CAUSES AS DIFFERENCE-MAKERS FOR PROCESSES[*]

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ABSTRACT. It is natural to think of causes as difference-makers. What exact difference causes make, however, is an open question. In this paper, I argue that the right way of understanding difference-making is in terms of causal processes: causes make a difference to a causal process that leads to the effect. I will show that this way of understanding difference-making nicely captures the distinction between causing an outcome and helping determine how the outcome happens and, thus, explains why causation is not transitive. Moreover, the theory handles tricky cases that are problematic for competing accounts of difference-making.

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§1 Introduction

It is natural to think of causes as difference-makers. David Lewis characterizes this idea, which he puts at the center of his counterfactual account of causation, as follows:

> We think of a cause as something that makes a difference, and the difference it makes must be a difference from what would have happened without it. (Lewis 1986, p. 167)

What exact difference causes make, however, still is an open question. In this paper, I argue that the right way of understanding difference-making is in terms of causal processes: causes make a difference to a causal process that leads to the effect.

Understanding difference-making in terms of causal processes provides an extremely attractive theory of causation that handles tricky cases that are problematic for competing accounts of difference-making, such as Halpern and Pearl (2005), Hitchcock (2001), Lewis (1986, 2004), Sartorio (2005, 2013), Woodward (2003), and Yablo (2002, 2004). Moreover, the theory elegantly captures the intuitive distinction between causing and merely helping determine how an outcome happens and, thus, explains why causation is not transitive.[1]

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1 Schaffer (2001) and Strevens (2004, 2008) also combine elements from difference-making and process theories of causation. Schaffer argues that causes are probability raisers of causal processes and, thus, difference-makers for causal processes if determinism is true (as I will assume in this paper). He, however, provides no standards for when a causal

My theory is non-reductive because it presupposes information about causal processes in order to provide a necessary and sufficient condition for causation. I will show that the theory nonetheless has enormous explanatory power. Taking for granted certain facts about causal processes, the theory explains a wide range of further, more fine-grained causal facts. Moreover, there is a prospect of making the theory reductive by supplying a suitable account of causal processes. The current paper is an advertisement that theories of causation need an account of causal processes to capture the full richness of our causal distinctions.

My plan for the rest of the paper is as follows: In §2, I motivate my theory by showing that causal processes have the right modal profile to capture the difference causes make. In §3, I clarify the notion of a causal process that underlies my account. In §4 and §5, I show that difference-making in terms of processes provides a necessary and sufficient condition for causation that explains important causal distinctions. In §6, I argue that my account is superior to existing theories of difference-making.

§2 The Basic Idea

In this section, I introduce and motivate my theory by showing how it improves upon two failed attempts of capturing difference-making. A naïve analysis of difference-making is in terms of simple counterfactual dependence:

(DM-1) C causes E, iff: if C had not occurred, then E would not have occurred.

DM-1, however, is too strong because not all effects counterfactually depend on their causes. For example, consider the following case of early preemption:

> *Early Preemption*. Suzy and Billy are both aiming at throwing stones at a bottle, but Suzy is faster. So Billy does not bother to throw. Suzy's stone shatters the bottle. Had Suzy not thrown, Billy would have thrown and destroyed the bottle (at around the same time, in a similar way, etc.).

Suzy's throw causes the shattering of the bottle. But if Suzys had not thrown, the bottle still would have shattered because Billy would have thrown. So whatever difference causes make is not (or at least not always) a difference in whether or not their effects occur.

In response to cases like Early Preemption, Lewis (1986) identifies difference-making with the ancestral of counterfactual dependence.

(DM-2) C causes E, iff: there is a chain of stepwise counterfactual dependence from C to E.

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process would or would not have occurred. As I will argue, such standards are central for fully explaining the nuances of our causal judgments. Strevens's theory of explanatory relevance includes an account of identity conditions for causal processes, but his account is different from the one in this paper (see FN 9). He also reaches different conclusions about certain cases (see Strevens 2008, sect. 6.5).

This analysis handles Early Preemption. The shattering of the bottle counterfactually depends on the impact of Suzy's stone: If Suzy's stone had not impacted the bottle, then the bottle would not have shattered. And the impact of Suzy's stone counterfactually depends on Suzy's throw: If Suzy had not thrown, then her stone would not have impacted the bottle. (It is important that these counterfactuals do not backtrack. For example, in assessing what would have happened if Suzy's stone had not impacted the bottle, we hold as much of the actual past fixed as possible, including that Billy did not throw.) So Lewis's proposal correctly predicts that Suzy's throw causes the bottle shattering.

But DM-2 is too weak because it counts too many events as causes. Consider Engineer:

> *Engineer.* A train approaches a switch. Before it gets there, an engineer flips the switch such that the train turns onto a side track. Because the tracks reconverge ahead, the train arrives at its destination all the same. Moreover, let us assume it arrives in the same manner and around the same time as it would have if the engineer had not flipped the switch.[2]

There is step-wise counterfactual dependence between the train's arrival and the flipping of the switch. The train's arrival counterfactually depends on its being on the side track shortly before the arrival (again, holding fixed as much of the past as possible, including that the train has been directed onto the side track). Moreover, the train's being on the side track counterfactually depends on the flipping of the switch. So Lewis's account falsely treats the flip in Engineer on par with Suzy's throw in Early Preemption and counts it as a cause.[3] The flip does make some kind of difference: If the flip had not occurred, then the train would have arrived via the main track rather than the side track. This difference, however, is not causally relevant (see Sartorio 2005, p. 74).

An adequate account of difference-making needs to specify how Suzy's throw in Early Preemption does make a causally relevant difference while the flip in Engineer does not. Our judgments show that the non-occurrence of the effect (as in DM-1) is not necessary to make a causally relevant difference, while the non-occurrence of merely some event on which the effect counterfactually depends (as in DM-2) is not sufficient. So, the difference causes make must lie somewhere in-between.

I argue that the difference causes make concerns a causal process leading to the effect. I will defend the following account of difference-making:

(DM-3) C causes E, iff: if C had not occurred, then some causal process that leads to E would not have occurred.

