Reply to Commentaries on 'Factual Difference-Making'

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Abstract

In response to the commentaries on 'Factual Difference-Making', we refine our analysis of causation. We argue that our refinements succeed in dealing with all the counterexamples leveled against our analysis.
Keywords. Causation; Difference-Making; Factual Conditionals; Deviancy; Indeterminate Causation; Graded Causation.

1 Introduction

We argued in our lead article that causation is perhaps better understood in terms of factual rather than counterfactual difference-making. If so, a research program is born which seeks to analyse causation in terms of the new notion of factual difference-making. Roughly, an occuring event C makes a factual difference to another occurring event E iff there is a state minimally unsettled on C and E, in which the assumption of C settles E. The general notion of factual difference-making can be spelled out in different frameworks, for example in belief revision theory (Andreas and Günther, 2020), in Halpern and Pearl's (2005) causal models (Andreas and Günther, 2021), and in our causal models (Andreas and Günther, 2022).

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We see the concrete analysis we provided in the lead article as a first attempt to improve on. In this vein, Christopher Hitchcock (2025, p. 1) thinks that our approach to analysing causation is 'promising' and Ned Hall (2025, p. 1) says that our analysis strikes him as 'a welcome addition to the pantheon of analyses of causation, one whose novelty and ingenuity will repay close study as well as further development.'

Our concrete analysis is developed within our framework of structural equation models. It takes causal models as input without addressing the meaning and foundations of structural equations, as Brad Weslake (2025), Jennifer McDonald (2025), Lennart Ackermans (2025), and Hall (2025) point out. However, we have offered reductive analyses of causation which aim to answer these questions in Andreas and Günther (2024b,a) and our forthcoming book *From Reasons to Causes* (Andreas and Günther, forthcoming). Both propose a foundation of structural equations inspired by the best system account of lawhood. Each proposal is centered on the notion of a *non-redundant regularity* and has no need for counterfactuals.

Structural equations can but need not be understood in terms of counterfactuals—pace Hoffmann-Kolss (2025b). We have, for example, shown that binary structural equations can be understood as direct non-redundant regularities, which can be reduced to true propositions of particular fact. This approach avoids the model relativity of causation by *metaphysically direct* regularities that remain non-redundant under any apt extension of the causal model under consideration (Andreas and Günther, 2024b, Section 5). We could adopt this approach to the model relativity of our analyses in terms of factual difference-making. Doing so would also partially answer McDonald's (2025) question 'which causal models are apt?'

We think leaving the meaning and foundation of structural equations open is justifiable in a programmatic paper that sets forth the notion of factual difference-making—a notion that is compatible with many ways of how to interpret structural equations, as Ackermans (2025, p. 6) observes. It should be noted that the understanding of structural equations in terms of counterfactuals is not without its difficulties. This approach inherits all the problems of Lewis's (1979) attempt to base the direction of causation on the semantics of counterfactuals and the overdetermination thesis. We explain these problems before adding a new one in Andreas and Günther (forthcoming, Ch. 9, Sections 7&8).

In what follows, we reply to the challenges raised in the commentaries. We refine our preliminary analysis in response to Hall's (2025) counterexamples Redundant Joint Causation and Tampering in sections 2 and 3, respectively. We defend the use of a deviancy condition against Weslake's (2025) argument to the contrary in Section 4 and repair our deviancy condition in Section 5 in response to his challenge that there seem to be causal scenarios where deviancy plays no role at all. We follow Weslake's proposal to solve switching scenarios by adopting a version of Sartorio's (2005) *Causes as Difference-Makers* principle in Section 6. We show how our repaired deviancy condition solves Hitchcock's (2025) Sprinkler scenario in Section 7 and tackle his Blow Off scenario in Section 8.

We answer McDonald's (2025) challenge of causal relativism in Section 9. We show how our refined analysis can handle Wysocki's (2025) counterexamples to our original analysis in sections 10, 11, and 12, respectively. Notably, our refined analysis is the first advanced account of causation that solves the Cuckoo's Nest. In Section 13, we answer Hoffmann-Kolss's (2025b) challenge by extending our analysis to cover *indeterminate* causation. In Section 14, we provide an algorithm for Kominsky and Phillips's (2025) extension of our original analysis to *graded* causation. We discuss Ackermans's (2025) claim that our original analysis is equivalent to a counterfactual account in Section 15. Section 16 concludes by summarizing our refined analysis—an analysis that can solve all genuine counterexamples put forth in the commentaries.

We would like to thank all commentators for their highly valuable and inspiring challenges and suggestions. They allowed us to further improve our analysis in terms of factual difference-making. We could not discuss all of their worries for lack of space. But some of them are addressed elsewhere. An extension of our framework of causal models to non-binary variables may be found in Andreas and Günther (forthcoming, Appendix A, Section 6). We also clarify there how our causal models differ from Halpern and Pearl's (2005) and why.

2 Redundant Joint Causation

In his insightful commentary, Ned Hall (2025) provides a genuine counterexample to our analysis—a causal scenario of *redundant joint* causation. We reproduce his neuron diagram for convenience:

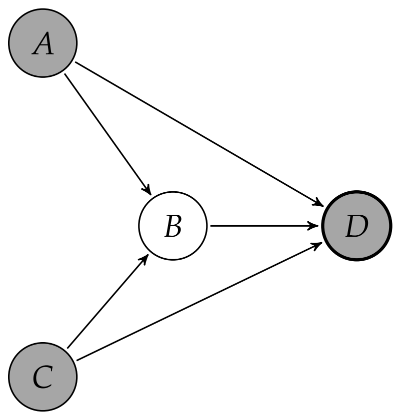


Figure 1: Redundant Joint Causation

The joint part of the scenario is that both occurring events, C and A, are needed for the occurrence of event D. If C and A occur, B will not occur, and then C and A jointly cause D's occurrence. The redundant part is that the event C alone would be sufficient for the effect D to occur without the occurrence of event A. If only C were to occur, B would occur, and they would then jointly cause D's occurrence. Symmetrically, if only A were to occur, B would, and they would jointly cause D's occurrence. It's no option to deny that C is a cause of D. By symmetry, A would then not be cause of D either. But D's occurrence is not uncaused. We have established that C and A are causes—redundant joint causes—of D. Indeed, C intuitively makes a factual difference to D.

The causal scenario of redundant joint causation may also be described as one of *tampering*: the occurring event C causally contributes to the effect D while at the same time tampering with the $A - B - D$ process by reducing the causal contribution of A via B to the effect.

Our analysis in Andreas and Günther (2025) neither counts C nor A as a factual difference-maker of D. The reason is that there is no state $\langle M', V' \rangle$ such that D is not settled and C causally implies D in the state $\langle M', \emptyset \rangle [V']$. In response, Hall suggests to extend our test for factual difference-making: the occurring event C makes a factual difference to the occurring event D iff it does so on our analysis—$\langle M, V \rangle \models C \gg D$—*or* $\langle M, V \rangle [V'] \models C \gg D$, where $V' \subseteq V$ is such that $\langle M, V' \rangle$ is minimally unsettled on C and D. We think Hall's suggestion is an elegant solution for the present scenario. But we do not endorse it. The suggestion fails to work for a tampering scenario, as Hall observes in Section 4 of his commentary. And it backfires for certain switching scenarios, such as the simple switch in Andreas and Günther (2024b).

Hall's suggestion nonetheless merits further examination. It works for the present scenario of redundant joint causation because it allows cancelation of the causal arrows to the variable B by permitting consideration of $\langle M, V \rangle [\{B\}]$ in the test for factual difference-making. When testing whether C is a cause of D, we do not want to cancel the arrow from C to B because B is a descendant of C. Hall's suggestion inspired us to provide a solution by cancelling only the arrow from A to B.

