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Poisoned Babies, Shot Fathers, and Ruined Experiments: Experimental Evidence in Favor of the Compositionality Constraint of Actual Causation

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(Received 13 July 2021; revised 05 May 2022; accepted 30 December 2022; first published online 17 February 2023)

Abstract

Livengood and Sytsma (2020) challenge the *compositionality constraint of actual causation* (CCAC), according to which each intermediary of a causal chain is an effect of its predecessor and a cause of its successor link. In several studies, they find support for their hypothesis that the CCAC is not in accordance with the ordinary causal attributions of laypeople. We argue that there are three interrelated problems in their studies' design that we call the *causality-responsibility confusion* (CRC), the *intermediary-ontology confusion* (IOC), and the *cause-end questioning* (CEQ). Avoiding the CRC, the IOC, and the CEQ leads to strong empirical support for the CCAC.

1 Introduction

Livengood and Sytsma (2020) (hereafter L&S 2020) challenge the *compositionality constraint of actual causation* (CCAC) that is implicitly entailed by many philosophical accounts of actual causation (e.g., Reichenbach 1956; Salmon 1994; Dowe 1995; Ehring 1997; Lewis 1973, 1986; for a brief summary, see L&S 2020, 43–47). They illustrate the CCAC by a chain of dominoes. There are two ways a person could cause the last domino in a chain to fall: First, they could cause it directly by flicking the last domino of the chain. Second, they could cause it indirectly by flicking, for example, the first domino of the chain. It then falls against the second domino, which falls against the third domino, and so on, until the last domino of the chain finally falls, too. According to the CCAC, the person causes the last domino to fall in both cases. However, if they do it indirectly, then there must be a number of *intermediaries*—the falling of one domino against the next one—such that

the person transitively caused the last domino to fall by means of a causal chain.¹ L&S (2020, 44) formulate the CCAC as follows:

CCAC: If c is an actual cause of e , then either c causes e directly, or every intermediary d by which c indirectly causes e is itself an actual effect of c and an actual cause of e .

There are two presuppositions to L&S's (2020) questioning of the CCAC. First, they presuppose the *folk attribution desideratum* (FAD) (Livengood et al. 2017), according to which theories of actual causation need to be in accordance with ordinary causal attributions. Hence, the question of whether the CCAC holds becomes a question that can be answered empirically. Second, they presuppose the *responsibility view* (RV). The RV maintains that the default concept of causation of ordinary causal attributions is a thick concept that also has an evaluative content akin to the concepts of *responsibility* and *accountability* (Sytsma et al. 2019; Livengood et al. 2017; Sytsma et al. 2012). This is why ordinary people's judgments of statements like " a causes b " depend not only on the question of whether a is a cause of b in a strict sense but also on the question of whether a is responsible for b (Livengood et al. 2017; Knobe and Fraser 2008). One could argue against the RV that ordinary people just confuse causation with responsibility and thus give wrong answers.² However, it is not that easy. If one accepts the FAD, one cannot simultaneously state that ordinary people give wrong answers and that the ordinary concept of causation actually does not entail *responsibility*. If data show that ordinary people are significantly more likely to agree with the statement " a causes b " if a is responsible for b , and less likely if a is not responsible for b , then the FAD seems to entail the consequence that the concept of causation is a normatively laden concept that contains *responsibility*, and hence the RV holds.

Presupposing the FAD and the RV, L&S (2020) challenge the CCAC through surveys based on vignettes in which "someone or something is responsible for an effect by way of an intermediary that does not share in the responsibility" (L&S 2020, 48), such as the following:

POISONED CUP VIGNETTE: Amy wants to kill her daughter, Jessica, but she doesn't want to go to prison for murder. As such, Amy hatches a plan. She arranges for a babysitter, Courtney, to take care of Jessica while she is out of town on business. Before leaving, Amy laces one of Jessica's sippy cups with a deadly poison that is very difficult to detect. That evening, Courtney gives Jessica juice in the poisoned sippy cup. Jessica drinks the juice and dies two hours later. (L&S 2020, 49–51)

¹ Note that the CCAC is (hypothesized to be) a property of causal chains that is to be distinguished from *collider cases* of causation, in which there are two or more direct causes for one and the same effect.

² The idea that laypeople's views on causation may be influenced by thoughts of responsibility is—in different forms—not new; see, for example, Alicke et al. (2011), Danks et al. (2014), Samland and Waldmann (2016), and Sytsma (2021, 2022).

Presented with the statements

- (1) AMY CAUSED JESSICA'S DEATH,
- (2) COURTNEY CAUSED JESSICA'S DEATH,

subjects significantly agree with statement (1) but disagree with statement (2). That is, for causal chains of this kind, subjects tend to accept the if clause of the CCAC because they agree with (1), but they also tend to reject the second conjunct of the or-disjunct of the CCAC because they reject (2). Although the if clause is true, the CCAC seems to be refuted empirically, at least for theories concerned with the *ordinary* concept of causation (L&S 2020, 64–65). L&S find support for this finding through nine studies.

In this article, we empirically defend the CCAC against L&S (2020). In section 2, we argue that the refutation of the CCAC presented by L&S is contestable because of three interrelated problems that we call the *causality-responsibility confusion* (CRC), the *intermediary-ontology confusion* (IOC), and the *cause-end questioning* (CEQ). Thereafter, we show, by means of 16 studies, that the vignettes of L&S (2020) lead to results confirming the CCAC if the IOC, the CRC, and the CEQ are avoided.

2 Three interrelated problems of the supposed refutation of the compositionality constraint of actual causation (CCAC)

In the following, we introduce three problems that—in our view—the design of L&S (2020) suffers from. According to the CRC (section 2.1), the design leads subjects to confuse causality with responsibility, which can easily happen in any such study asking for causes in situations that also include instances of responsibility. Ambitions to disentangle causation and responsibility, thus, are of special importance for studies interested in people's evaluations of causation. If we avoid the CRC, we can show that subjects—contrary to L&S (2020)—clearly distinguish between causality and responsibility.

According to the IOC (section 2.2), the design of all but one of the studies of L&S (2020) uses individuals instead of events as intermediaries of causal chains. We argue that this ontological confusion supports the CRC.

According to the CEQ (section 2.3), in each statement that L&S (2020) ask their subjects to evaluate, the effect of a cause is always the end link of the causal chain presented in the vignette. We argue that the CEQ directly supports the CRC because it triggers responsibility considerations. Further, we argue that the CEQ supports the CRC indirectly because it disguises the IOC, which in turn supports the CRC.

In section 2.4, we provide a brief overview of our studies and explain how we avoid the CRC, the IOC, and the CEQ.

2.1 The causality-responsibility confusion (CRC)

The CRC results from the design used by L&S (2020), which, combined with the IOC (section 2.2) and the CEQ (section 2.3), leads to a confusion of causation with responsibility or accountability. As Samland and Waldmann (2014) already pointed out, in statements of the kind “a caused b,” the verb *cause* is ambiguous and might be

understood as causation in the narrow sense or as being responsible or accountable, especially in the context of human actions.³ The results presented by Samland and Waldmann (2014) support their ambiguity hypothesis and hence give rise to the assumption that the statements presented to subjects for evaluation by L&S (2020) bring about the same ambiguity because all of them are of the form “a causes b.”