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2 Cases like Engineer are discussed in Hall (2000, p. 205), Hall (2007, p. 118), Hitchcock (2009, p. 394), Paul (2000, pp. 250–251), Paul and Hall (2013, p. 232), Sartorio (2005, pp. 74–75), and Yablo (2004, pp. 134–135).

3 Lewis (2004) appeals to "influence," i.e., patterns of counterfactual dependence between alterations of events, instead of simple counterfactual dependence. This theory, however, equally counts the flip in Engineer as a cause of the train's arrival.

DM-3 says that causes make a difference to at least one causal process that leads to the effect.[4]

Causal processes have the right modal profile to capture why Suzy's throw in Early Preemption makes a difference with respect to the bottle shattering while the flip in Engineer does not make a difference with respect to the train's arrival. Making a difference to a causal process requires less than making a difference to the effect but more than making a difference to some event on which the effect counterfactually depends. The rough idea, which I will develop in detail below, is the following: In Early Preemption if Suzy had not thrown, then the bottle still would have shattered because Billy would have thrown. Suzy's throw, however, makes a difference to the causal process that connects Suzy's throw to the bottle shattering. If Suzy had not thrown, then this causal process would not have occurred because her stone would not have hit the bottle (though a different causal process, involving Billy's throw, would have occurred). In Engineer, by contrast, the flip does not make a difference to a causal process that leads to the train's arrival. If the engineer had not flipped the switch, then the train would have arrived along a different route. This different route, however, is similar enough to the original route to constitute the same causal process (per the standards I will defend in §3). So the flip does not make a difference to any causal process that leads to the arrival.

DM-3 is non-reductive because it presupposes that we already know what causal processes exist. For example, in Early Preemption there is a causal process from Suzy's throw to the shattering, and in Engineer there is a causal process from the flip to the arrival. In contrast, there is no causal process in Early Preemption from Billy's standing idle to the shattering. My goal in this paper is to show that given this information about what causal processes exist, DM-3 provides an adequate difference-making theory of causation that accounts for the full richness of our causal distinctions.

DM-3 is informative for at least four reasons. First, though it presupposes information about causal processes, DM-3 explains causal distinctions that are far more fine-grained than this input. For example, Suzy's throw in Early Preemption and, respectively, the flip in Engineer are each connected to the relevant outcome by a causal process. These facts about causal processes, however, do not explain why Suzy's throw is a cause of the outcome while the flip is not. Based on the occurrence-conditions for causal processes that I will provide in the next section, DM-3 distinguishes the two cases, and it similarly explains our causal judgments about other cases.

Second, we have a good grip on the notion of a causal process even without a reductive analysis. We naturally think of causal interactions in terms of processes, such as a stone shattering a bottle or a train hurtling toward its destination. Moreover, recent work in the philosophy of action suggests that causal processes are essential to understanding human actions (see, for example, Steward 2013). Even if you are initially skeptical of the notion of a causal process, the success of DM-3 should convince you of its importance.

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4 Usually there is only a single causal process leading to an effect, but I want to allow for symmetric overdetermination where multiple causal processes lead to the same effect. See §4 for discussion.

Third, most competing analyses of difference-making that try to improve upon DM-1 and DM-2 are equally non-reductive.[5] These accounts provide criteria for causation that can only be applied if we already have some causal background knowledge. So, it is not a dialectical disadvantage that my account already presupposes causal knowledge about which events are connected by a causal process. Moreover, I will argue that my account provides an improved account of difference-making.

Finally, DM-3 can be made reductive by providing a suitable analysis of causal processes. The most well-known analysis is in terms of a physical connection, specifically the transfer of energy (Fair 1979), a trope (Ehring 1997), or some conserved physical quantity (Dowe 1992 and Salmon 1994). Plugging such a reductive analysis into DM-3 would make the condition reductive. In fact, causal process theorists should welcome DM-3 as a way of linking up causal processes with causation *simpliciter*. Providing a full reductive analysis of causal processes, however, is beyond the scope of this paper.[6] Instead, my focus will be on demonstrating the explanatory power of DM-3.

§3 Occurrence-Conditions for Processes

DM-3 says that an event C causes another event E, just in case: if C had not occurred, then some causal process that leads to E would not have occurred. I take for granted that we know what causal processes there are. However, even if we know which causal processes lead to E, we still need to be able to determine whether at least one of these processes would not have occurred if C had not occurred. Answering this question requires an account of when a given causal process would or would not have occurred. This section will supply such occurrence-conditions for causal processes.[7]

Causal processes are sequences of events that evolve toward an outcome, such as a train hurtling toward its destination or a rock flying toward a bottle. It is natural to think that

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5 See Halpern and Pearl (2005, p. 849), Hitchcock (2007, pp. 503–506), Sartorio (2005, pp. 75–76), Sartorio (2013, p. 194), and Woodward (2003, pp. 20–22). Yablo (2002, 2004) is intended to be reductive, but it is doubtful whether it succeeds (see Paul and Hall 2013, p. 98).

6 I am skeptical whether causal processes can be fully analyzed in terms of a physical connection (for reasons given in Paul and Hall 2013, pp. 55–58). An alternative reductive account is what Hall (2004, p. 265) calls the "blueprint" strategy. Hall proposes this strategy as an analysis of (one kind of) causation, but I think it is better suited as an analysis of causal processes. The idea is to identify blueprints of causal processes via a simple sufficient but not necessary condition (such as unique minimal lawful sufficiency) and then extend the analysis to other cases via a suitable notion of similarity. My remarks in the next section are at least the beginning of such an account.

7 Counterfactual theories such as DM-1 and DM-2 face an analogous question for events. For example, to determine whether in Early Preemption the bottle still would have shattered if Suzy had not thrown, we need an account of when an event is identical to the bottle shattering. A further question is what replaces C in the counterfactual scenario where we assume that it did not occur. See Hitchcock (2007, pp. 506–507) and Paul and Hall (2013, pp. 51–53) for discussion.

causal processes could be altered in certain ways while remaining the same individuals (Steward 2013, pp. 807-809). For example, the process of the train hurtling toward its destination still would have happened if the tracks had been curvier or if the train had moved faster. Causal processes are analogous to individual objects like statues in this respect. A statue can undergo changes in its parts, for example lose its nose, yet remain the same individual.