Standard interventions on a variable in causal models cancel all arrows to this variable. We want a less invasive operation of intervention. Rather than replacing a structural equation by a determinate value, an *indeterminate intervention* on a variable A relative to B modifies the equation of B. Such an indeterminate intervention allows us to cancel the arrow between A and B without cancelling the other arrows to B.

To define indeterminate interventions, we introduce the notion of an *indeterminate variable*. Such a variable is indeterminate twice over: its value is indeterminate and so are its relations of identity to the 'ordinary' variables in the causal model $\langle M, V \rangle$. Indeterminate variables have no occurrences in the literals V. They allow us to remove a single arrow from A to B: we replace all occurrences of A in the structural equation of B by an indeterminate variable U.

For Hall's scenario of redundant joint causation, an indeterminate intervention on A relative to B turns the structural equation

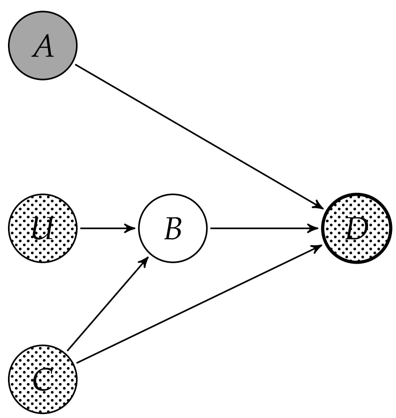
$$B = (A \land \neg C) \lor (\neg A \land C)$$

into

$$B = (U \wedge \neg C) \vee (\neg U \wedge C).$$

The indeterminate intervention replaces the arrow from A to B by one from U to B. Everything else stays the same in the resulting causal model $\langle M', V \rangle$, in particular the arrow from C to B is still in place. $\langle M', V \rangle$ is unsettled as to whether A and U are identical. Neither U nor $\neg U$ is a member in V.

Our analysis extended by indeterminate interventions counts C as a factual difference-maker of D. For this to be seen, consider the causal model $\langle M', V' \rangle$ unsettled on C and D:



$B = (U \wedge \neg C) \vee (\neg U \wedge C)$ $D = (A \wedge C) \vee (A \wedge B) \vee (C \wedge B)$
$A, \neg B$

Figure 2: Unsettled model for Redundant Joint Causation

It holds that $\langle M', \varnothing \rangle [V'][C] \models D$, where V' is maximal among the sets $V'' \subseteq V$ such that $\langle M', V'' \rangle$ is unsettled on C and D. Recall that the indeterminate variable U is possibly identical with the variable A. Therefore, $\langle M', V' \rangle$ entails nothing that contradicts the original model $\langle M, V \rangle$. Our extension is one way to save our concrete analysis from Hall's counterexample in line with the general idea of factual difference-making.

It's striking that indeterminate interventions solve all the problems which motivated a transformation of $\langle M, V \rangle$ into a causal model $\langle M', V \rangle$ such that $M' \subseteq M$ and M' contains the structural equations of C's descendants.[1]

[1] Take for example the famous boulder scenario, as described in Section 5.3 of An-

It's just important to keep in mind that we must not intervene—by an indeterminate intervention—on a descendant of the candidate cause C or C itself. The rationale for this constraint is that we want to preserve the causal connection, if there's any, from the candidate cause to its effect.

Hall's counterexample led us to a refinement of our preliminary analysis that solves redundant joint causation.

Definition 1. $\langle M, V \rangle \models C \gg E$
Let $\langle M, V \rangle$ be a causal model. $\langle M, V \rangle \models C \gg E$ iff there is $V' \subseteq V$ and M' such that

(i) $\langle M', V' \rangle$ is unsettled on C and E,

(ii) there is no $V'' \subseteq V$ such that $V' \subset V''$ and $\langle M', V'' \rangle$ is unsettled on C and E,

(iii) $\langle M', \emptyset \rangle [V'][C] \models E$, and

(iv) M' is just M or obtained from M by indeterminate interventions on non-descendants of C other than C.

Indeterminate interventions introduce a way to unsettle the value of a variable which differs from removing literals and entire structural equations. Hence, a final analysis should impose a deviancy condition on the literal or value of the variable on which an indeterminate intervention is performed. Otherwise, there will be issues with causal scenarios like bogus prevention.

3 Tampering

We show now that our indeterminate interventions also solve Hall's second counterexample—a causal scenario of *tampering*. Let us first provide a

dreas and Günther (2025): an indeterminate intervention on F relative to B yields a causal model $\langle M', V \rangle$ from which we can obtain an unsettled model $\langle M', V' \rangle$ such that $\langle M', V' \rangle [V'][D] \models \neg E$. By means of indeterminate interventions we can thus show that ducking makes a factual difference to the hiker remaining unscathed, as desired.

story for Hall's (2025) neuron diagram of tampering. Billy's parents want to give him a new bike for his 15th birthday. His parents are economically independent from one another. His dad is willing to pay the full amount. If Billy's mom were not to contribute, his dad would buy the bike and gift it to Billy on his own. But his mom wants to make an equal contribution so that his dad ends up only paying half the sum. Both contributions are causes of Billy's having a new bike. This is what it means that the new bike is a gift from both parents.

Hall points out that our analysis in Andreas and Günther (2025) fails to count the mother's intention to contribute (C) as a cause of Billy's receiving a new bike (E). However, our just developed indeterminate interventions solve the problem. We reproduce Hall's neuron diagram and causal model for convenience:

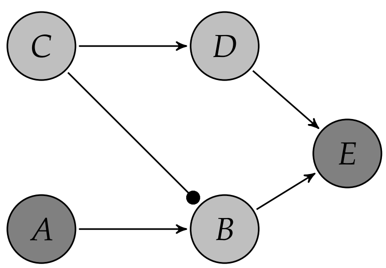
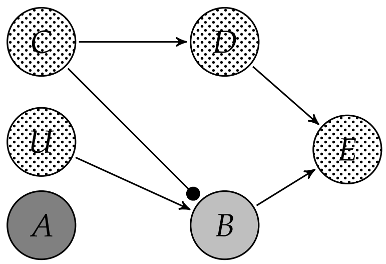


Figure 3: Tampering

$$D = C$$
$$B = A - C$$
$$E = 1 \text{ if } B + D \geq 10; 0 \text{ otherwise}$$
$$C = 5, A = 10, D = 5, B = 5, E = 1$$

We need to specify the range of an indeterminate variable in an indeterminate intervention as soon as non-binary variables are involved. We stipulate that the range of an indeterminate variable must be greater or equal to the range of the variable intervened upon. We can thus make an indeterminate intervention on the binary variable A relative to the ternary variable B such that the indeterminate variable U has the range $\{1, 2, ..., 10\}$. This intervention turns the equation $B = A - C$ into $B = U - C$. Everything else remains the same in the resulting causal model $\langle M', V \rangle$.

From $\langle M', V \rangle$ we obtain a model $\langle M', V' \rangle$ which is unsettled on $C = 5$ and $E = 1$:



$$D = C$$
$$B = U - C$$
$$E = 1 \text{ if } B + D \geq 10; 0 \text{ otherwise.}$$
$$A = 10, B = 5$$

Figure 4: Unsettled model for Tampering

$E = 1$ follows from $C = 5$ in the presence of the structural equations M' and the literals V'. In formal terms, $\langle M', \emptyset \rangle [V'][C = 5] \models E = 1$. It is easy to show that V' is maximal among the sets $V'' \subseteq V$ such that $\langle M', V'' \rangle$ is unsettled on $C = 5$ and $E = 1$. We have shown that C is a factual difference-maker of E on our refined analysis, as desired.

4 For Deviancy

Brad Weslake (2025) argues that no theory of causation should impose a deviancy condition. So why should deviancy matter for causation at all?