However, there are two critical differences in the approach of Samland and Waldmann (2014). First, they are only concerned with collider cases of actual causation and not with causal chains as in L&S (2020). Second, Samland and Waldmann (2014) are only concerned with agents causing effects, whereas L&S (2020) also present studies with causal chains containing objects or events as causes.

Hence, we will use designs that exclude the ambiguous understanding of the term *cause*. However, L&S could respond to our objection concerning the CRC that we “might be worried that participants in our study were confusing causation with responsibility. On our view, ordinary people are not confused” (2020, 52). Because causal judgments are sensitive to responsibility considerations, L&S (2020, 52) conclude that “the default concept of causation at play in ordinary causal attributions has both descriptive content and normative, evaluative content.” We argue that L&S confuse the use of the word *cause* with the content of the concept of causation. Of course, we would not argue that ordinary people are confused regarding the use of the word *cause*—they use it as they are used to using it, and to use a word in a way that is accepted by the respective linguistic community means to use the word the right way. However, L&S do not distinguish between the use of the word and the mental representation, that is, the concept of causation. The CCAC is concerned with the concept of causation, and as we will show, ordinary people have a concept of causation that is not ambiguous in the way proposed by L&S.

2.2 The intermediary-ontology confusion (IOC)

In eight of nine studies of L&S (2020), the intermediaries of the causal chains are individuals (agents or individual objects) instead of events.⁴ However, individuals cannot be intermediaries of causal chains. For example, in the poisoned cup vignette, the individual agent Amy is presented as the first link *c* of the chain, the individual agent Courtney is the intermediary *d*, and the event of Jessica’s death is the end link *e* of the chain. If the agent Courtney were the intermediary, she would have to be the effect of the first link of the chain. Obviously, the agent Courtney is not the effect of the agent Amy, but Courtney’s action of giving Jessica juice in a poisoned sippy cup is an effect of Amy’s action of poisoning the sippy cup.

Generally speaking: for ontological reasons, individuals (agents or objects) cannot be intermediaries of causal chains. Typically, it is events that are intermediaries of causal chains. Hence, there is an *ontological confusion* concerning the presentation of the intermediaries in all studies but one of L&S (2020). L&S could argue that the name “Courtney” in statement (2) is only an abbreviation expressing the whole event of giving Jessica juice in a poisoned sippy cup. However, they do not. Instead, they point out that they follow the FAD and that “one clear finding in recent empirical work on

³ Also consider Schwenkler and Sievers (2022) for a series of experiments that avoid using the term *cause* in this context. See also Rose et al. (2021).

⁴ Only study 5 of L&S (2020) presents events instead of individuals as intermediaries.

causal attribution is that ordinary people often count agents as causes” (L&S 2020, 53). That means that L&S think they do not need to use events because for ordinary people, individuals can be causes—even if they are intermediaries of (supposed) causal chains. However, we do not think that ordinary people would accept individuals as intermediary causes of causal chains because individuals cannot be effects of the respective predecessor links of the chains. Otherwise, ordinary people would have to accept statements like “Amy caused Courtney” in the case of the poisoned cup vignette or “The hammer caused the gunpowder” in the case of the revolver vignette (see later discussion). It is all the more surprising that L&S (2020, 44) explicitly introduce the CCAC with respect to events. So why do they choose individuals as intermediaries and, especially, an individual agent as an intermediary in their first and decisive study? An answer to this question might be that they found no differences between individuals and events as being causes in a previous study (see Livengood et al. 2017, 286). However, Livengood et al. were concerned with collider cases (in contrast to causal chains), and hence, the individuals were not *intermediaries* of causal chains (i.e., in the vignettes, they were not caused by anything else). Additionally, the phrases denoting the events contained the names of the individuals involved in the event and thus emphasized the role of the individual in the respective event.

Contrary to L&S (2020), we argue that the IOC triggers the CRC: using agents instead of events leads people to understand the verb *cause* as *being responsible* for something because only events, not agents, can be causes as intermediaries in causal chains. By contrast, only agents, not events, can be responsible or accountable for something. Hence, the IOC (using agents instead of events as intermediaries) supports the CRC (the confusion of causation with responsibility). For example, with respect to the poisoned cup vignette, the IOC supports the subjects’ disagreement with the statement that Courtney caused Jessica’s death because Courtney is not considered to be responsible for Jessica’s death.

If it is true that the CRC is triggered by the IOC, then replacing the agents with events should have an effect on the agreement or disagreement of subjects with the respective statements. However, only in study 5 do L&S (2020) compare the replacement of agents with events in the statements that are rated by the subjects for the poisoned cup vignette. Here, subjects were asked to rate their agreement with the following statements on a 7-point scale:

(3) AMY’S ACTION OF POISONING THE SIPPY CUP CAUSED JESSICA’S DEATH.

(4) COURTNEY’S ACTION OF GIVING JESSICA JUICE IN THE SIPPY CUP CAUSED JESSICA’S DEATH.

The disagreement with statement (4) was clearly weaker (mean $[M] = 3.36$) than that with statement (2) of study 1 ($M = 2.06$). However, L&S still conclude that “[t]he results again suggest that causal attributions of most ordinary people do not satisfy the compositionality constraint” (2020, 55) because the rating for the event expressed by (4) was smaller than the scale’s neutral value of 4. On the one hand, that is right. On the other hand, it seems obvious that replacing individuals with events as intermediaries in causal chains weakens the refutation of the CCAC. However, stressing the agent Courtney as the actor of the action in statement (4) might trigger the responsibility interpretation of the term *cause*. They should have used the following statement: “The action of giving Jessica juice in the sippy cup caused

Jessica's death." This statement might have achieved an even higher agreement than statement (4) while also avoiding the responsibility interpretation.

We are not the only ones making this point. Samland and Waldmann (2016) also note that in studies (supposedly) showing that causal judgments are influenced by moral evaluations, the causes are always agents, not events. They assume that "using the name of an agent as a pointer to an abnormal action possibly creates a context that invites the interpretation of the test question as a request to assess accountability" (Samland and Waldmann 2016, 171). Their results show a clear difference between statements mentioning and not mentioning individual agents as being involved in the causes expressed by the statements. However, Samland and Waldmann (2016) criticize the *culpable control model of blame* (Alicke 2000) and the *counterfactual reasoning account of causal selection* (Hitchcock and Knobe 2009). They are not concerned with the RV presupposed by L&S (2020). Further, they are exclusively concerned with collider cases of causation, not with causal chains, and therefore they use different vignettes than L&S (2020). Hence, we cannot transfer their results to our discussion of the CCAC. Therefore, we conducted a couple of studies excluding the IOC from the causal chains of the vignettes of L&S (2020).

However, replacing individuals with events and using events that do not focus on the actor of the respective action of the event constitute just one piece of the puzzle to resolve the confusions that lead to the refutation of the CCAC. This brings us to the third problem, the CEQ, which—we think—simultaneously directly triggers the CRC and supports the IOC.