Occurrence-conditions for causal processes require an account of when a given causal process is numerically the same as a causal process in some counterfactual scenario. This relation is often called "cross-world identity." I will argue that our judgments support the following condition: Two causal processes are (cross-world) identical, just in case they have: (i) the same form, and (ii) the same constitutive material parts.

Steward (2013, p. 808) introduces the idea that processes have a form in analogy with how we individuate ordinary objects:

> If a thing is to be cross-world identifiable with an entity whose parts—be they spatial or temporal—are distinct from its actual-world constituents, this must be because the thing in question is singled out in thought by way not of those parts but rather by way of something one might call its form. In saying, for example, that the statue of Goliath would still have been that self-same statue, even without its right foot, say, we show our commitment to a principle of identity for such things as statues which neglects precise spatial composition in favour of other considerations—in this case, perhaps, general coherence of a body of matter in a certain rough shape. We do not care, so far as statues are concerned, about the precise masses of matter which go to make them up. A statue can be the same statue despite large cross-world variation in composition.

We, analogously, can think of processes as having a form such that they can loose or gain some of their parts as long as their form stays the same. The form of a process, I will argue, consists in the way in which it unfolds toward the outcome. More precisely, two processes share the same form, just in case there is a mapping from the events composing one process into the events composing the other process that preserves salient features, such as energy expended, distance traveled, time taken, and the role individual events play in the larger structure of events.[8] I will call such a mapping "structure-preserving."

Consider the form of the causal process in Engineer, which is made up from events where the train moves toward its destination on the side track. First, there are relations concerning how much distance the process covers. For example, if the side track is 80 miles long, then the process covers 80 miles of distance between the event where the train enters the side track and the event where it gets back onto the main track. Second, there are temporal relations. For example, the train's entering the side track and its getting back onto the main track may occur one hour apart. Third, while the train is moving along the tracks, it expends a certain amount of energy. So there are relations of how much energy is expended between any two events. Fourth, each event in the structure bears distinctive relations to other types of events. For example, events of the train's traveling over the tracks stand in distinctive relations (spatial and temporal relations, as well as transfer and conservation of energy and

8 Here I am drawing from Yablo (2004, p. 126) who uses these criteria for a different purpose.

momentum) to other events, such as the working of the engine, the heating up of the tracks, etc.

A mapping is structure-preserving, just in case it maps the events in one process onto events in another process in a way that preserves most of these features. The mapping must preserve these relations well-enough to allow us to identify most events in one sequence as playing analogous roles to events in the other sequence. For example, if the engineer had not flipped the switch in Engineer, the train would have travelled on the main track instead of the side track. The journey via the main track (let us assume) is of the same length and is otherwise similar to the journey via the side track. Hence, there is a structure-preserving mapping of events in the actual process onto events in the counterfactual process. The processes cover the same distance, take the same time, expend a similar amount of energy, and events stand in similar relations to other events. So, the processes have the same form.

The mapping does not have to perfectly preserve all features to be structure-preserving. Imagine a variation where the journey via the main track is several miles longer, but the train would also move faster and so arrive at the same time. In this case, no mapping preserves both the distances between events and the expended energy (the train would have expended more energy if it had stayed on the main track due to the increased speed). But the processes still have the same form if these differences are not too drastic and other features are preserved. Events in the two processes still can be matched up in virtue of temporal relations and their role in the overall structure of events. Both processes take the same time and events of the train's moving toward its destination stand in similar relations to the working of the engine and the existence of the tracks. So, the processes still have the same form.

But now take a more drastic variation where if the engineer had not flipped the switch, the train would have been stopped, taken-apart, and shipped toward its destination (cf. Hall 2000, p. 207). There is no structure-preserving mapping between events in this sequence and events in the actual sequence where the train travels on the side track. Any mapping that (even approximately) preserves the distances covered between events and the time passed will not preserve how much energy is expended and the role individual events play in the larger structure of events. For example, segments of the train moving on the side track in the original process expend vastly different amounts of energy than corresponding segments in the alternative process where the train is taken apart and shipped. Moreover, events in the process where the train is shipped are related to events such as the existence of water and the movement of the boat, but no events in the original process are similarly related to events of this kind. So, the processes have a different form.[9]

[9] Strevens (2004, 2008) defends a somewhat similar criterion for process individuation. According to Strevens, to decide whether two causal processes are identical, we look at all possible microphysical realizers. The processes are identical, only if their microscopic realizers are *contiguous*, whereby a set of realizers are contiguous "if, roughly speaking, you can get from any realizer to any other realizer by a process of minimal tweaks." (Strevens 2012, p. 498) Strevens argues that using contiguity rather than similarity has important advantages (ibid., p. 498–499). I prefer my own account for two reasons. First, deciding which microphysical entities are eligible realizers of a causal process seems to already presupposes substantial information about the identity of the process. And, second, in

Consider another example. Compare a process where I write my paper in my office to one where I write it in a coffee shop. First, assume that in each scenario I work on a computer for three hours. The individual events might not match up perfectly: I might work on my laptop at the coffee shop but on my desktop computer at the office. Nonetheless, there is a structure-preserving mapping if in both cases I write at approximately the same speed and events of me thinking and looking at my notes are similarity related to events of me typing. There is then a mapping of writing and thinking events from one sequence into the other that preserves temporal relations between events and their role in the overall structure. So, the processes have the same form.

But, second, suppose that at the coffee shop, instead of writing steadily as I would at my office, I chat with some friends, take in the atmosphere, and only during the last hour, fueled by stronger coffee, I jot down the paper. In this case, there is no structure-preserving mapping from one sequence of events into the other. For example, no mapping would preserve the temporal relations between thinking and writing events, and events such as the drinking of stronger coffee have no analog in the original sequence where I work in my office. Consequently, we are inclined to say that it is a different causal process.

Sameness of form, understood in terms of a structure-preserving mapping, is necessary for the identity of processes, but it is not sufficient. Another necessary condition is that the processes have the same constitutive material parts. Processes have a main actor (or set of actors) that carry out or undergo the process. These objects are constitutive for the process such that identical processes need to have the same constitutive parts. Two processes thus are identical, just in case they have the same form and the same constitutive part(s).