Well, suppose there is no deviancy condition on causation. This has undesirable consequences. First, there would be no distinction between prevention and bogus prevention. Either there would be no causation by prevention at all, and so no distinction between genuine and bogus prevention, or else there would be causation by prevention but then all bogus preventers would count as genuine preventers and so genuine causes. Either bodyguard's administration of antidote is not a cause of victim's survival even if the victim has been poisoned, or bodyguard's administration is a cause of victim's survival even if the victim has not been poisoned in the first place. The second horn of this dilemma is one of the main reasons why the leading counterfactual accounts of causation impose deviancy or normality conditions. Otherwise, they could not distinguish genuine from bogus preventers (see, for example, Halpern and Hitchcock (2015)).

Second, there would be no distinction between causal and non-causal omissions. There would either be no causation by omission at all, or too much causation by omission. Either my neighbor's failure to water my plants after promising to do so is not a cause of my plants's dying, or else Putin's failure to water my plants, and Trump's failure to water my plants, and so on are all causes of my plants's dying (Beebee, 2004; McGrath, 2005). Causes abound for my plants's dying. In general, many events and absences could have been prevented if someone had interfered. My present absence from any place but here, for example, is then caused by my failure to travel there. This proliferation of causes is, at the very least, not economical.

The proliferation of causal omissions leads to further troubles under a standard view of responsibility: an agent is responsible for some outcome if the agent caused the outcome, the agent foresaw the outcome, and the agent intended the outcome. Let us say Putin foresaw that his failure to water my plants would lead to their death, intended this outcome, but did not promise to water them. If his omission is also a cause of the death of my plants, the view entails that he is responsible for this outcome. But he is not. Although he foresaw and intended the death of my plants, he did not cause it. He had bad intentions, but *he didn't cause it by failing to act*.

My neighbor, on the contrary, promised to water the plants, and so she is responsible for the death of my plants if she foresaw and intended that they die due to her failure to act. *She caused their death by failing to act*. The first horn—there is no causation by omission at all—is therefore no option either, at least if we do not abandon the standard view that an agent is responsible for an outcome only if the agent caused the outcome. We think this abandonment would be too costly.[2]

We have argued for the view that causation depends on defaults and what norms are active in a causal scenario. The view entails that normal, or equivalently non-deviant, events and absences are no causes. I am, for example, currently not in Italy. If my present absence from Italy is default,

[2]Hitchcock (2025) asks what the function of actual causation is (see also Hitchcock (2017) and Fischer (2024b,a)). A key function is that it figures in causal explanations of why a particular fact obtained. A related function is that it serves as a necessary condition for attributions of moral and legal responsibility. A complete answer must be given elsewhere for lack of space.

it is not a cause of any event or absence. However, we endorse only a specific version of the view we argued for, as will become clear in the next section.

5 Repairing Our Deviancy Condition

Weslake (2025) does not only attack the idea of imposing any deviancy condition on causation, but also our deviancy condition in particular:

> for any literal $C' \in V \setminus V'$ whose variable is neither a descendant nor an ancestor of C, C' is more deviant than $\neg C'$. (Andreas and Günther, 2025, p. 26)

We agree with Weslake that our deviancy condition needs repair. In particular, we need to supplant our original definition of a literal's deviancy by new definitions of deviancy and weak deviancy. Let N be the set of norms active in the scenario under consideration and the defaults. The defaults are generated by the *absence rule*: by default, an event is absent.[3]

We say a literal L is *weakly deviant* relative to a set N of active norms and defaults iff there is a consistent subset of N which entails L's complement. We say a literal L is *deviant* relative to N iff there is some subset of N which entails L's complement but there is no such subset for L itself. Note that a literal's deviancy implies its weak deviancy.

It follows that any occurring event is weakly deviant because N entails its absence. Moreover, an occurring event is deviant only if it is not entailed by the set of norms active in the scenario under consideration. Intuitively, an occurring event is deviant only if it does not conform to the active norms.

An absence cannot be deviant, merely weakly deviant. An absence is weakly deviant and weakly normal iff its corresponding occurring event

[3]See Andreas and Günther (forthcoming, Ch. 5, Section 2) for a justification of the absence rule.

is entailed by the norms active in the scenario under consideration. Intuitively, an absence is weakly deviant and weakly normal iff it violates the set of active norms.

Let's say that a literal is a descendant of another literal iff the variable of the former is a descendant of the variable of the latter. Our repaired deviancy condition reads as follows:

(5) C is weakly deviant and any other literal C' in $V \setminus V'$ is deviant unless it is a descendant of C in M'.

Our new definition of a literal's weak deviancy may apply even when our intuition does not detect deviancy. But it is strong enough together with the repaired deviancy condition to preserve our treatment of preventions and omissions. Our new definitions make possible a unified notion of causation.

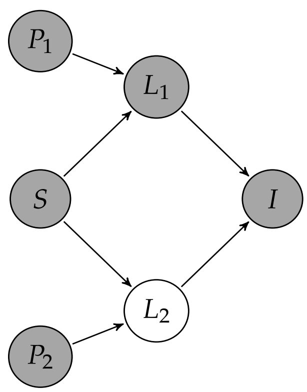
One of Weslake's (2025) reasons against imposing any deviancy condition is that there seem to be causal scenarios where norms play no role at all. To use his example, the switch being in position 1, rather than position 2, is a cause of the light being blue, rather than green. He argues that this is so independently of deviancy considerations. By our definition, however, the switch being in position 1 is at least weakly deviant because it is an occurring event. Hence, the switch being in position 1 is a cause on our refined analysis.[4]

6 Expanded Switch

Weslake (2025) challenges our analysis by an expanded switch. We are grateful for the clear presentation of this genuine counterexample to our

[4]Here is a brief comparison of two causes, a norm-violating occurring event and a norm-conforming occuring event. Suppose your son promises *not* to do his homework but then does it. His doing of the homework is then deviant by being an occurring event and violating the norm of promise-keeping. By contrast, suppose your son promises to do his homework and does so. His doing of the homework is weakly deviant because it is an occurring event. In fact, doing the homework can cause him to pass the test the next day. He may even be praised for doing his homework as he promised.

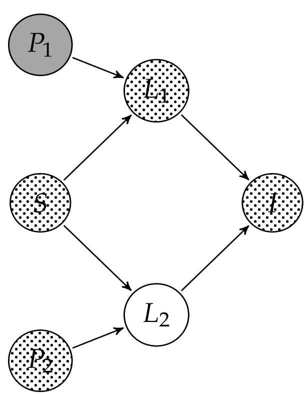
analysis and for his proposal to remedy the situation. The scenario can be summarized as follows. Light one is on (L_1) iff the switch is in position one (S) and light one is plugged in (P_1). Light two is on (L_2) iff the switch is in position two ($\neg S$) and light two is plugged in (P_2). The room is illuminated (I) iff light one is on (L_1) or light two (L_2). Here is Weslake's directed graph and causal model of the expanded switch:



$L_1 = S \wedge P_1$ $L_2 = \neg S \wedge P_2$ $I = L_1 \vee L_2$
$P_1, S, P_2, L_1, \neg L_2, I$

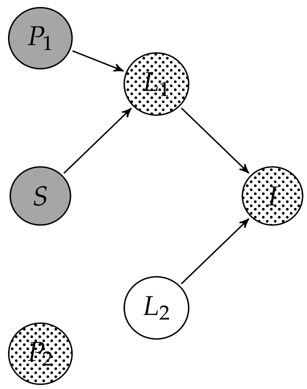
Figure 5: Expanded Switch

The following causal model $\langle M, V' \rangle$ is minimally unsettled on S and I:



$L_1 = S \wedge P_1$ $L_2 = \neg S \wedge P_2$ $I = L_1 \vee L_2$
$P_1, \neg L_2$

Intervening by V' and S yields:



$L_1 = S \wedge P_1$
$I = L_1 \vee L_2$
$P_1, S, \neg L_2$

This causal model determines I to be true. In symbols, $\langle M, \emptyset \rangle [V'][S] \models I$. And the switch being in position one (S) is an occurring event. Hence, the occurring event that the switch is in position one (S) is a cause of the room being illuminated (I) on our analysis. But this verdict is wrong.