2.3 The cause-end questioning (CEQ)

In all studies of L&S (2020), subjects are asked to state their agreement with statements of the kind "*a causes b*" that work the following way: *b* is always the end link *e* of a causal chain presented in the vignettes, and *a* is either the first link *c* of a causal chain or an intermediary *d*. That is, each statement that is to be rated by subjects in each study of L&S (2020) expresses a certain cause for the end link *e* of the causal chain. This is what we call the CEQ. There is no statement in L&S (2020) expressing that a link *n* of a causal chain is a cause for the respective next link *n + 1* if the link *n + 1* is not the end of the chain. However, as Bauer and Romann (2022) showed for the revolver vignette, a more detailed causal chain that includes more intermediaries leads to a much higher agreement with statements stating that link *n* is a cause for link *n + 1* (regardless of whether link *n + 1* is the end of the chain or not).

Which effects does the CEQ have? First, in all cases, subjects are asked about their agreement or disagreement only regarding the second conjunct of the or-disjunct of the CCAC (the intermediary *d* is an actual cause of the end link *e*) but not for the first conjunct (the intermediary *d* is an effect of the first link *c*). Thus, the CEQ disguises the IOC because it never becomes obvious that the intermediary *d* cannot be an effect of its predecessor link of the chain if *d* is an agent. Hence, by disguising the IOC, the CEQ indirectly supports the CRC because the IOC directly supports the CRC (see section 2.2). Second, the CEQ directly supports the CRC because each of the end links of the causal chains presented in the vignettes of L&S (2020) is an undesirable or morally reprehensible event: a poisoned baby, a shot father, or a ruined experiment. Hence,

we hypothesize that subjects intuitively look for someone who is responsible for those awful events and thus tend to understand the verb *cause* as meaning being *responsible*.

Therefore, we think that more detailed chains, in which the intermediaries not only appear as causes for the end links of the chains but also as both effects of predecessor links and causes for a further intermediary of the chain, will prevent the problematic effects of the CEQ.

2.4 How to exclude the IOC, CRC, and CEQ

In the previous sections, we discussed three problems of L&S's (2020) refutation of the CCAC that are deeply interrelated: first, the CEQ disguises the IOC, and second, both the IOC and the CEQ support the CRC. In the following, we present our strategy for reevaluating the CCAC, which does not fall prey to these problems:

- **REPLICATION:** First, we present the results of a replication of L&S's (2020) initial studies 1, 8, and 9 on the poisoned cup vignette, the revolver vignette, and the ground fault circuit interrupter (GFCI) vignette. In doing so, we will first show that we compare our variations to the same results as those obtained by L&S and, second, that the results of L&S are not restricted to English and the usage of the English word *cause* but are replicable in German with the use of the respective German word *verursachen*.
- **IOC EXCLUSION:** In order to exclude the IOC, we then used events instead of individuals as intermediaries of causal chains for the poisoned cup vignette, the revolver vignette, and the GFCI vignette. In doing so, we expected to find a higher agreement with the statements referring to events as intermediary causes compared to the statements referring to agents as intermediary causes. However, according to study 5 of L&S, we did not expect to find an effect significantly different from the neutral value of 4 by only conducting this modification. Thus, for the poisoned cup vignette, we additionally tested the difference between statements mentioning the names of the agents acting in an event and statements not mentioning the names of the agents. In the revolver vignette and the GFCI vignette, there are no agents involved as intermediaries of the causal chains. Hence, we tested this variation only for the poisoned cup vignette.
- **CRC EXCLUSION:** In order to exclude the CRC, we investigated the ordinary concept of causation without using the word *cause* for the poisoned cup vignette, the revolver vignette, and the GFCI vignette. Statements of the kind "*a causes b*" tempt participants to understand the term *cause* as *a* being responsible or accountable for *b*, especially if *a* is an agent. Therefore, we investigated the ordinary concept of causation by, first, replacing the individuals *a* and *b* with the statements Φ and Ψ expressing events and, second, presenting subjects with counterfactual conditionals of the kind " Ψ would not have happened if Φ had not happened," assuming that subjects would agree if the event expressed by Φ is a cause of the event expressed by Ψ .⁵ However, we are aware of the challenges of

⁵ A reviewer argued that defenders of the RV would not accept counterfactual conditionals because counterfactual dependence would not be sufficient for actual causation, as they illustrate with the pen case of Knobe and Fraser (2008). We agree that the problem depends counterfactually on both actions in

preemption and *overdetermination* for the counterfactual theory of causation because for cases of preemption and overdetermination, Ψ would also have happened if Φ had not happened.

- **CEQ EXCLUSION:** In order to exclude the CEQ, we presented statements in which an intermediary d_1 of a causal chain is an effect of a predecessor link c and, simultaneously, the cause of an effect that is not the end link e of the causal chain but a further intermediary d_2 . We tested this variation for the poisoned cup vignette, the revolver vignette, and the GFCI vignette.
- **SIMULTANEOUS IOC, CRC, AND CEQ EXCLUSION:** In a final set of studies, we excluded the three problems—IOC, CRC, and CEQ—simultaneously for the poisoned cup vignette, the revolver vignette, and the GFCI vignette in order to test whether these variations would suppress each other when combined.

3 Design and procedures

Prior to our main study, we conducted a series of pilot studies with a rather small sample size to test our initial assumptions in the context of one of the vignettes used by L&S (2020). Details on the design, procedure, and results of our pilot studies can be found in Supplementary Appendix A.

In the main course, we then conducted a total of 16 studies to test the solutions proposed in section 2.4. Here, the studies are presented for each vignette separately. For each vignette, we first tried to replicate the original findings from L&S (2020). Here, the subjects' task was to rate their disagreement or agreement with a number of statements related to the vignette's story. This was done on a scale from 1 ("don't agree at all") to 7 ("fully agree").

Subjects were randomly assigned to one of the 16 studies. Every subject was asked to rate their disagreement or agreement with two, three, or four statements, depending on the respective study. Those statements were all presented on the same screen, together with the vignette's text. Hence, as did L&S (2020), we presented all statements of a given study to the subjects.

Prior to the vignette and rating task, subjects were greeted with a welcome text (see Supplementary Appendix B.1). A questionnaire was implemented to appear after the rating task to gain some sociodemographic information.

Furthermore, we asked subjects to answer two to three control questions about the vignette to promote internal validity (see appendices B.2, B.3, and B.4). Only those subjects who answered every question correctly were included in our analysis. Those 1,189 subjects received a flat fee of 2.10 euro, which roughly equals an hourly wage of 12.60 euro. Another 1,370 subjects were excluded from our analysis after having failed to answer our control questions correctly. As was announced beforehand, they did not receive compensation.

the pen case. However, in accordance with Samland and Waldmann (2014), we argue the other way around: using counterfactual conditionals in the experimental design shows that the subjects' judgments in Knobe and Fraser (2008) result from the ambiguous meaning of the verb *cause* and thus do not reflect their causal representations. Using an experimental design that omits the ambiguous verb and contains counterfactual conditionals instead seems to be more adequate.

The studies were programmed in LimeSurvey (2021) and conducted online in May 2021. Subjects were recruited by the private market research institute *respondi*, where they were randomly drawn from a pool of registered subjects from Germany. Hence, the vignettes and statements were presented to them in German.