To get our judgments about causal processes right, we need to pay close attention to which objects are constitutive for a given process. These objects are often distinguished by how we pick out the relevant processes, such as "*Suzy's* throw" or the "*train's* journey." For example, in Engineer the actual sequence of events involves the engineer who flips the switch, the train, and the tracks. The counterfactual sequence of events, where the engineer does not flip the switch and the train travels on the side tracks, by contrast, does not involve the engineer and involves different tracks. But both sequences involve the train, who is the main actor undergoing the process, and so they involve the same constitutive object.

Processes that have different constitutive parts are distinct from each other even if they have the same form. In Early Preemption, Suzy throws a stone that shatters a bottle. If Suzy had not thrown, Billy would have thrown and his stone would have shattered the bottle. The two processes have the same form. We can match events involving Suzy's throw and the trajectory of her stone with events involving Billy's throw and the trajectory of his stone. The relevant events expend similar amounts of energy, cover a similar distance, take a similar time, and stand in similar relations to other events. Nonetheless, the two sequences of events constitute different causal processes. Suzy's throw involves Suzy, who carries out the

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explaining our everyday judgments, I am reluctant to lean too heavily on facts about the microphysical level (but see Strevens 2008, p. 108).

throwing, as a constitutive part, but the counterfactual sequence of events, where Billy throws, does not.[10]

To sum up, I have argued that there are robust identity conditions for processes involving a shared form and shared constitutive parts. A process's constitutive part is the main agent that initiates or carries out the process. Processes can vary with respect to their non-constitutive parts if their form is preserved.

§4 Causes as Difference-Makers for Processes

In this and the next section, I will use the just provided occurrence-conditions for causal processes to defend DM-3 as necessary and sufficient for causation. To establish that DM-3 is necessary for causation, I need to show that it is satisfied by all causes. Counterfactual dependence between distinct events is sufficient for causation and in many ordinary cases effects counterfactually depend on their causes (see Lewis 1986: 563). So, the first step of my argument for DM-3's necessity is to show that counterfactual dependence entails DM-3. This entailment establishes that all causes that are such their effects counterfactually depend on them satisfy DM-3.

Whenever an effect E counterfactually depends on C (such that if C had not occurred, E would not have occurred), then if C had not occurred, some causal process that leads to E also would not have occurred (cf. Schaffer 2001, p. 86–87). This entailment is extremely plausible because if an effect is caused, then there is a process doing the causing. And, moreover, if the effect had not occurred, then this process also would not have occurred; else, it would have led to the effect. So, DM-3 is satisfied whenever an effect counterfactually depends on its cause(s).

The second step of my argument is to show that DM-3 is also met by causes whose effects do not counterfactually depend on them. Counterfactual dependence fails in cases of redundant causation, which comprise early preemption, late preemption, and symmetric overdetermination. I cannot discuss every single such case, but I will show that DM-3 is met by standard cases and has no clear counterexamples.

Let me start with the case of early preemption discussed earlier:

> *Early Preemption*. Suzy and Billy are both aiming at throwing stones at a bottle, but Suzy is faster. So Billy does not bother to throw. Suzy's stone shatters the bottle. Had Suzy not thrown, Billy would have thrown and destroyed the bottle (at around the same time, in a similar way, etc.).

[10] We can imagine a variation of Early Preemption where if Suzy had not thrown, Billy would have wrestled the stone from her hands and would have used that same stone to still shatter the bottle (at around the same time, in a similar way, etc.). But these two sequences of events would still constitute different processes because Suzy is a constitutive part of the throw that leads to the shattering in the actual circumstances but she is not a constitutive part of the counterfactual process (where she no longer is the main actor carrying out the throwing).

Suzy's throw, which causes the bottle shattering, satisfies DM-3 because if Suzy had not thrown, then a causal process that leads to the bottle shattering would not have occurred. The causal process that leads to the shattering is carried out by Suzy and, hence, involves her as a constitutive part. If Suzy had not thrown, then this process would not have occurred. A different causal process, involving Billy's throw, would have occurred, but this process is different because it does not have Suzy as a constitutive part.

Late preemption cases satisfy DM-3 for the same reason. Here is an example:

> *Late Preemption*. Suzy and Billy both throw rocks at a bottle. Suzy's rock hits the bottle a moment before Billy's, and the bottle shatters. Had Suzy not thrown, Billy's rock would have destroyed the bottle (at around the same time, in a similar way, etc.).

Suzy's throw causes the bottle shattering and it also satisfies DM-3. Suzy is a constitutive part of the causal process that leads to the bottle shattering. If Suzy had not thrown, then this process would not have occurred because the alternative causal process is carried out by Billy, not Suzy.[11]

The third standard case of redundant causation concerns symmetric overdetermination where a single event has two distinct sufficient causes:

> *Symmetric Overdetermination.* Suzy and Billy both throw rocks at a bottle. Their two rocks hit the bottle at exactly the same time, each with sufficient force to shatter it, and the bottle shatters.

In this case both Suzy's and Billy's throw are causes of the shattering, and DM-3 delivers this verdict. Each event is connected to the effect by a causal process: one process contains Suzy as a constitutive part; the other process contains Billy as a constitutive part. If either Suzy's throw or Billy's throw had not occurred, then the respective causal process would not have occurred. Both causes thus meet DM-3. Hence, DM-3 is satisfied both in ordinary cases of causation and in paradigmatic cases of redundant causation.

Things get a trickier when we consider causation by prevention. DM-3 handles ordinary cases of prevention. Suppose a ball flies toward a window, but before it reaches the window, Suzy catches the ball. If Suzy had not caught the ball, it would have destroyed the window. DM-3 accounts for the judgments that Suzy's catch causes the intact state of the window. If Suzy had not caught the ball, then the causal process that leads to the intactness of the window a few seconds later (roughly, the glass retaining its chemical structure) would not have occurred. So, Suzy's catch makes a difference to a causal process that leads to the effect.