Weslake proposes to rely on the *Causes as Difference-Makers* principle proposed by Sartorio (2005, p. 75):

> If C caused E, then, *had* C not occurred, the absence of C wouldn't have caused E. (our emphasis)

As Weslake (2025, p. 14) points out, our analysis can be extended to satisfy the principle by a third condition: if C had not occurred, $\neg C$ would not make a factual difference to E. We add that factual difference-making should here be understood without the deviancy condition. Otherwise, the third condition would be satisfied by any default absence $\neg C$. This solves the expanded switch and all other switching scenarios we are aware of.

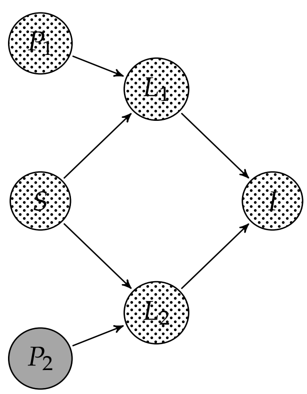
The absence of C is a counterfact in Sartorio's principle because C is a fact if C causes E. As it turns out, the extension of our analysis does not need the supposition of the counterfact *had* C *not occurred* in her principle to treat switches. Hence, we extend our analysis to satisfy the simpler principle omitting the counterfactual supposition:

> If C caused E, then the absence of C wouldn't have caused E.

The idea is that C is a cause of E iff both are facts, C makes a factual difference to E, and $\neg C$ would not make a factual difference to E. We define:

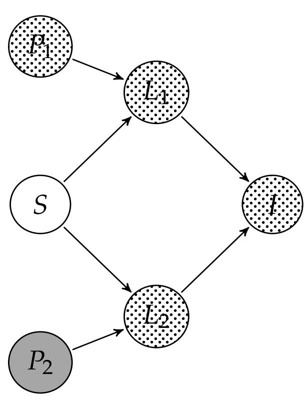
> C is a cause of E relative to $\langle M, V \rangle$ iff
>
> (C1) $\langle M, V \rangle \models C \wedge E$,
>
> (C2) $\langle M, V \rangle \models C \gg E$, and
>
> (C3) it is not the case that $\langle M, V \rangle \models \neg C \gg_{\backslash d} E$, where $\gg_{\backslash d}$ denotes our settling conditional without the deviancy condition.

The last condition (C3) is not satisfied in the expanded switch because it is the case that $\langle M, V \rangle \models \neg S \gg_{\backslash d} I$. For this to be seen, consider the causal model $\langle M, V' \rangle$ which is minimally unsettled on $\neg S$ and I:



$L_1 = S \wedge P_1$ $L_2 = \neg S \wedge P_2$ $I = L_1 \vee L_2$
P_2

Intervening by V' and $\neg S$ yields:



$L_1 = S \wedge P_1$ $L_2 = \neg S \wedge P_2$ $I = L_1 \vee L_2$
$\neg S, P_2$

This causal model determines I to be true. In symbols, $\langle M, \emptyset \rangle [V'][\{\neg S\}] \models I$. Hence, S is not a cause of I, as desired.

Adopting Sartorio's principle, or our simpler version thereof, may come at a cost. It seems to us that the principles rely on a counterfactual. If C causes E, C and E are facts. The absence of C is then contrary-to-fact in Sartorio's principle and the simpler version. Our main goal in the lead article was to propose the notion of factual difference-making as an alternative to counterfactual difference-making. We still do not employ counterfactuals of the form 'If a cause had not occurred, its effect would not have occurred'. However, by relying on the simplified version of Sartorio's principle, we lose the stark contrast to accounts of counterfactual difference-making to this extent: we need to suppose a counterfact in order to check for causation. Perhaps the principle is worth the cost because it allows for a unified treatment of switches. We discuss Sartorio's principle and switches in more detail in Andreas and Günther (forthcoming, Chs. 3&5).

7 Sprinkler

Hitchcock (2025) challenges our analysis by a sprinkler scenario. He assumes that the following story of the scenario fits the standard scenario of early preemption:

> **Sprinkler**: I plan to be away, and the timer on my automatic sprinkler system is broken so the sprinkler rarely comes on when it is supposed to. I ask my trusty neighbor to water my outdoor plants while I am away. Setting out to do so, she turns on the faucet that supplies water to my garden hose (A). She is about to pull the handle on the nozzle of the hose to spray water on the plants. Unexpectedly, the sprinkler system activates (C). As a result, my neighbor does not spray water with the hose ($\neg B$). The sprinkler sprays water on the plants (D) and the plants get wet (E).

Hitchcock argues as follows. The occurring event A—turning on the faucet—is more normal than its absence because the trusty neighbor promised to water the plants. The activation of the sprinkler system (C) is therefore no cause of the plants getting wet (E) on our analysis. For this to be seen, note that the causal model $\langle M, \{\neg B\}\rangle$ settled only on the failure of my neighbor to spray water with the hose is the only causal model that satisfies conditions (1)-(4). In this causal model, A is a literal in $V \setminus V'$ whose variable is not a descendant of C, and yet A is more normal than $\neg A$ on our original definition of deviancy. Hence, the causal model violates our deviancy condition of the lead article.

Recall that we have refined our analysis above by repairing the deviancy condition and by indeterminate interventions. There is a causal model $\langle M', V'\rangle$ unsettled on C and E for $V' = \{A, \neg B\}$ and M' obtained from M by an indeterminate intervention on A relative to B, replacing $B = A \wedge \neg C$ by $B = U \wedge \neg C$. The neighbor's turning on the faucet (A) is only weakly deviant because it is a norm-conforming occurring event. However, A is not in $V \setminus V'$. As any literal in $V \setminus V'$ is deviant, our repaired deviancy condition is satisfied in Hitchcock's Sprinkler. It follows that the activation of the sprinkler system (C) is a cause of the plants getting wet (E) on our refined analysis, as desired.

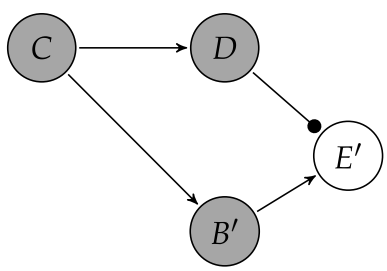
8 Blow Off

Hitchcock (2025) levels another putative counterexample to our deviancy condition. The informal story is as follows:

> **Cover**: A horticulturist has told me that my plants have been over-watered and that they should not receive any more water for at least a week. My unpredictable sprinkler system begins to activate (C). I hear this. Being mechanically inept, I am unable to turn off my sprinkler system. Instead, I rush out and cover my plants (D). The sprinkler system sprays water (B') but the plants do not get wet ($\neg E'$) .

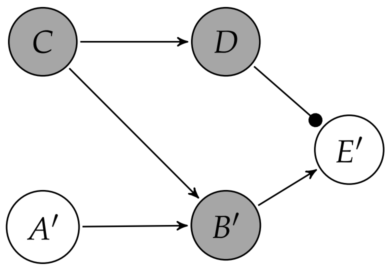
Blow Off: Before the horticulturist told me that my plants were over-watered, I had plans to travel, and asked my trusty neighbor to water the plants while I was away. The neighbor promised to do so. Then, a minor emergency forced me to cancel my travel plans, and in the ensuing confusion I forgot that the neighbor had promised to water the plants, and I did not inform her that my plans had changed. My neighbor is more mechanically inclined than me, so she planned to water the plants by manually activating the sprinkler system. Moreover, she planned to do this at a particular time of day when I was briefly away from home. If she had followed through on her plans, I would not have been able to cover the plants and they would have gotten wet. Uncharacteristically, however, my neighbor decided to blow off her watering responsibilities and never activated the sprinkler system ($\neg A'$). When I returned, events unfolded as described in Cover. $(C, D, B', \neg E')$.