4 Results

In the following, we analyze the evaluations made by our subjects.⁶ In subsection 4.1, we first take a look at our studies conducted on the poisoned cup vignette. Thereafter, in subsection 4.2, we investigate the studies on the revolver vignette before turning to the studies regarding the GFCI vignette in subsection 4.3. Because of space restrictions, we mainly focus on the items most interesting for our hypothesis: those containing intermediaries. A more comprehensive list at the end of each subsection, though, contains detailed descriptive information on every item presented to our subjects, as well as figures illustrating our results.

4.1 Poisoned cup vignette

First, we present the results of the six different studies conducted on the poisoned cup vignette. Each study introduced the following vignette and asked subjects to rate their agreement with several statements concerning that vignette.

Gabi wants to kill her daughter, Nele, but she doesn't want to go to prison for murder. As such, Gabi hatches a plan. She arranges for a babysitter, Kathrin, to take care of Nele while she herself is out of town on business. Before leaving, Gabi laces one of Nele's sippy cups with a deadly poison that is very difficult to detect. That evening, Kathrin gives Nele juice in the poisoned sippy cup. Nele drinks the juice and dies two hours later.

4.1.1 Replication

The first study's aim was to replicate the findings from L&S (2020) for the poisoned cup vignette. Figure 1a shows the mean agreement of our subjects ($N = 71$, male: 38, female: 33, mean age: 49.169) with the two statements presented to them:

- (1) GABI CAUSED NELE'S DEATH.
- (2) KATHRIN CAUSED NELE'S DEATH.

As can be seen in figure 1a (also see figures 12 and 13 in Supplementary Appendix C for relative frequencies), the findings from L&S (2020) were successfully replicated with a German-speaking sample and a German translation of their vignette. Whereas L&S (2020, 50) found a mean agreement of 7.00 with the first statement, we found a

⁶ Data are available at <https://github.com/alephmembeth/causality-compositionality/>.

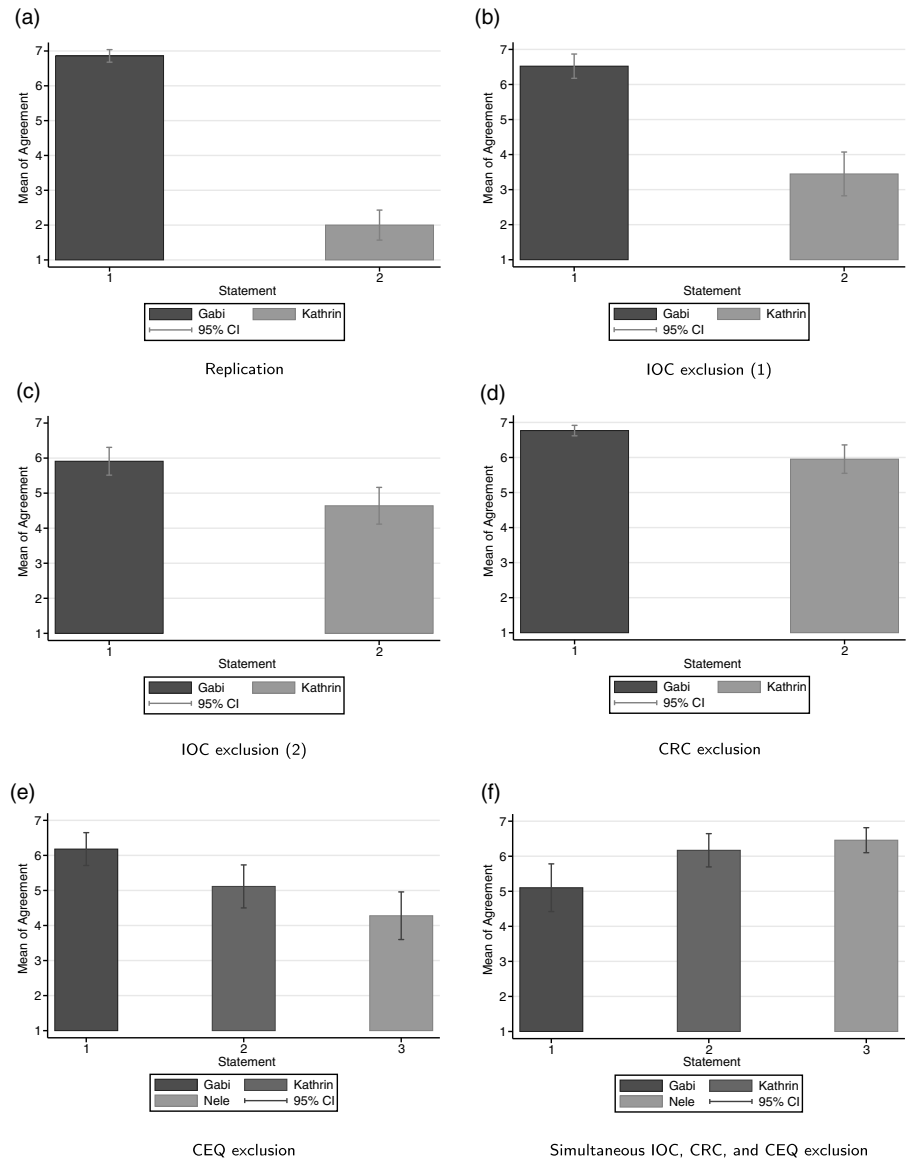


Figure 1. Means of agreements for the replication (1a); the first (1b) and second (1c) IOC exclusions; the CRC exclusion (1d); the CEQ exclusion (1e); and the simultaneous IOC, CRC, and CEQ exclusions (1f) with the poisoned cup vignette.

mean of 6.859 (95% confidence interval $[CI] = [6.679, 7.039]$). For the second statement, they found a mean agreement of 2.06; we found a mean of 2.000 (95% $CI = [1.569, 2.431]$). Wilcoxon signed-rank tests further revealed, as was the case in L&S's study, that the difference to the neutral value of 4 on the scale from 1 to 7 was

significant both for the first and the second statement ($p \leq 0.001$).⁷ Following L&S (2020), this can be seen as an indication that subjects predominantly agreed with the statement that Gabi caused Nele's death while disagreeing with the statement that Kathrin caused Nele's death. The effect sizes for this were very large in the first case ($r = 1.166$) and the second ($r = -0.842$).⁸

4.1.2 Exclusion of the intermediary-ontology confusion (IOC) (1)

In order to avoid the IOC, we modified the statements slightly to focus on events instead of agents. This also replicated a modification done by L&S (2020, 54–55). Subjects ($N = 67$, male: 35, female: 32, mean age: 48.970) now had to state their agreement with the following statements:

- (1) GABI'S ACTION OF POISONING THE SIPPY CUP CAUSED NELE'S DEATH.
- (2) KATHRIN'S ACTION OF GIVING NELE A POISONED SIPPY CUP CAUSED NELE'S DEATH.

As can be seen in figure 1b (also see figures 14 and 15 in Supplementary Appendix C for relative frequencies), the mean agreement with the first sentence was equally high ($M = 6.522$, 95% $CI = [6.176, 6.868]$). The mean agreement with the second statement, though, increased to 3.448 (95% $CI = [2.823, 4.072]$). Again, this is very close to the findings from study 5 of L&S (2020, 54f.), who reported a mean of 6.52 for the first statement and a mean of 3.36 for the second. A Wilcoxon signed-rank test indicated that the difference to the neutral value of 4 remained highly significant for the first statement ($p \leq 0.001$) but was no longer significant for the second one ($p = 0.155$). The effect sizes were very large in the first case ($r = 0.865$) but vanishingly small in the second ($r = -0.174$).