But what about redundant prevention? Here is a case of "preemptive prevention" due to McDermott (1995).[12] Suzy catches a ball that flies toward a window. But if Suzy had not caught the ball, the window still would not have shattered because it was protected by a solid

[11] Schaffer (2001, p. 87) defends the same treatment of preemption cases, though he is less explicit about why the backup cause would give rise to a different causal process.
[12] The same issues arise for preemptive double prevention (Hall 2004, p. 271) and symmetric overdetermination by double prevention (Hitchcock 2009, p. 399).

brick wall. Did Suzy's catch cause the intact state of the window a few seconds after her catch? Our judgment is ambivalent (see Lewis 2004, p. 102 and Paul and Hall 2013: 188–189). You may think: No—the window was protected by the wall and was never under any threat of shattering. So, Suzy's catch did nothing to prevent it from shattering. Or, you may think: Yes—if the ball had made it past both Suzy and the wall, the window would have shattered. But the wall did nothing. So, Suzy's catch prevented the window from shattering and thus caused its intact state a few seconds later.

DM-3 predicts that Suzy's catch is not a cause of the intact state of the window. If Suzy had not caught the ball, it would have been stopped by the wall, and so the causal process that leads to the intact state of the window (roughly, the glass retaining its chemical structure) still would have occurred. This verdict does not fully match our intuitive reaction because we feel at least some inclination to count Suzy's catch as a cause.[13]

I argue that we should regard DM-3 as necessary for causation despite this discrepancy. It would be problematic if we were confident that Suzy's catch causes the intact state of the window. But, in fact, our judgment is ambivalent and malleable. As seen above, we can be easily led to think that Suzy's throw is not a cause.[14] So the discrepancy between our judgment and DM-3's verdict is only minor. Moreover, it is not clear that we, at least presently, should take preemptive preemption seriously when developing a theory of causation since we lack good understanding of what principles govern our judgments about these cases (see Paul and Hall 2013, pp. 186–190). Absent such understanding and given the malleability of our judgments, it is too early to call the shots on what a theory of causation should say about these cases. Hence, in light of its successful treatment of the other cases, it is plausible that DM-3 is necessary for causation. (I will provide additional evidence for this claim below.)

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[13] Lewis (2004, pp. 102–103) suggests that our tendency to count Suzy's catch as a cause stems from considering far-fetched counterfactual scenarios where if Suzy had not caught the ball, the ball would have somehow made it past the wall and shattered the window. If we consider such far-fetched scenarios, then DM-3 also predicts that Suzy's throw is a cause. In the relevant scenario, if Suzy had not caught the ball, then the causal process that actually leads to the intactness of the window would not have occurred. I am, however, skeptical that what happens in these counterfactual scenarios is relevant for the causal structure of the case (see FN 14).

[14] Collins (2004, p. 108) reports that he has a stronger intuition that Suzy's catch causes the intactness of the window when the backup preventer is a second catcher rather than a solid brick wall. But even if this reaction is widely shared, we should be suspicious of it. People plausibly feel more inclined to consider Suzy's catch a cause in this scenario because it is easier to imagine that the ball, if Suzy had not caught it, would have gotten past a second catcher than a solid brick wall (ibid., p. 112). However, in cases like Early Preemption, everybody agrees that it is irrelevant for the causal evaluation of the case how easy it is to imagine the backup mechanism failing (that is, to imagine that the backup cause would not have produced the effect if the actual cause had not occurred). Why then should it matter in preemptive prevention how easy it is to imagine the backup prevention mechanism failing? So, we have reason to think that the relevant intuitions are misguided.

§5 Difference-Makers for Processes as Causes

To show that DM-3 is also sufficient for causation, I need to show that it is satisfied only by causes. DM-3 obviously is not met by events that do not interact with how an effect happens at all. After all, no such event makes a difference to any causal process that leads to the effect. Potential counterexamples to DM-3's sufficiency are "switching" cases, where an event makes some kind of difference to how an effect happens but this difference is not causally relevant. I will defend the sufficiency of DM-3 by showing that it is not satisfied in standard cases of switching.

The flip in Engineer (see §2) is a paradigmatic example. The flip is not a counterexample to DM-3 because it does not make a difference to the causal process that leads to the arrival. This causal process involves the train traveling on the side track. If the engineer had not flipped the switch, then the train would have travelled on the main track instead. Yet, as argued in §3, this alternative route would constitute the same causal process because it has the same form and involves the same constitutive object as the original process. So, if the flip had not occurred, the causal process that actually leads to the train's arrival still would have occurred. Flipping the switch helps determine how this causal process leads to the arrival, but it does not make a difference to whether the process occurs.

Here is a similar case, due to McDermott (1995, p. 531):

> *Dog Bite*. A terrorist plans to detonate a bomb, but a day earlier a dog bites of her right forefinger. So, when she presses the button, she uses her left forefinger rather than her right forefinger, which causes the detonation. Being naturally right handed, if the dog had not bitten her, she would have pressed the button with her right forefinger. Nonetheless, the dog bite is not a cause of the detonation of the bomb.

DM-3 correctly predicts that the dog bite is not a cause of the detonation. The terrorist's pushing the button with her right forefinger would have been the same causal process as the actual process where she pushes the button with her left forefinger. The terrorist, who carries out the process and so is constitutive of it, figures in both sequences. (She lacks a right forefinger in one sequence, but her forefinger is plausibly not an essential part of her.) Moreover, we can map events from the left-finger sequence onto events in the right-finger sequence in a structure-preserving way. In each sequence, the button pushing takes a similar amount of time, expends a similar amount of energy, and events are related to other events in a similar way. So the dog bite does not make a difference to the causal process that leads to the effect.

A third case goes back to Hartry Field (see Paul and Hall 2013: p. 216):

> *Bomb.* Suzy's enemy (Enemy) places an old-style bomb, fuse burning, outside her apartment door. But moments before the bomb would have exploded, Billy comes along and pinches out what is left of the fuse. Billy's act causes Suzy's survival (she was sitting next to the door, and would certainly have been killed by the blast).

DM-3 correctly predicts that Enemy placing the bomb is not a cause of Suzy's survival. The causal process that leads to Suzy's survival, among other things, involves Suzy's general good health, the proper working of her essential organs, the presence of enough oxygen in her apartment, as well as Billy's disabling of the bomb.