Here are Hitchcock's formal representations of these two causal scenarios:



$$D = C$$
$$B' = C$$
$$E' = \neg D \wedge B'$$
$$C, D, B', \neg E'$$

Figure 6: Cover



$D = C$
$B' = C \vee A'$
$E' = \neg D \wedge B'$
$C, \neg A', D, B', \neg E'$

Figure 7: Blow Off

Our analysis has no problems with Cover, as Hitchcock notes. However, he argues that our analysis counts the activation of the sprinkler (C) as a cause of the plants remaining dry ($\neg E$) in Blow Off. We agree with his formal argument based on his causal model. But we take issue with his formal representation of the informal story.

Hitchcock's informal story of Blow Off implies this counterfactual: 'if my neighbor had activated the sprinkler (A'), I would not have been able to cover the plants ($\neg D$).' But this counterfactual is false according to Hitchcock's causal model. An intervention by A' *in the causal model* does not change the fact that the unpredictable sprinkler activates (C), and so that you cover your plants (D). His causal model does not capture all relevant counterfactual dependences of the informal story.

The underlying issue seems to be that Hitchcock's causal model does not distinguish between two activations of the same sprinkler, but the informal story does. My neighbor's merely planned activation of the sprinkler at one time differs from the spontaneous activation later on. If my neighbor had activated the sprinkler, I would *not* have been able to cover the plants. By contrast, if there were a spontaneous activation later on, I would cover the plants. The consequences of the two activations are different, depending on whether or not I am at home when my neighbor planned to water the plants. Indeed, my neighbor's failure to activate the sprinkler during my absence from home would be a cause of my plants's not getting over-watered. My neighbor's failure to activate the sprinkler during my presence, by contrast, is not a cause of my plants's not getting over-watered. For I would have noticed it and covered the plants had my neighbor activated the sprinkler in my presence.

Still, one must wonder whether there is some scenario that fits Hitchcock's causal model of Blow Off, implies that $\neg A'$ is weakly deviant, and suggests that C is not a cause of $\neg E'$. Cover is a variant of the boulder scenario (see Andreas and Günther (2025, p. 20)). C corresponds to the boulder being dislodged, D to the hiker's ducking, B' to the boulder's rolling toward the hiker, and $\neg E'$ to the hiker's not being hit by the boulder. Suppose we extend the boulder scenario by the variable for a second boulder that may hit the hiker but is not actually dislodged ($\neg A'$). We assume that the hiker would not spot the second boulder before he gets hit. Our analysis has no troubles. The dislodgement of the first boulder (C) is not a cause of the hiker's remaining unscathed ($\neg E'$) because the non-dislodgement of the second boulder ($\neg A$) is normal. Boulders are normally not dislodged all of a sudden.

Hitchcock's point may be put as follows: what if the non-dislodgement of the second boulder were (weakly) deviant? Here is an attempt to create such a scenario by providing a background story to our extended boulder scenario. Suppose Billy joined a criminal gang. He has an order to dislodge a boulder in order to injure a hiker so that the members of the gang can rob the hiker. However, Billy fails to dislodge the second boulder. The first boulder gets dislodged, the hiker ducks, and so remains unscathed. Our refined analysis seems to run into a problem here because Billy's failure is weakly deviant on our refined definition of deviancy.

On our refined analysis, the dislodgement of the first boulder alone is not a cause of the hiker's remaining unscathed because Billy's failure to dislodge the second boulder is only weakly deviant. Billy's failure alone is also not such a cause. However, Billy's failure together with the dislodgement of the first boulder come out as overdetermining causes of the hiker's remaining unscathed. We think that's fairly plausible. Both the dislodgement of the first boulder and Billy's failure are lucky accidents. If the first boulder had not been dislodged and Billy had dislodged the second boulder, the hiker would have been injured and robbed. For the time being, our repaired deviancy condition remains defendable.

9 Causal Relativism and the Boulder Scenario

McDonald (2025) challenges our analysis by a modified causal model of the boulder scenario. In the original causal model, the boulder's dislodgement is not a cause of the hiker's survival. She proposes a causal model on which it is only possible that the *boulder is noticeably dislodged* or else *surreptitiously dislodged*. Our analysis says that the boulder being noticeably dislodged is a cause of the hiker's survival relative to her model.

For McDonald, 'we could say both that the boulder falling causes the hiker to survive [relative to one causal model or space of possibilities] and that it doesn't [relative to another].' (p. 10) This means she embraces causal relativism—the idea that an event 'can count as a cause relative to one model but not another.' (ibid.) And she adds that there 'is no further metaphysical question about which space of possibilities is priviledged—they are metaphysically on a par.' (ibid.)

However, McDonald's view of causal relativism faces a problem concerning the attribution of responsibility. If responsibility entails causation and the latter is relative, so is the former. Do we then find someone responsible who (knew that they deliberately) caused some harm according to one veridical model but not according to another? It seems that not all veridical causal models are apt—pace causal relativism.

We think McDonald's causal model is not apt for three reasons. First, her model says that the boulder rolls toward the hiker whether the boulder is noticeably or surreptitiously dislodged (and there is no other possibility). This structural equation is empirically redundant relative to McDonald's set of variables—in the sense explained in Andreas and Günther (2024b). For this reason it is ruled out by our foundation of structural equations which allows only for direct non-redundant regularities. Second, the possibilities that the boulder is either falling noticeably or else surreptitiously do not seem to be exhaustive—the possibility that the boulder is not falling is left out. The original causal model does not distinguish between the two possibilities of McDonald's model. But note that the two possibilities of the boulder either falling or not exhaust the logical space about the boulder. Third, the possibility of the boulder falling noticeably merges two distinct events: the dislodgement of the boulder and the hiker noticing it. Indeed, the dislodgement causes the hiker to notice it in the scenario.

This leads us to the following apt causal model for McDonald's boulder scenario:

$B = F$ $N = F \wedge L$ $D = N$ $E = B \wedge \neg D$
$F, L, B, N, D, \neg E$

The boulder falls (F), the hiker notices the falling boulder (N) because he, let's say, looks to the left (L), and so he ducks (D). The hiker survives ($\neg E$). All non-actual possibilities are the respective complements of the actual possibilities, and so all variables are exhaustive. Relative to this causal model, there is no dilemma for our analysis: the dislodged boulder is not a cause of the hiker's survival but his noticing the dislodgement is.[5]

10 Cuckoo's Nest

Wysocki (2025) challenges our analysis by the Cuckoo's Nest—a clever scenario no account of causation we are aware of can handle except the simple counterfactual account.

> **Cuckoo's Nest**: A patient is prescribed an antipsychotic for his hallucinations and a sedative to counteract its side effects. Unlike on other days, today the medic forgot to give the patient

[5]McDonald (2025, p. 9) claims that our analysis relies on miracles. We grant that our original analysis relies on the unsettling or suspension of a structural equation or law. However, our analysis has no need for a violation of a structural equation or law. Such a violation amounts to events that satisfy the right hand side but not the left hand side. Take one of the structural equations $B = A \wedge \neg C$ of early preemption for illustration. According to this equation, it is causally impossible that Billy's does not touch the window ($\neg B$) if Suzy were not to throw her rock ($\neg C$) and Billy were to throw his (A). Counterfactual accounts need to rely on such violations of structural equations to determine whether this is a cause of that.

the antipsychotic, without which the patient hallucinates. But like on other days, the nurse still administered the sedative.