In sum, the indication that subjects predominantly disagreed with the statement that Kathrin caused Nele's death seemed to decrease when the singular term referring to Kathrin was replaced by a singular term referring to an event involving Kathrin. However, as we expected, in accordance with study 5 of L&S (2020), merely excluding the IOC did not lead to *agreement* with the second statement because of the CRC and the CEQ.

4.1.3 Exclusion of the intermediary-ontology confusion (IOC) (2)

In a further alteration aiming at avoiding the IOC, we focused on the respective actions without including Gabi's or Kathrin's name in the statements. This time, subjects ($N = 81$, male: 34, female: 55, mean age: 45.169) had to state their agreement with the following statements:

- (1) THE ACTION OF POISONING THE SIPPY CUP CAUSED NELE'S DEATH.
- (2) THE ACTION OF GIVING NELE JUICE WITH A POISONED SIPPY CUP CAUSED NELE'S DEATH.

⁷ Here and in the following, we did not correct for multiple comparisons.

⁸ Effect sizes for Wilcoxon signed-rank tests are calculated by dividing the z value by the square root of N . To prevent confusion, we refer to the same ordinary-language descriptions as L&S (2020), following McGraw and Wong (1992): $[0.0] - [0.2]$ is practically no effect, $[0.2] - [0.4]$ is a small effect, $[0.4] - [0.6]$ is a moderate effect, $[0.6] - [0.8]$ is a large effect, and $[0.8]$ is a very large effect.

Figure 1c (also see figures 16 and 17 in Supplementary Appendix C for relative frequencies) shows that the mean agreement with the second statement further increased ($M = 4.640$, $95\% CI = [4.116, 5.164]$). Here, a Wilcoxon signed-rank test showed that the difference to the neutral value of 4 now became significant at the 5% level for the second statement ($p = 0.011$), showing at least a small effect ($r = 0.270$). As we hypothesized, replacing a singular term denoting an individual with a singular term referring to an event had a greater influence on the agreement with the second statement if it did not mention an agent.⁹ We argue that the reason for this is that subjects did not consider the responsibility of the person involved in the event. However, as we expected, we still did not find a clear agreement with the intermediary being a cause of the next link of the causal chain because of the CRC and the CEQ.

4.1.4 Exclusion of the causality-responsibility confusion (CRC)

In order to outwit the CRC, we rephrased the statements as counterfactual conditionals avoiding the term *cause*. Here, subjects ($N = 86$, male: 40, female: 46, mean age: 43.256) had to state their agreement with the following sentences:

- (1) NELE WOULD NOT HAVE DIED THAT EVENING IF GABI HAD NOT POISONED HER SIPPY CUP.
- (2) NELE WOULD NOT HAVE DIED THAT EVENING IF KATHRIN HAD NOT GIVEN HER JUICE IN A POISONED SIPPY CUP.

Figure 1d (also see figures 18 and 19 in Supplementary Appendix C for relative frequencies) shows that the mean agreement with the second statement clearly increased further ($M = 5.953$, $95\% CI = [5.548, 6.359]$). A Wilcoxon signed-rank test revealed that the difference to the neutral value of 4 was now highly significant for this statement ($p \leq 0.001$), showing a large effect ($r = 0.724$). We take this to be strong evidence in favor of our hypothesis that excluding the CRC by avoiding the use of the ambiguous word *cause* supports the CCAC. Presenting statements with counterfactual conditionals enables an investigation of the ordinary *concept* of causation and prevents the production of misleading evidence concerning the ordinary uses of the ambiguous word *cause*.

4.1.5 Exclusion of the cause-end questioning (CEQ)

In order to avoid the CEQ, we introduced the further intermediary of Nele's action of ingesting poison into the causal chain. Hence, we presented the following three statements to subjects ($N = 61$, male: 27, female: 34, mean age: 48.295):

- (1) GABI'S ACTION OF POISONING NELE'S SIPPY CUP CAUSED KATHRIN TO GIVE NELE JUICE IN A POISONED SIPPY CUP.
- (2) KATHRIN'S ACTION OF GIVING NELE JUICE IN A POISONED SIPPY CUP CAUSED NELE TO INGEST POISON.
- (3) NELE'S ACTION OF INGESTING POISON CAUSED HER DEATH.

⁹ A reviewer argued that sentence (2) could be understood as referring to Gabi's instead of Kathrin's action. However, for sentence (2), we used the same verb and the same complements of the verb as in the vignette story. Therefore, we think that there is no reason to assume that subjects confused Gabi's with Kathrin's action.

The mean agreement with every statement was higher than the neutral value of 4, as can be seen in figure 1e (also see figures 20–22 in Supplementary Appendix C for relative frequencies). Again, we are mainly interested in the second statement because we introduced a further intermediary of which Kathrin's action of giving Nele juice in a poisoned sippy cup is the cause. For the second statement, the mean agreement was 5.115 (95% CI = [4.501, 5.728]). A Wilcoxon signed-rank test showed that the difference to the neutral value of 4 was highly significant for this statement ($p \leq 0.001$), with a moderate effect ($r = 0.437$). We expected that changing the effect of Kathrin's action to a less undesirable event would reduce the support of the CEQ to the CRC and thus would lead to a higher agreement. We found that even if the effect was only slightly less undesirable—causing someone to ingest poison might be only slightly better than causing someone to die—there was a highly significant agreement with the second statement as opposed to the agreement with the second statement of the replication. Thus, excluding the CEQ showed a clear effect supporting the CCAC, contrary to L&S (2020).

4.1.6 Simultaneous IOC, CRC, and CEQ exclusion

Lastly, a set of subjects ($N = 59$, male: 30, female: 29, mean age: 45.610) was presented with sentences that combined the previous approaches. They had to state their agreement with the following sentences:

- (1) KATHRIN WOULD NOT HAVE GIVEN NELE JUICE IN A POISONED SIPPY CUP IF GABI HAD NOT POISONED NELE'S SIPPY CUP.
- (2) NELE WOULD NOT HAVE INGESTED POISON IF KATHRIN HAD NOT GIVEN HER JUICE IN A POISONED SIPPY CUP.
- (3) NELE WOULD NOT HAVE DIED THAT EVENING IF SHE HAD NOT INGESTED THE POISON.

The mean agreement with every statement was higher than the neutral value of 4, as can be seen in figure 1f (also see figures 23–25 in Supplementary Appendix C for relative frequencies). The second statement was evaluated at 6.169 (95% CI = [5.695, 6.644]). A Wilcoxon signed-rank test showed that the difference to the neutral value of 4 was highly significant for the second case ($p \leq 0.001$), exhibiting a large effect ($r = 0.757$). Again, the agreement with the second statement with Kathrin's action being the cause of the next link of the chain is of special interest to us. It has the highest agreement of all statements with Kathrin's action being a cause. Clearly, the modifications of IOC exclusion, CRC exclusion, and CEQ exclusion do not suppress and might even support one another.