If Enemy had not planted the bomb, then Billy's disabling of the bomb would not have occurred and, hence, would not have been part of the sequence of events leading to Suzy's survival. Nonetheless, the causal process that leads to Suzy's survival still would have occurred. Suzy is the only constitutive part of this process, and she is part of the alternative sequence of events as well. Moreover, there is a structure-preserving mapping from events in the original process onto events in the alternative process. Although events involving the planting and disabling of the bomb have no analogs in the alternative process, most other events can be mapped onto almost exact duplicates. All events involving Suzy's general health, the working of her organs, and the presence of oxygen in her apartment also are part of the alternative causal process. Due to this exact match, the mapping preserves numerous relations between these events, including spatial relations, temporal relations, and how much energy is expended. So, since the two causal processes have the same form and involve the same constitutive object, planting the bomb does not make a difference to which causal process leads to Suzy's survival.[15] That DM-3 gets our judgments about these switching cases right is strong evidence that it is sufficient for causation.

We can get even more evidence for the sufficiency and necessity of DM-3 for causation by testing the following predictions. If DM-3 is sufficient for causation, then if we modify a switching case such that some event does make a difference to some causal process, this event now causes the relevant outcome. Furthermore, if DM-3 is necessary for causation, then if we find a switching case where the switching event is a cause, then this event also must make a difference to some causal process leading to the outcome in question. In the following I will test both of these predictions.

First, consider a variation of Engineer where, after the flip directs the train onto the side track, "it stops after a short while, gets taken apart, shipped piece-meal to a point near its destination, reassembled, and all this in such a way as to guarantee that nothing distinguishes its counterfactual from its actual arrival." (Hall 2000, p. 207) As mentioned earlier, in this case the flip does make a difference to the causal process that leads to the arrival. After all, there is no structure-preserving mapping from events in the sequence where the train is shipped onto events in the sequence where the flip does not occur and the train stays on the main track. If DM-3 is sufficient for causation, then the flip should cause the arrival in this variation. And, indeed, we are much more inclined to treat the flip as a cause of the arrival in this variation than in the original case (see Paul and Hall 2013, p. 241).

Second, Hall (2000, p. 209) constructs a case that is structurally similar to Engineer but where the switching event is a cause of the outcome:

15 Schaffer (2001, FN 28) also suggests that Billy's placing the bomb is not a difference-maker for the causal process that leads to Suzy's survival. However, he does not spell out this idea or motivate why the same causal process still would have occurred if Billy had not placed the bomb.

> *Kiss.* Billy and Suzy have grown up. One day, they meet for coffee. Instead of greeting Billy with her usual formal handshake, however, Suzy embraces him and kisses him passionately, confessing that she is in love with him. Billy is thrilled-for he has long been secretly in love with Suzy, as well. Much later, as he is giddily walking home, he whistles a certain tune. What would have happened had she not kissed him? Well, they would have had their usual pleasant coffee together, and afterward Billy would have taken care of various errands, and it just so happens that in one of the stores he would have visited, he would have heard that very tune, and it would have stuck in his head, and consequently he would have whistled it on his way home, and, just to give the case the right "shape," let us stipulate that matters are rigged in such a way that the time and manner of the whistling would not have differed at all.

Kiss resembles other switching cases in that Suzy's kiss helps determine how Billy's whistling comes about. But, in contrast to cases like Engineer, Suzy's kiss also causes Billy's whistling. Hall proposes this case as a challenge for difference-making accounts of causation. (In fact, as I will show in §5, Kiss is a counterexample to several other difference-making accounts.)

Since Suzy's kiss causes Billy's whistling, DM-3 predicts that the kiss must make a difference to some causal process that leads to the whistling. And this is exactly what we find. If Suzy had not kissed Billy, then the causal process that leads to Billy's whistling also would not have occurred. The alternative sequence of events, involving running errands and hearing the tune in the store, would constitute a different causal process than the one initiated by Suzy's kiss. Though the alternative sequence also involves Billy and Suzy, the way it unfolds toward the whistling of the tune is completely different. There is no structure-preserving mapping from the actual sequence of events where Suzy and Billy enjoy their newfound love to the alternative sequence where Billy is running errands. For example, events like the kiss and Billy feeling joyful have no analog in the alternative sequence. So, Suzy's kiss does make a difference to the causal process that leads to the effect. Kiss and the modified Engineer case thus illustrate that our causal judgments indeed are sensitive to facts about causal processes in the way DM-3 predicts.

DM-3 also sheds light on why switching cases are counterexamples to the transitivity of causation. Transitivity says that if C causes D and D causes E, then C also causes E. Many philosophers have argued that cases like Engineer, Bomb, and Dog Bite are counterexamples to this principle.[16] For example, in Engineer the flip causes the train to travel on the side track and its traveling on the side track causes the train's arrival. Yet, the flip does not cause the train's arrival. Or, in Bomb, Enemy's planting the bomb causes Billy to deactivate the bomb and the deactivation of the bomb causes Suzy's survival. Yet, Enemy's planting the bomb does not cause Suzy's survival.

DM-3 explains why transitivity fails in these cases. Events like the flip in Engineer help determine how an outcome happens, but they do not cause the outcome. DM-3 captures

16 See, for example, Hall (2007, p. 118), Hitchcock (2001, pp. 276–277), and Sartorio (2005, p. 81). Lewis (2004, pp. 96–99) tries to explain away the counterexamples, but see Hall (2000, p. 221) for decisive criticism of this strategy.

this difference. The flip in Engineer redirects the causal process that leads to the train's arrival by causing the train to travel on the side track rather than on the main track. It thereby causes a cause of the arrival. However, it does not make a difference to *whether* that process happens. If the flip had not occurred, the same causal process still would have led to the arrival. So, DM-3 explains why the flip is not a cause of the arrival and, hence, why transitivity fails.

§6 Alternative Accounts of Difference-Making

In this section, I will highlight the explanatory power of DM-3 by showing that alternative accounts of difference-making all fail to explain some cases that DM-3 can explain. De facto dependence accounts understand difference-making in terms of conditional counterfactual dependence.

(DM-4) C causes E, iff: there is some suitable fact F such that holding F fixed if C had not occurred, E would not have occurred (cf. Paul and Hall 2013, p. 79).

The challenge for these accounts is to find some suitable fact F to hold fixed such that the events in Early Preemption and Kiss will come out as causes but not the flip in Engineer.