The sedative prevents the crippling anxiety that arises when the patient takes the antipsychotic, but since he didn't take the antipsychotic, no anxiety was forthcoming today. The sedative has a side effect itself, though—hiccups. And these did happen.

a. Failing to administer the antipsychotic ($\neg A$) caused hallucinations (H).

b. Administering the sedative (S) didn't prevent anxiety, i.e., cause the lack thereof ($\neg X$).

c. Administering the sedative (S) caused hiccups (I).

The causal model is as follows:

$$\begin{array}{|l|} \hline H = \neg A \\ X = A \wedge \neg S \\ I = S \\ \hline \neg A, S, H, \neg X, I \\ \hline \end{array}$$

Wysocki (2025, p. 3) correctly observes that our analysis of the lead article wrongly counts the administration of the sedative (S) as a cause of the lack of anxiety ($\neg X$). However, our refined analysis achieves the desired verdict. Due to the absence rule, $\neg A$ is not deviant. Hence, there is no causal model $\langle M', V' \rangle$ unsettled on S and $\neg X$ which satisfies the repaired deviancy condition. The administration of the sedative comes out as a bogus preventer on our refined analysis.

Our refined analysis also counts the weakly deviant failure to administer the antipsychotic ($\neg A$) as a cause of the patient's hallucinations (H), and the administration of the sedative (S) as a cause of the hiccups (I). To our knowledge, our refined analysis is the first analysis which solves the overdetermination problem and captures all of the desired verdicts a.–c.

11 Don Quixote

Wysocki's (2025) Don Quixote example remains a problem even for our refined analysis if we don't take the foundation of causal models into account.

> **Don Quixote**: Don Quixote attacks the windmill, which collapses. Had he not attacked the windmill, Sancho would have [(S)], and the windmill would have collapsed all the same. Quixote's attack (Q) caused the collapse (W).

The causal model is as follows:

$S = \neg Q$ $W = Q \vee S$
$Q, \neg S, W$

Wysocki describes Quixote's attack (Q) as a preempting cause of the collapse of the windmill (W). However, our original and refined analyses fail to say so relative to the simple causal model. The underlying reason is that there is no model unsettled on W. S is a descendant of Q, and so its structural equation cannot be removed, and it cannot be indeterminately intervened upon. Hence, the only two possibilities consistent with the structural equations are $Q, \neg S, W$ and $\neg Q, S, W$. The causal laws alone imply that the windmill collapses since they imply that at least one cause of the collapse is present. This is not plausible and should be considered a reason for questioning whether the causal model is appropriate for the scenario.

In Andreas and Günther (2024b), we say that genuine causation is causation on the metaphysically most fine-grained level. Hence, causation can be revealed by extending an impoverished model. Extend the causal model by the true literal that Sancho is ready to attack (A). The structural equation $S = \neg Q$ then turns into $S = \neg Q \wedge A$. The collapse of the windmill is no longer causally necessitated. The extended causal model is the one of early preemption. Relative to it, our analyses say that Quixote's attack (Q) is a preempting cause of the collapse of the windmill (W). And, roughly speaking, Quixote's attack is a cause of the windmill's collapse *simpliciter* if it remains so under any apt extension of the causal model.

In the simple model of Don Quixote, his attack acts like a switch. Whether or not he attacks does not make any difference to the collapse of the windmill. Q is functionally equivalent to taking a direct train connection to some destination W and $\neg Q$ to taking an indirect connection via S to the same destination W. If you must take either the direct or indirect train connection, the causal model describes a switching scenario and so Q should not count as a cause. If, by contrast, it is causally possible that you do not take any train or there is any other causal possibility where you do not arrive at the destination for some reason, the causal model may describe a preemption scenario and so Q should count as a cause. But in the latter case, the structure of the causal model must be extended. In a realistic scenario of Don Quixote, it is causally possible that the windmills do not collapse. Hence, the simple causal model should be extended.

12 Embedded Switch

Wysocki (2025) aims to challenge our analysis by the scenario Embedded Switch. The scenario embeds a simple switch and comes in two stages:

> **Embedded Switch**: *Stage 1*. When switch C is up, wind turbine M is on and supplies energy to lighthouse E; none of that happens when switch C is down. Diverter valve L can be in two states: if up, it sends water from the river to water turbine [D]; if down, it sends water to water turbine [U]. If either turbine is in operation, power plant R generates energy and supplies it to E. The lighthouse is on if it receives energy from M or R.
>
> *Stage 2*. Switch C also controls diverter valve L: L is up/down if C is up/down.
>
> *In both stages*: switch C being up (C) causes the lighthouse to be on (E).

The diverter valve L acts like a simple switch: whether it is up or down does not make any difference as to whether the power plant R generates energy. The valve merely determines the pathway by which energy is generated, namely by either turbine D or U.

On our analyses, the switch being up (C) is a cause of the lighthouse being on (E) in *Stage 1*, and it is *not* a cause of the lighthouse being on (E) in *Stage 2*. Wysocki argues that the latter verdict is wrong. We disagree. The causal model of *Stage 2* is as follows:

$M = C$ $L = C$ $U = \neg L$ $D = L$ $R = U \vee D$ $E = M \vee R$
$C, M, L, \neg U, D, R, E$

The switch C acts like a switch, as it were. Whether or not the switch is up does not make any difference as to whether or not the lighthouse is on. The switch C being up does not determine *that* energy is supplied. The switch C merely determines the pathways by which energy is supplied to the lighthouse, namely by either the windturbine M and the water turbine D or else by the water turbine U alone.

Wysocki (2025, p. 6) argues that C is a cause of E in *Stage 2* because C is a cause of E in *Stage 1* and connecting L to C 'changes nothing consequential'. This argument pattern is not valid. Remove the structural equation $U = \neg L$ from the embedded switch $L - U - D - R$. L is now a cause of R (stage 1). With the structural equation $U = \neg L$, however, L is a switch and so no cause of R (stage 2). For this to be seen, apply the responsibility test. Suppose C in *Stage 2* stands for a person deliberately flipping the switch up. Is the person responsible for the lighthouse being on (E)? We wouldn't say so. If causation is necessary for responsibility, C is not a cause of E in *Stage 2*.

The scenarios put forth by Wysocki mean trouble for our original analysis. Our refined analysis, however, does better than any extant counterfactual alternative. As far as we know, our refined analysis is the first advanced account that can handle the Cuckoo's nest. Wysocki's (2025) Gated Switch poses no problem for the refined analysis in virtue of our condition (C3) for switches. Don Quixote is solved by truthfully extending the simple causal model. Admittedly, this move requires us to rely on our preferred substance of causation. The simple causal model of Don Quixote is intended to represent a scenario of preemption but it is also isomorphic to a causal model for a switch. It is therefore a virtue and a vice if an analysis counts Don Quixote's attack as a cause of the windmill's collapse relative to the simple model. We have also just argued that the verdict of our analyses in Embedded Switch is as desired.

13 Indeterminate Causation

Hoffmann-Kolss (2025b) challenges the factual difference-making approach by a scenario in which causation seems to be *indeterminate*. She argues that the counterfactual approach is better in this scenario because it can account for the causal indeterminacy, unlike factual difference-making. Here is the scenario first discussed in Hoffmann-Kolss (2025a, p. 261):

> **Janitor**: An hour before the start of the 10am classes, the janitor of a large university building learns that the lighting systems in four lecture rooms do not work. Fixing one of the systems takes almost an hour, so the most he can do is fix one of them. Not feeling up to discussing with the lecturers which of the systems he should fix, he decides to stay in his office and do nothing. As a result, four 10am classes must be cancelled. [...] his inaction caused someone's class to be cancelled. Now suppose that Jane was scheduled to teach in one of the four rooms. Was the janitor's doing nothing also a cause of Jane's having to cancel her class? (Hoffmann-Kolss, 2025b, p. 8)

Following Bernstein (2016) and Swanson (2017), Hoffmann-Kolss's desired verdict is that it's indeterminate whether the janitor's omission caused the cancellation of Jane's class. For this to be seen, consider two cases. Suppose first that his failure to act is a cause of Jane's class being cancelled. By parity of reasoning, his omission is then also a cause of the other classes being cancelled. But his inaction did not cause all cancellations because he could have only fixed one lighting system. Second, suppose his omission was not a cause of Jane's class being cancelled. By parity of reasoning, he did also not cause the other cancellations. But his inaction was a cause of *some* cancellation. Either supposition has false consequences, and so we should choose causal indeterminacy. Or so goes the argument in a nutshell.