4.1.7 Summary

Figure 1 shows the means of our subjects' agreement with the respective statements for the replication (figure 1a); the first (figure 1b) and second (figure 1c) IOC exclusions; the CRC exclusion (figure 1d); the CEQ exclusion (figure 1e); and the simultaneous IOC, CRC, and CEQ exclusion (figure 1f). Additionally, table 1 summarizes the statements presented in our studies on the poisoned cup vignette. Beyond the modifications of IOC exclusions (1) and (2), we can see a highly significant agreement with the second statement of each study, considering the intermediary to be a cause

Table 1. Summary of Statements for the Poisoned Cup Vignette

Study	Statement	N	M	95% CI	Versus Neutral Value			Versus Replication	
					z	p	r	z	p
Replication	(1) "Gabi caused Nele's death."	71	6.859	[6.679, 7.039]	8.242	< 0.001***	1.166	—	—
	(2) "Kathrin caused Nele's death."		2.000	[1.569, 2.431]	-5.952	< 0.001***	-0.842	—	—
IOC (1)	(1) "Gabi's action of poisoning the sippy cup caused Nele's death."	67	6.522	[6.176, 6.868]	7.076	< 0.001***	0.865	1.918	0.055
	(2) "Kathrin's action of giving Nele a poisoned sippy cup caused Nele's death."		3.447	[2.823, 4.072]	-1.424	0.155	-0.174	-3.587	< 0.001***
IOC (2)	(1) "The action of poisoning the sippy cup caused Nele's death."	89	5.910	[5.514, 6.306]	6.648	< 0.001***	0.705	4.333	< 0.001***
	(2) "The action of giving Nele juice with a poisoned sippy cup caused Nele's death."		4.640	[4.116, 5.164]	2.551	0.011	0.270	-6.441	< 0.001***
CRC	(1) "Nele would not have died that evening if Gabi had not poisoned her sippy cup."	86	6.767	[6.618, 6.917]	8.783	< 0.001***	0.947	1.812	0.070
	(2) "Nele would not have died that evening if Kathrin had not given her juice in a poisoned sippy cup."		5.953	[5.548, 6.359]	6.716	< 0.001***	0.724	-8.927	< 0.001***
CEQ	(1) "Gabi's action of poisoning Nele's sippy cup caused Kathrin to give Nele juice in a poisoned sippy cup."	61	6.180	[5.714, 6.649]	6.145	< 0.001***	0.787	2.812	0.005**
	(2) "Kathrin's action of giving Nele juice in a poisoned sippy cup caused Nele to ingest poison."		5.115	[4.501, 5.728]	3.413	< 0.001***	0.437	-6.678	< 0.001***
	(3) "Nele's action of ingesting poison caused her death."		4.279	[3.599, 4.958]	0.596	0.551	0.076	—	—

(Continued)

Table 1. (Continued)

Study	Statement	N	M	95% CI	Versus Neutral Value			Versus Replication	
					z	p	r	z	p
Combination	(1) "Kathrin would not have given Nele juice in a poisoned sippy cup if Gabi had not poisoned Nele's sippy cup."	59	5.102	[4.421, 5.782]	2.969	0.003**	0.387	5.008	< 0.001***
	(2) "Nele would not have ingested poison if Kathrin had not given her juice in a poisoned sippy cup."		6.169	[5.695, 6.644]	5.814	< 0.001***	0.757	-8.237	< 0.001***
	(3) "Nele would not have died that evening if she had not ingested the poison."		6.458	[6.101, 6.814]	6.609	< 0.001***	0.860	—	—

N gives the number of participants for each study. Thereafter, the mean agreement (M) and 95% confidence intervals (95% CI) are given for every statement. Furthermore, the results of Wilcoxon signed-rank tests comparing the agreement with each statement with the neutral value of 4 are reported, followed by the effect size (r), calculated by dividing the z value by the square root of N. Additionally, two-sample Wilcoxon rank-sum tests are reported comparing the statements from subsequent studies to those from our replication. Asterisks denote significance levels: **p < 0.01; ***p < 0.001.

in the causal chain, contrary to L&S (2020). Further, the two-sample Wilcoxon rank-sum tests comparing the statements of our modifications to those of our replication (right column of table 1) show that the second statement of each modification was evaluated significantly differently compared to our replication in each and every subsequent study. We take our results to be strong evidence in favor of the CCAC—contrary to the original findings of L&S (2020). The design of L&S (2020), we suppose, led subjects to understand the word *cause* as “being responsible for,” and hence, they tended not to agree with statements expressing that agents who do not share in the responsibility are causes. However, excluding the CRC by avoiding the ambiguous word *cause*, as well as the IOC and the CEQ both supporting the CRC, led, for the same vignette as used by L&S, to strong evidence in favor of the CCAC.

4.2 Revolver vignette

Next, we take a look at another five studies that were conducted with the following revolver vignette:

Leeve has decided to kill his father, Uwe. He aims his loaded revolver at Uwe and pulls the trigger, releasing the hammer. The hammer strikes the cartridge, igniting the gunpowder. The gunpowder explodes, driving the bullet from the gun. The bullet hits Uwe in the head. He dies instantly.

4.2.1 Replication

The first study aimed at replicating the findings from L&S (2020) for the revolver vignette. Here, subjects ($N = 63$, male: 26, female: 37, mean age: 40.095) had to state their agreement with the following statements:

- (1) LEEVE CAUSED UWE’S DEATH.
- (2) THE HAMMER CAUSED UWE’S DEATH.
- (3) THE GUNPOWDER CAUSED UWE’S DEATH.
- (4) THE BULLET CAUSED UWE’S DEATH.

The mean agreement with the first statement from L&S (2020, 60) was 6.705; our mean was 6.603 (95% $CI = [6.285, 6.922]$), as can be seen in figure 2a (also see figures 26–29 in appendix C for relative frequencies). Statement (2) had a mean agreement of 2.490 in the original; our mean agreement was 3.000. The third statement’s original mean was 2.275; we found a mean of 2.984. Lastly, L&S (2020) found a mean of 4.373 for the fourth statement; we found a mean of 5.048.¹⁰ Wilcoxon signed-rank tests showed that the first three statements from L&S (2020) were significantly different from the neutral value of 4.¹¹ The same holds true for our first ($z = 7.108, p \leq 0.001$), second ($z = -3.288, p \leq 0.001$), and third statements ($z = -3.391, p \leq 0.001$). Only the last statement was evaluated differently from the original study; here, we found a

¹⁰ L&S (2020, 60) only report the mean for the first statement. We are thankful to them for sharing their data with us so that we can report the original means for all four statements.

¹¹ Statement 1: $z = 6.464, p \leq 0.001$; statement 2: $z = -4.068, p \leq 0.001$; statement 3: $z = -4.732, p \leq 0.001$; statement 4: $z = 0.847, p = 0.397$.