Hitchcock (2001, pp. 286-287) proposes, roughly, that C causes E, just in case C counterfactually depends on E holding fixed variables at their actual values that are not on the causal path from C to E (cf. Woodward 2003). This proposal can handle Early Preemption and Kiss. If we hold fixed in Early Preemption that Billy does not throw, then if Suzy had not thrown, the bottle would not have shattered. And if we hold fixed in Kiss that Billy does not go to the store, then if Suzy had not kissed Billy, he would not have whistled the tune. So the account would explain why the events in Early Preemption and Kiss are not causes. However, it incorrectly predicts that the flip in Engineer causes the arrival. If we hold fixed that the train does not travel on the main track, then if the engineer had not flipped the switch, the train would not have reached its destination. So it is hard to see how any such account could distinguish Early Preemption and Kiss from Engineer.[17]

Sartorio's (2005, 2013) interpretation of difference-making provides the following necessary condition for causation that is designed to handle cases like Engineer:

(DM-5) C causes E, only if: if C had not occurred, then the absence of C would not have caused E.[18]

Sartorio argues that DM-5 explains why the flip in Engineer is not a cause. She points out that

17 See Hall (2007, p. 118–119). Hitchcock (2001) provides a convincing explanation of Dog Bite, but the same strategy does not work for Engineer. Halpern's and Pearl's (2005) account is even more permissive than Hitchcock's. But, as Engineer shows, Hitchcock's account is already too permissive because it erroneously counts the flip as a cause.

18 Sartorio assumes that absences can be causes. Otherwise, DM-5 would be true of any event since no absence would cause anything.

the contribution the flip makes to the train's arrival and the contribution its absence would have made to it are on par. Any considerations that would lead us to count the flip as a cause of the arrival also would lead us to count its absence as a cause of the arrival in the counterfactual scenario where the engineer does not flip the switch. But DM-5 does not allow that both are causes, so it follows that neither is a cause.

Sartorio's account, however, cannot handle Kiss. Suzy's kiss causes Billy's whistling, but it is equally plausible that in the counterfactual scenario where Suzy fails to kiss Billy, the absence of the kiss would also cause Billy's whistling. After all, the absence of the kiss sends Billy to the store where he hears the melody that he later whistles. So, Kiss is a counterexample to DM-5. Suzy's kiss causes Billy's whistling, yet its absence also would have caused it.

Yablo (2002, 2004) defends an interpretation of difference-making that, if spelled out in full detail, is a version of a de facto dependence account. I will omit most of the technical details and simplify the account to bring out its central idea. Yablo's guiding idea is that effects have *needs* that must be met for them to occur, where different events can meet the same need of an effect. For example, the shattering of a bottle is in need of a certain amount of force being exerted on it. Billy's throw, Suzy's throw, an earthquake, (etc.) could each meet that same need.

Yablo then proposes that causes meet *genuine* needs of their effects.

(DM-6) C causes E, iff C meets a genuine need of E.

A need of E is genuine, just in case E still would have had that need if C had not occurred. Yablo tries to reductively explicate what counts as a genuine need in terms of counterfactual dependence, but I will instead clarify DM-6 by applying it to cases.[19]

In Early Preemption, Suzy's throw meets a need of the bottle shattering. For the bottle to shatter something needs to exert a sufficiently large force on it. Suzy's throw meets this need by supplying the required force. Moreover, this need is genuine: even if Suzy had not thrown, the bottle still would have been in need of this force in order to shatter. As it happens, the bottle would have shattered even if Suzy had not thrown, but only because Billy's throw would have met the same need by also exerting the required force on the bottle. So Yablo's account rightly predicts that Suzy's throw causes the bottle shattering.

Flipping the switch in Engineer, by contrast, does not meet a genuine need of the train's arrival. It contributes to the arrival by changing the route of the train's journey: it directs the train onto the side track. But if the flip had not occurred, the train's arrival would not have been in need of this contribution. Being not prevented from moving on the main track, the train would not have been in need of moving onto the side track in order to reach its destination. Flipping the switch, therefore, does not meet a genuine need of the arrival. So Yablo's theory accounts for Engineer and how it is different from Early Preemption.

Kiss appears to be a problem for Yablo. You might think that the kiss also does not count as a cause according to DM-6 for the following reason: The kiss contributes to Billy's

19 See Paul and Hall (2013, section 2.3.3) for an in-depth discussion and criticism of Yablo's reductive account.

whistling by putting Billy in the right mood for whistling, but Billy's whistling would not have been in need of that contribution if the kiss had not also prevented Billy from going to the store where the tune would have got stuck in his head. However, Yablo argues that his account distinguishes Kiss from Engineer and correctly treats Suzy's kiss as a cause. Here is the relevant passage in full:

> The kiss is among the causes of the whistling. But [Kiss] is not really typical of switching cases, or at least, it is missing features present in ''pure'' cases like [Engineer]. The effect's fallback needs (its needs absent the kiss) are heavily weighted toward the period after Billy leaves the coffee shop. They include, for instance, Billy's deciding to drop into that particular store, the store's staying open until he arrives, the playing of that particular tune, and so on. It is because Suzy's kiss relieves the effect of this heavy burden of late-afternoon needs that we are ready to accept it as a cause. (Yablo 2004, p. 136)

Yablo argues that the kiss causes Billy's whistling because it relieves it of needs such as Billy deciding to visit the store and the store's staying open. These needs are genuine because Billy's whistling still would have been in need of them if Suzy had not kissed Billy.

My criticism of Yablo's account is that even if this is an adequate account of Kiss, Yablo cannot give the same treatment in a counterfactual scenario where Suzy does not kiss Billy:

> *Missed Opportunity.* Suzy has long wanted to kiss Billy, but when the opportunity comes she feels embarrassed and only greets him with a formal handshake after which they have their usual pleasant coffee together. Billy, disappointed that Suzy did not kiss him, listlessly takes care of various errands, and in one of the stores he visits, he hears a tune that sticks in his head, and consequently he whistles it on his way home. What would have happened if Suzy had not felt embarrassed but kissed Billy? Billy would have been thrilled—for he has long been secretly in love with Suzy as well and they would have spent the afternoon together. Much later, as he would have been giddily walking home, he would have whistled a certain tune. And let us stipulate that matters are rigged in such a way that the time and manner of the whistling would not have differed at all.