Hoffmann-Kolss says that the counterfactual approach delivers the desired verdict because 'it is indeterminate which of the four rooms he would have fixed if he had decided to do something'. (p. 8) Our analysis in the lead article cannot account for the causal indeterminacy, she correctly claims, because it 'seems impossible to find a structural equation' that describes the indeterminate relation between the janitor's omission and the cancellations (p. 10). We would add that we are not alone. Any extant account in terms of the standard structural equations cannot account for causal indeterminacy, including the leading causal model accounts due to Hitchcock (2001), Halpern and Pearl (2005), Halpern (2015), and Gallow (2021)—all of which employ interventionist and determinate counterfactuals. Furthermore, Lewis's (1973) counterfactual analysis of causation does not deliver *any* verdicts of indeterminate causation because the employed counterfactuals are either determinately true or else determinately false. The Lewis counterfactual 'if the janitor had decided to do something, Jane's class would not have been cancelled' is determinately false, and so the janitor's omission is not a cause of Jane's class being cancelled on Lewis's analysis.

In fact, we are aware of only one extant counterfactual account that allows for metaphysically indeterminate causation. Swanson (2017, p. 612-8) proposes to pair Lewis's analysis with Stalnaker's (1980) supervaluationist semantics, effectively allowing for indeterminate counterfactuals and so for indeterminate causation. However, this account cannot uphold the semantic difference of might- and would-counterfactuals without resorting to Stalnaker's 'quasi-epistemic reading' of 'might'. And it inherits the shortcomings of Lewis's account. Most importantly for our concerns, however, is that what formally captures indeterminate causation are not counterfactuals by themselves but supervaluationism.

Not unlike supervaluationist accounts of semantic indeterminacy, Barnes and Williams (2011) define metaphysical indeterminacy in terms of multiple distinct actualities—multiple supercomplete precisifications of reality. It is indeterminate on this view that the janitor's omission is a cause of Jane's class being cancelled iff there is at least one superprecise actuality in which the janitor's omission is a cause of Jane's class being cancelled and there is at least one superprecise actuality in which his omission is not. An actuality is superprecise iff it is strictly more precise than the actual world. The actual world entails the janitor's omission to fix *some* lighting system ($\neg C$), but it does not entail which lighting system he fails to fix. One superprecise actuality entails that the janitor fails to fix the lighting system in room 1 ($\neg C_1$). The story suggests that there are only four such superprecise distinct actualities (because it is only possible that the janitor fixes one of the four systems in the available time). If so, the actual world is indeterminate in this sense: it is indeterminate whether the janitor's omission is a failure to fix the lighting system in either room 1, room 2, room 3, or room 4, respectively. And so there is a superprecise actuality in which his failure, let's say, to fix room 1 is a cause of Jane's class being cancelled, and there is a superprecise actuality in which his failure to fix room 2 is not a cause of Jane's class being cancelled.

Barnes and Williams's idea of metaphysical indeterminacy can also be used to represent indeterminate causation in causal models. We offer now one way to do so which may serve as a proof of concept for the proponent of indeterminate causation. This being said, we would like to remain agnostic here on whether indeterminate causation exists.

We represent the janitor example by four superprecise causal models. Each causal model contains the literals $\neg E_i$ ($1 \leq i \leq 4$) standing for the actual cancellations of the four classes. The first causal model contains, moreover, the literal $\neg C_1$ representing that the janitor fails to fix room 1 and the structural equation $E_1 = C_1$ saying that Jane's class takes place iff the janitor fixes room 1. Each of the four superprecise causal models has the same structure: model i contains $\neg C_i$ and $E_i = C_i$ ($1 \leq i \leq 4$), respectively.

The four superprecise causal models are one way to represent that it is indeterminate whether $\neg C$ *is* $\neg C_1$, $\neg C_2$, $\neg C_3$, or $\neg C_4$.

Our analysis says relative to the superprecise causal model 1 that the janitor's failure to fix the lighting system of Jane's class room ($\neg C_1$) is a cause of the cancellation of her class ($\neg E_1$)—assuming that $\neg C_1$ is weakly deviant. Relative to the superprecise causal model 2, however, it says that the janitor's failure to fix the lighting system of room 2 ($\neg C_2$) is not a cause of Jane's class being cancelled ($\neg E_1$). Hence, it is indeterminate whether $\neg C$ is a cause of $\neg E_1$: it is indeterminate whether the janitor's failure to fix *some* lighting system is a cause of Jane's class being cancelled. While it 'seems impossible to find *a* structural equation' describing an indeterminate causal relation, multiple structural equations are up to the job.

Note that the janitor's omission is a cause of *some* class being cancelled. In each superprecise causal model i, $\neg C_i$ is a cause of $\neg E_i$. Hence, it is true simpliciter—true relative to all four causal models—that $\neg C$ is a cause of some class being cancelled ($\neg E_1 \vee \neg E_2 \vee \neg E_3 \vee \neg E_4$). We have just extended our analysis of factual difference-making to cover indeterminate causation.

14 Graded Causation

The cognitive scientists Jonathan Kominsky and Jonathan Phillips observe that the

> [f]actual Difference-Making account presented by Andreas and Günther (2025) offers an elegant explanation of many otherwise puzzling patterns of causal judgments. (Kominsky and Phillips, 2025, p. 1)

They also observe that

> there is no obvious way to examine whether two [variable values] that have been identified as causes are causal to the same

> degree, or if one is comparatively *more of a cause* than the other. (p. 5, our emphasis)

Indeed, our metaphysical analysis of causation in terms of factual difference-making is not designed to capture judgments of *graded causation*. They agree by writing

> while the FDM account was presented as a philosophical account of causation, we think it may also have some promise as a cognitive account of lay causal intuitions.[6] (p. 11)

To understand judgments of graded causation, consider their case of overdetermination. As usual, Suzy throws a rock at a bottle (C). A truck kicks up a rock at the bottle (A)—a rare coincidence. The rocks shatter the bottle at the same time. Each rock alone would have been sufficient for the bottle to shatter (E). Empirical data suggests that people judge Suzy as more of a cause of the bottle breaking than the truck (Icard et al., 2017). Here is an attempt to explain the phenomenon: C is more normal than A. Hence, C is more of a cause than A.

Contrast the overdetermination case with the conjunctive scenario, where both Suzy's rock and the truck's are necessary for the bottle's shattering. Empirical data suggests a judgment reversal: people judge the truck as more of a cause of the bottle breaking than Suzy (Knobe and Fraser, 2008; Kominsky et al., 2015; Samland et al., 2016). Here is an attempt to explain the phenomenon: C is more normal than A. Hence, A is more of a cause than C.

Kominsky and Phillips (2025) provide an extension of our original analysis to accommodate judgments of graded causation. The central idea is that factual difference-makers can be evaluated sequentially from most normal to least normal. In the conjunctive scenario, there are only two causes. If the most normal cause, Suzy's rock, alone does not settle the effect, but

[6] Hitchcock (2025, p. 14) thinks this promise is 'an avenue worthy of exploration.' We engage with this avenue in what follows by considering judgments of graded causation in a certain disjunctive and conjunctive scenario. But a comparison to Morris et al.'s (2025) recently updated but unpublished manuscript must await another occasion.

the second most normal cause, the truck's rock, does (in the presence of the most normal one), then the second one is more of a cause than the most normal one.

