am indebted to one of the anonymous referees for bringing up this point.

[2] This point was brought to my mind by one of the anonymous referees.

[3] One may attempt to make it explicit that *Dependence* concerns the primary sense of "cause", for instance, by adding to the antecedent of *Dependence* the requirement that the two events, c and e, must not be temporally prolonged events but instantaneous events – here I do not mean that this is the only or best way of doing that. On this view, the antecedent of *Dependence* is not satisfied in the case of football match because the two events, my watching the football match live on TV as a whole and the football match as a whole are temporally prolonged events. This is supported by the fact that the first event is not caused by the second event in the primary sense of "cause". Likewise, S_1's and S_2's descents, taken as a whole, are temporally prolonged events and hence the antecedent of *Dependence* is not satisfied by them.

Again, this is supported by the fact that S_1's descent as a whole is not a cause of S_2's descent as a whole in the primary sense of "cause".

[4] It is remarkable that we can describe the causal structure of the case of football match in terms of the primary sense of "cause". For instance, my watching a player scoring a goal on TV at a time t is caused by the player's scoring a goal at a time shortly before t, where "cause" is used in its primary sense, that is, the sense in which a cause is temporally prior to its effects. In general, each time slice of the event of my watching the football match live on TV is caused by some time slice of the event of the football match in the primary sense of "cause". This, I think, is what we mean when we simply say that my watching the football match on TV is caused by the football match. The same can be said about Barker's example.

[5] Of course, the more compressed S_1 is, the less compressible it is. Therefore, in the closest antecedent worlds of (3), S_1 would stop its downward movement soon. But this makes no difference to the truth value of (3).

[6] This causes no troubles for *Dependence* because, on the assumption that S_2 is not ideally incompressible, e_2 does not cause e_1. Among other things, e_1 is temporally prior to e_2. Hence, barring backwards causation, it is reasonable to deny that e_2 causes e_1.

[7] It is remarkable that Barker cannot object that because e_1 causes S_1's exerting a non-vanishing downward force on S_2 at t that in turn causes e_2, by the transitivity of causation, e_1 causes e_2. I agree that S_1's exerting a non-vanishing downward force on S_2 at t is a cause of e_2. But I deny that e_1 causes S_1's exerting a non-vanishing downward force on S_2 at t. As already stated, the second event is temporally prior to the first event. Hence, barring backwards causation, it is reasonable to deny that e_1 causes S_1's exerting a non-vanishing downward force on S_2 at t.

[8] Evidently the assumption that both S_1 and S_2 are ideally incompressible is at work here.

[9] I think that there is some inclination to say that e_1 is simultaneous with e_2. On this view, if it is true that e_2 causes e_1, it should be a case of simultaneous causation. It is clear that this does not save Barker's tacit argument under consideration because most advocates of simultaneous causation hold that there are a number of everyday examples of simultaneous causation (Huemer and Kovitz 2003, 557).

[10] I do not mean that the afore-mentioned three connotations of being a cause are exhaustive. For instance, as Mellor (1995, 60) points out, being a cause has such connotations as that causes are contiguous to their immediate effects and that causes and effects are evidence for each other. Because these two connotations do not reflect the asymmetry between causes and effects, however, I cannot appeal to them to support my claim that e_2 is a cause of e_1 but not the other way around. Meanwhile, the three connotations of being a cause that I have considered above reflect the asymmetry between causes and effects. This is why I have appealed to them in order to establish my claim that e_2 is a cause of e_1 but not the other way around. I thank one of anonymous referees to bringing up this point.

[11] In personal communication, Barker brought up this objection.

[12] One might flirt with a possible world where the wire breaks, the gravitational force on S_1 is not balanced by the tension in the wire, S_1 exerts a non-vanishing downward force on S_2, but the solder bonds do not break. In this world, neither S_1 nor S_2 would fall down. However, this world is less close to the actual world than what I call the second candidate for the closest antecedent worlds of (5).

[13] In personal communication, Barker seems to consider a modification like this.

REFERENCES

Barker, S.: 2003. 'Counterfactual Analyses of Causation: The Problem of Effects and Ephiphenomena Revisited', *Nous* **37**, 133–150.

Bennett, J.: 1984. 'Counterfactuals and Temporal Direction', *Philosophical Review* **93**, 57–91.

Hall, N.: 2000. 'Causation and the Price of Transitivity', *Journal of Philosophy* **97**, 198–222.

Hall, N.: 2002. 'Non-locality on the Cheap? A New Problem for Counterfactual Analyses of Causation', *Nous* **32**, 276–294.

Horwich, P.: 1987, *Asymmetries in Time*, The MIT Press, Cambridge

Huemer, M. and B. Kovitz: 2003. 'Causation as Simultaneous and Continuous', *The Philosophical Quarterly* **53**, 556–565.

Lewis, D.: 1979, 'Counterfactual Dependence and Time's Arrow', *Noûs* **13**, 455–476. Reprinted in D. Lewis, (1986), *Philosophical Papers: Vol. II*. Oxford University Press, Oxford (References are to the reprint).

Mellor, D.: 1995, *The Facts of Causation*, Routledge, London.

Menzies, P.: 1989. 'Causation and Causal Processes: A Critique of Lewis', *Philosophy of Science* **56**, 642–663.

Schaffer, J.: 2000. 'Overlappings: Probability-Raising without Causation', *Australasian Journal of Philosophy* **78**, 40–46.

Programs in History and Philosophy of Science
College of Natural Sciences
Seoul National University
Kwan-ak-gu, Seoul, 151-742
Korea
E-mail: choise80@snu.ac.kr

Department of Philosophy
Queen's University
Kingston, Ontario, K7L 3N6
Canada

Department of Philosophy
University of Sydney
Main Quad, A14, NSW 2006
Australia