It is natural to describe Suzy's embarrassment as a cause of Billy's whistling. But Yablo cannot account for this judgment. First, Suzy's embarrassment does not relieve the whistling of any needs it otherwise would have had. On the contrary, Suzy's embarrassment creates additional needs, namely the very needs her kiss would relieve, such as the store staying open, the tune being played in the store, etc. Maybe there is some other need of the whistling that Suzy's embarrassment does relieve. However, it is hard to see what that need could be, and there is certainly no heavy burden of such needs.

Second, you might think that the case is analogous to Early Preemption and that Suzy feeling embarrassed meets some need that would have been met by a different event if Suzy had not felt embarrassed. Yablo's criteria for two events meeting the same need require that the events can be paired off in a way that preserves salient features such as "energy expended, distance traveled, time taken, place in the larger structure of needs." (Yablo 2004, p. 126).

The two alternative causal routes, however, are so different that it is hard to see which event in the scenario where Suzy does kiss Billy could match Suzy's embarrassment in the actual scenario. Suzy's embarrassment contributes to the whistling by sending Billy on his way running errands, whereas the alternative causal sequence involves a romantic afternoon. (Note that this incommensurability between the two sequences is the very reason why my account allows for Suzy's embarrassment to be a cause: the two sequences constitute different causal processes.) So Yablo's account cannot explain our judgment about Missed Opportunity. I conclude that alternative accounts of difference-making all fail to explain cases that my account can explain.[20]

References

Broadbent, A. (2012) "Causes of Causes," *Philosophical Studies* **158**: 457-476.

Collins, J. (2004) "Preemptive Prevention," in: Collins, J., N. Hall, and L. A. Paul (eds.) *Causation and Counterfactuals*. Cambridge: MIT Press, 107–118.

Dowe, P. (1992) "Wesley Salmon's Process Theory of Causality and the Conserved Quantity Theory," *Philosophy of Science* **59**: 195-216.

Ehring, D. (1997) *Causation and Persistence*. New York: Oxford University Press.

Fair, D. (1979) "Causation and the Flow of Energy," *Erkenntnis* **14**: 219-50.

Hall, N. (2000) "Causation and the Price of Transitivity," *Journal of Philosophy* **97**: 198-222.

Hall, N. (2004) "The Intrinsic Character of Causation," *Oxford Studies in Metaphysics. Vol. 1*. Oxford: Oxford University Press, 255-300.

Hall, N. (2007) "Structural Equations and Causation," *Philosophical Studies* **132**: 109-136.

Halpern, J. Y. & Pearl, J. (2005) "Causes and explanations: A structural-model approach. Part I: Causes," *British Journal of the Philosophy of Science* **56:** 843-887.

Hitchcock, C. (2001) "The Intransitivity of Causation Revealed in Equations and Graphs," *Journal of Philosophy* **98**: 273-299.

Hitchcock, C. (2007) "Prevention**,** Preemption, and the Principle of Sufficient Reason," *Philosophical Review* **116**: 495–532.

Hitchcock, C. (2009) "Structural Equations and Causation: Six Counterexamples," *Philosophical Studies* **144**: 391–401.

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20 Some philosophers appeal to contrasts (e.g., Schaffer 2005, Strevens 2008: sect. 6.5) or the default/ deviant distinction (see, e.g., Hall 2007, Hitchcock 2007, and Hüttemann 2013) to do similar work as I do with processes. However, there still are many open questions about these approaches (see Paul and Hall 2013, pp. 51–52 and pp. 110–111). Broadbent (2012) defends a necessary condition for causation in terms of effects making a difference to their causes. But this proposal, while interesting, does not capture the original idea that causes make a difference.

Hüttemann, A. (2013) “A Disposition-Based Process Theory of Causation,” in: Mumford, S., and M. Tugby (eds.) *Metaphysics and Science*. Oxford: Oxford University Press, 101–122.

Lewis, D. (1986) “Causation,” in: *Philosophical Papers 2*. Oxford: Oxford University Press, 159–213.

Lewis, D. (2004): “Causation as Influence," in: Collins, J., N. Hall, and L. A. Paul (eds.) *Causation and Counterfactuals*. Cambridge: MIT Press, 75–106.

McDermott, M. (1995) “Redundant Causation,” *British Journal for Philosophy of Science* **46**: 523–44.

Paul, L.A. (2000) “Aspect Causation,” *Journal of Philosophy* **97**: 235–256.

Paul, L.A., and N. Hall (2013) *Causation: A User’s Guide*. Oxford University Press.

Salmon, W. (1994) “Causality Without Counterfactuals,” *Philosophy of Science* **61**: 297–312.

Sartorio, C. (2005) “Causes as Difference-Makers,” *Philosophical Studies* **123**: 71–96.

Sartorio, C. (2013) “Making a Difference in a Deterministic World,” *Philosophical Review* **122**: 189–214.

Schaffer, J. (2001) “Causes as Probability Raisers of Processes,” *Journal of Philosophy* **98**: 75–92.

Schaffer, J. (2005) “Contrastive Causation,” *Philosophical Review* **114**: 327–358.

Steward, H. (2013) “Processes, Continuants, and Individuals,” *Mind* **122**: 781–812.

Strevens, M. (2004) “The Causal and Unification Approaches to Explanation Unified—Causally,” *Noûs* **38**:154–176.

Strevens, M. (2008) *Depth*. Cambridge: Harvard University Press.

Strevens, M. (2012) “Replies to Weatherson, Hall, and Lange,” *Philosophy and Phenomenological Research* **84**: 492–505.

Woodward, J. (2003) *Making Things Happen*. New York: Oxford University Press.

Yablo, S. (2002) “De Facto Dependence,” *Journal of Philosophy* **99**: 130–148.

Yablo, S. (2004) “Advertisement for a Sketch of an Outline of a Proto-Theory of Causation,” in Collins, J., N. Hall, and L. A. Paul (eds.) *Causation and Counterfactuals*. Cambridge: MIT Press, 119–138.