The extension takes the factual difference-makers, C and A, and orders them according to their normality: $C > A$. Take the most normal cause C first. As it is a cause, we know that $\langle M, V \rangle \models C \gg E$. And so there is V' such that $\langle M, \emptyset \rangle [V'][C] \models E$. V' is of course $\{A\}$ in the conjunctive scenario. The most normal cause, C, does not settle the effect E alone:

$$\langle M, \emptyset \rangle [V' \setminus \{A\}][C] \not\models E.$$

But, in the presence of the less normal cause A, C does settle the effect:

$$\langle M, \emptyset \rangle [V' \setminus \emptyset][C] \models E.$$

In this sense, the less normal A is required for settling E. Hence, A is more of a cause than C.

In their overdetermination case, Suzy's rock throw (C) is also more normal than the truck's kicking up of a rock (A). V' is the empty set. The most normal cause settles the effect alone:

$$\langle M, \emptyset \rangle [V' \setminus \{A\}][C] \models E.$$

In this sense, the less normal A is not required for settling E. Hence, C is more of a cause than A. Or so goes our reading of Kominsky and Phillips's extension.

The extension is not yet formalized. One way to understand their extension algorithmically for our original analysis is this:

1. Identify all causes on our analysis: $\{C_1, ..., C_n\}$.
2. Order the identified causes from most normal to least normal: $C_1 > C_2 > ... > C_n$.
3. Loop over C_j in $\langle C_1, C_2, ..., C_{n-1} \rangle$:

(a) Find the first C_i in $\langle C_j, ..., C_n\rangle$ such that

$$\langle M', \emptyset\rangle[V'_j \setminus \{C_{i+1}, ..., C_n\}][\{C_j\}] \models E,$$

where $V'_j \subseteq V$ and $M' \subseteq M$ witness that $\langle M, V\rangle \models C_j \gg E$.

(b) If $i = j$, C_i is more of a cause than C_k for any $k > i$; if $i > j$, C_i is more of a cause than C_k for any $k < i$.

4. End loop.

The algorithm is guaranteed to end. For each $C_j \in \{C_1, ..., C_n\}$ is a cause of E, and so there is M' and V'_j such that $\langle M', \emptyset\rangle[V'_j][C_j] \models E$. This is nothing but the central condition in 3(a) if there is no first C_i in $\langle C_j, ..., C_n\rangle$, and so $V'_j \setminus \{C_{i+1}, ..., C_n\} = V'_j \setminus \emptyset = V'_j$. 3(b) says, roughly, that C_i is more of a cause than C_k for any $k > i$ if C_i alone settles E; and C_i is more of a cause than C_k for any $k < i$ if settling E requires C_i plus any C_k.[7] This algorithm is clearly not yet the last word. But it suggests that the idea of factual difference-making is extendable to a promising account of lay causal intuitions.

15 Is Factual Difference-Making Equivalent to Counterfactual Difference-Making?

Ackermans (2025) aims to push back on our suggestion that we should think of causes as factual difference-makers by showing that our analysis is equivalent to a counterfactual account of causation. Off the bat, we encourage everyone who tries to show such an equivalence. In causal models, interventionist counterfactuals have more expressive power than our settling conditionals in virtue of their, as Ackermans calls them, 'propagating' interventions overwriting actual events and absences. So it seems that there should be a counterfactual account equivalent to our analysis.

[7] We are grateful to Shubhamkhar Ayare who helped us in formalizing the algorithm. We assume that causes can be strictly ordered from most normal to least normal. If two causes $C_j = C_{j+1}$ are equally normal, they are, if ever, jointly removed from $\{C_{i+1}, ..., C_n\}$, and are jointly assumed $[\{C_j, C_{j+1}\}]$ when checking whether they settle the effect.

Ackermans proves that our settling conditional of the lead article is equivalent to a conditional $\gg_3$ he calls 'partly counterfactual'. The basic idea is this: whenever C is a cause of E, C and E are actual; there is then an unsettled causal model in our sense iff there is a consistent model $\langle M', V' \rangle$ such that $\neg C$ and $\neg E$ are in the full but non-actual set V' of literals. Ackermans observes that the right hand side of the iff can be equivalently expressed by some counterfactual conditional. We agree.

However, his account equivalent to our original analysis also requires a factual conditional in condition (3) of his Definition 2: $\langle M', \emptyset \rangle [V' \cap V][C] \models E$, where V is the set of actual literals, and C and E are also actual. So his account is not purely counterfactual. Moreover, unsettled models like $\langle M', \emptyset \rangle$ are 'unheard of in counterfactual theories', as he admits (p. 4). He moves on to replace condition (3) with one that uses a propagating intervention. However, we fail to see that the resulting conditional is counterfactual: its antecedent is not contrary-to-fact. And the resulting account is *not* equivalent to our original analysis.

Ackerman's work provides a valuable view on our original analysis. His equivalent account can be thought of as featuring a counterfactual, but it also features a factual conditional and the notion of an unsettled causal model. We think it is still an open question whether there is a purely counterfactual account equivalent to our original and refined analysis in terms of factual difference-making.

Let's suppose there is a purely counterfactual account that is equivalent to our refined analysis. This would mean that the logical structure of our refined analysis can be equivalently expressed using counterfactual conditionals and none of another type. But would this also mean that factual difference-making is nothing but a counterfactual account? By analogy, would a proof establishing that Mackie's (1965) INUS account in terms of complex regularities is equivalent to an account in terms of more expressive counterfactuals show that the INUS account is a purely counterfactual account? We are inclined to answer both questions with no. Theories whose conceptual foundations require no counterfactuals deserve our attention, in particular if they employ less expressive conditionals and carry less metaphysical baggage. But our reasons for this view must await another occasion.

16 Conclusion

We have defended our analysis in terms of factual difference-making by two refinements. First, we have introduced indeterminate interventions. Second, we have repaired our deviancy condition and refined our notion of deviancy by distinguishing deviancy from weak deviancy. The refined analysis solves all the genuine counterexamples put forth in the insightful commentaries. We take this as evidence that analyses of causation in terms of factual difference-making are promising—evidence that a new research program is born.

We would like to point out that the deviancy considerations are somewhat orthogonal to a programmatic paper proposing the notion of factual difference-making. We take the fact that many challenges relate to our use of deviancy considerations as further evidence that the core notion of factual difference-making is promising for analyses of causation—even if one disagrees with our specific deviancy condition.

For definiteness, here is our final analysis:

> Let $\langle M, V \rangle$ be a causal model such that $V \models M$. C is a cause of E relative to $\langle M, V \rangle$ iff
>
> (C1) $\langle M, V \rangle \models C \wedge E$,
>
> (C2) $\langle M, V \rangle \models C \gg E$, and
>
> (C3) it is not the case that $\langle M, V \rangle \models \neg C \gg_{\backslash d} E$.

Recall that $\gg_{\backslash d}$ denotes our settling conditional without the deviancy condition. The settling conditional with the deviancy condition is defined as follows:

> $\langle M, V \rangle \models C \gg E$ iff there is $V' \subseteq V$ and M' such that
>
> (i) $\langle M', V' \rangle$ is unsettled on C and E,
>
> (ii) there is no $V'' \subseteq V$ such that $V' \subset V''$ and $\langle M', V'' \rangle$ is unsettled on C and E,

(iii) $\langle M', \emptyset \rangle \, [V'][C] \models E$,

(iv) M' is obtained from M by a possibly empty set of indeterminate interventions on literals which represent occurring events and are non-descendants of C other than C, and

(v) C is weakly deviant and any literal C' in $V \setminus V'$ other than C, which is a non-descendant of C in M', is deviant.

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