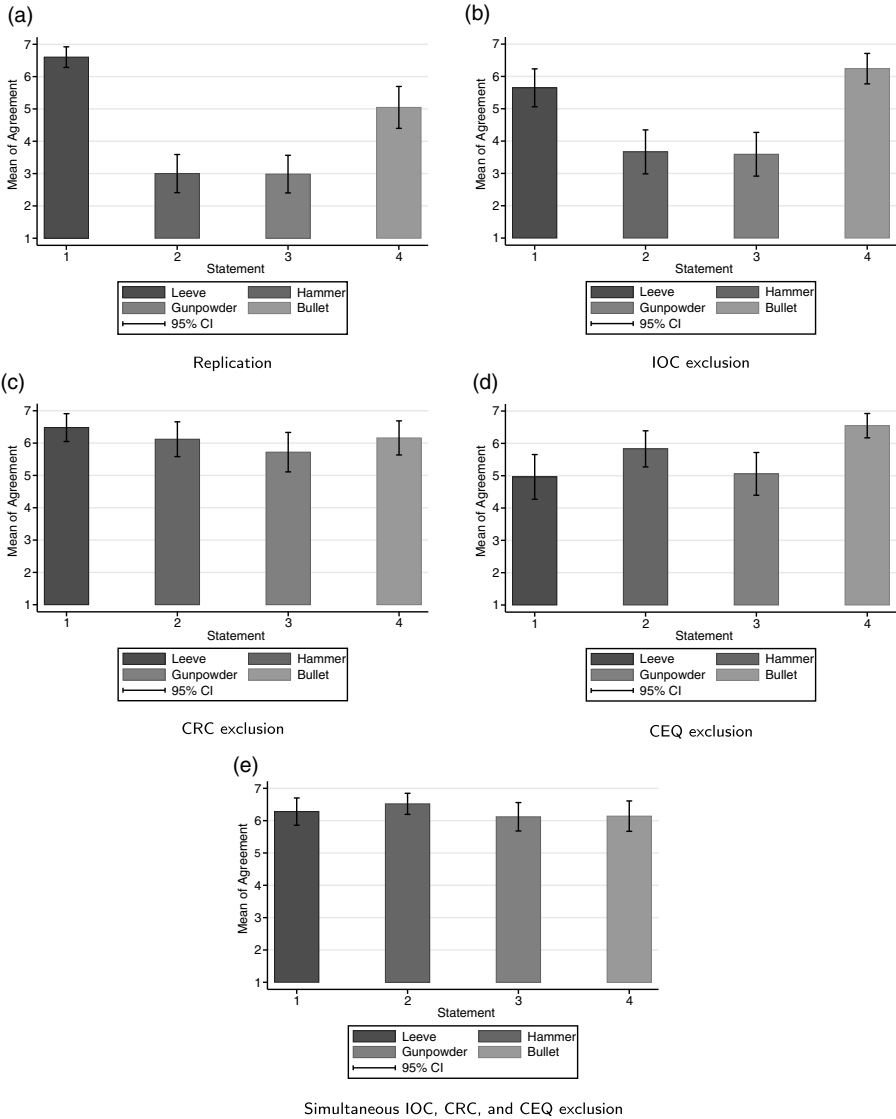


Figure 2. Means of agreements for the replication (2a); the IOC exclusion (2b); the CRC exclusion (2c); the CEQ exclusion (2d); and the simultaneous IOC, CRC, and CEQ exclusion (2e) with the revolver vignette.

significant deviation from the neutral value of 4 at the 1% level ($z = 2.826, p = 0.005$), whereas L&S found none. Overall, this suggests that subjects predominantly agreed with the statement that Leeve (or Trent in the original vignette) caused the death of Uwe (or Brad in the original vignette). At the same time, they disagreed with the statements that the hammer or the gunpowder caused Uwe's (or Brad's) death. Despite the slightly different means, we can consider this a successful replication of the original study. In the following, we will focus on statements (2) and (3),

mentioning intermediaries that, contrary to the CCAC, were not rated to be causes in L&S (2020) and in our replication.

4.2.2 *Exclusion of the intermediary-ontology confusion (IOC)*

The second study rephrased the statements to avoid the IOC. Subjects had to evaluate the following statements:

- (1) LEEVE'S ACTION OF SHOOTING AT UWE CAUSED UWE'S DEATH.
- (2) THE RELEASE OF THE HAMMER CAUSED UWE'S DEATH.
- (3) THE EXPLOSION OF THE GUNPOWDER CAUSED UWE'S DEATH.
- (4) THE BULLET HITTING UWE CAUSED UWE'S DEATH.

The responses to statements (2) and (3) are of special interest to us because subjects tended to disagree with them originally. As can be seen in figure 2b (also see figures 30–33 in appendix C for relative frequencies), subjects ($N = 54$, male: 26, diverse: 1, female: 27, mean age: 41.704) had a mean agreement of 3.667 (95% $CI = [2.988, 4.346]$) for the second statement and a mean agreement of 3.593 (95% $CI = [2.917, 4.269]$) for the third statement. Wilcoxon signed-rank tests showed that, in contrast to the replication described earlier, the mean agreements with the second ($p = 0.357$) and third ($p = 0.219$) statements were no longer significantly different from 4. Here, effect sizes were vanishingly small, though ($r = -0.125$, $r = -0.167$). It seems we can no longer infer that subjects would disagree with the statements that the release of the hammer or the explosion of the gunpowder caused Uwe's death. That is, as expected, we see the same effect of the IOC exclusion for those statements subjects tended to disagree with in the replication as in the poisoned cup vignette: excluding the IOC led subjects not to disagree with statements they tended to disagree with when the IOC was not excluded.

4.2.3 *Exclusion of the causality-responsibility confusion (CRC)*

In a third study, subjects ($N = 50$, male: 18, female: 32, mean age: 42.980) were presented with counterfactual conditionals that omitted the word *cause* to avoid the CRC. We asked them to rate the following statements:

- (1) UWE WOULD NOT HAVE DIED IF LEEVE HAD NOT SHOT AT HIM.
- (2) UWE WOULD NOT HAVE DIED IF THE HAMMER HAD NOT BEEN RELEASED.
- (3) UWE WOULD NOT HAVE DIED IF THE GUNPOWDER HAD NOT EXPLODED.
- (4) UWE WOULD NOT HAVE DIED IF THE BULLET HAD NOT HIT UWE.

As can be seen in figure 2c (also see figures 34–37 in appendix C for relative frequencies), the mean agreements with statements (2) and (3) were distinctly higher than the neutral value of 4. For the second statement, the mean was 6.12 (95% $CI = [5.582, 6.658]$); for the third, it was 5.720 (95% $CI = [5.110, 6.330]$). Wilcoxon signed-rank tests showed that the mean agreement with statements (2) and (3) was indeed significantly different from the neutral value ($p \leq 0.001$). Effect sizes were large for both statements ($r = 0.755$, $r = 0.631$). When excluding the CRC,

we found that subjects strongly agreed that both the release of the hammer and the explosion of the gunpowder were causes in the causal chain. As with the poisoned cup vignette, we take this to be strong evidence in favor of our hypothesis that excluding the CRC by avoiding the use of the ambiguous word *cause* supports the CCAC. Presenting statements with counterfactual conditionals enables an investigation of the ordinary *concept* of causation and prevents the production of misleading evidence concerning the ordinary uses of the ambiguous word *causation*.

4.2.4 Exclusion of the cause-end questioning (CEQ)

Next, we constructed a causal chain for the revolver vignette to avoid the CEQ. Here, subjects were shown the following statements:

- (1) LEEVE'S ACTION OF SHOOTING AT UWE CAUSED THE RELEASE OF THE HAMMER.
- (2) THE RELEASE OF THE HAMMER CAUSED THE EXPLOSION OF THE GUNPOWDER.
- (3) THE EXPLOSION OF THE GUNPOWDER CAUSED THE BULLET TO HIT UWE.
- (4) THE BULLET HITTING UWE CAUSED UWE'S DEATH.

Subjects' ($N = 53$, male: 23, female: 30, mean age: 40.774) mean agreements with statements (2) and (3) were again above 4, as can be seen in figure 2d (also see figures 38–41 in appendix C for relative frequencies). The mean agreement with the second statement was 5.830 (95% $CI = [5.272, 6.389]$), and the mean agreement with the third was 5.057 (95% $CI = [4.396, 5.717]$). Wilcoxon signed-rank tests showed that the mean agreement was significantly different from the neutral value ($p \leq 0.001$, $p = 0.003$). Here, effect sizes were large in the second case ($r = 0.675$) and moderate in the third ($r = 0.404$). Compared to the disagreements with statements (2) and (3) of the replication, subjects now tended to agree that the release of the hammer and the explosion of the gunpowder were causes in a causal chain. Thus, excluding the CEQ showed a clear effect in support of the CCAC.

4.2.5 Simultaneous IOC, CRC, and CEQ exclusion

Lastly, we presented a combination of the previous approaches. Here, subjects were given the following statements:

- (1) THE HAMMER WOULD NOT HAVE RELEASED IF LEEVE HAD NOT SHOT AT UWE.
- (2) THE GUNPOWDER WOULD NOT HAVE EXPLODED IF THE HAMMER HAD NOT RELEASED.
- (3) THE BULLET WOULD NOT HAVE HIT UWE IF THE GUNPOWDER HAD NOT EXPLODED.
- (4) UWE WOULD NOT HAVE DIED IF THE BULLET HAD NOT HIT UWE.

4.2.6 Summary

Figure 2 shows the means of our subjects' agreements with the respective statements for the replication (figure 2a); the IOC exclusion (figure 2b); the CRC exclusion (figure 2c); the CEQ exclusion (figure 2d); and the simultaneous IOC, CRC, and CEQ exclusion (figure 2e). Additionally, table 2 summarizes the statements presented in our studies on the revolver vignette. Beyond the IOC exclusion, we can see significant or highly significant agreements with statements (2) and (3) in each study, with effect

Table 2. Summary of Statements for the Revolver Vignette

Study	Statement	N	M	95% CI	Versus Neutral Value			Versus Replication	
					z	p	r	z	p
Replication	(1) "Leeve caused Uwe's death."	63	6.603	[6.285, 6.922]	7.108	< 0.001***	0.896	—	—
	(2) "The hammer caused Uwe's death."		3.000	[2.410, 3.590]	-3.288	< 0.001***	-0.414	—	—
	(3) "The gunpowder caused Uwe's death."		2.984	[2.402, 3.566]	-3.391	< 0.001***	-0.427	—	—
	(4) "The bullet caused Uwe's death."		5.048	[4.399, 5.696]	2.826	0.005**	0.356	—	—
IOC	(1) "Leeve's action of shooting at Uwe caused Uwe's death."	54	5.648	[5.062, 6.234]	4.404	< 0.001***	0.599	3.367	< 0.001***
	(2) "The release of the hammer caused Uwe's death."		3.667	[2.988, 4.346]	-0.921	0.357	-0.125	-1.754	0.0795
	(3) "The explosion of the gunpowder caused Uwe's death."		3.593	[2.917, 4.269]	-1.230	0.219	-0.167	-1.563	0.1181
	(4) "The bullet hitting Uwe caused Uwe's death."		6.241	[5.770, 6.712]	5.766	< 0.001***	0.785	-2.767	0.006**
CRC	(1) "Uwe would not have died if Leeve had not shot at him."	50	6.480	[6.049, 6.911]	5.943	< 0.001***	0.841	0.410	0.6819
	(2) "Uwe would not have died if the hammer had not been released."		6.120	[5.582, 6.658]	5.339	< 0.001***	0.755	-6.615	< 0.001***
	(3) "Uwe would not have died if the gunpowder had not exploded."		5.720	[5.110, 6.330]	4.463	< 0.001***	0.631	-5.855	< 0.001***
	(4) "Uwe would not have died if the bullet had not hit Uwe."		6.160	[5.633, 6.687]	5.165	< 0.001***	0.730	-2.505	0.012
CEQ	(1) "Leeve's action of shooting at Uwe caused the release of the hammer."	53	4.962	[4.270, 5.654]	2.565	0.0103*	0.352	4.399	< 0.001***
	(2) "The release of the hammer caused the explosion of the gunpowder."		5.830	[5.272, 6.389]	4.911	< 0.001***	0.675	-6.015	< 0.001***
	(3) "The explosion of the gunpowder caused the bullet to hit Uwe."		5.056	[4.396, 5.717]	2.943	0.003**	0.404	-4.471	< 0.001***
	(4) "The bullet hitting Uwe caused Uwe's death."		6.547	[6.170, 6.924]	6.376	< 0.001***	0.876	-3.748	< 0.001***

(Continued)

Table 2. (Continued)

Study	Statement	<i>N</i>	<i>M</i>	95% <i>CI</i>	Versus Neutral Value			Versus Replication	
					<i>z</i>	<i>p</i>	<i>r</i>	<i>z</i>	<i>p</i>
Combination	(1) "The hammer would not have released if Leeve had not shot at Uwe."		6.280	[5.858, 6.702]	5.969	< 0.001***	0.820	1.682	0.0926
	(2) "The gunpowder would not have exploded if the hammer had not released."	50	6.520	[6.194, 6.846]	6.232	< 0.001***	0.856	-7.377	< 0.001***
	(3) "The bullet would not have hit Uwe if the gunpowder had not exploded."		6.120	[5.680, 6.560]	5.725	< 0.001***	0.786	-6.757	< 0.001***
	(4) "Uwe would not have died if the bullet had not hit Uwe."		6.140	[5.670, 6.610]	5.593	< 0.001***	0.768	-2.294	0.0218

N gives the number of participants for each study. Thereafter, the mean agreement (*M*) and 95% confidence intervals (95% *CI*) are given for every statement. Furthermore, the results of Wilcoxon signed-rank tests comparing the agreement to each statement with the neutral value of 4 are reported, followed by the effect size (*r*), calculated by dividing the *z* value by the square root of *N*. Additionally, two-sample Wilcoxon rank-sum tests are reported comparing the statements from subsequent studies to those from our replication. Asterisks denote significance levels: ***p* < 0.01; ****p* < 0.001.

sizes being large or very large in all cases except one with a moderate effect size. Further, the two-sample Wilcoxon rank-sum tests comparing the statements of our modifications to those of our replication (right column of table 2) show that statements (2) and (3) of each modification beyond the IOC exclusion were evaluated significantly differently compared to our replication in each and every subsequent study. Hence, we take our results to be strong evidence in favor of the CCAC.

4.3 GFCI vignette

Finally, a last set of studies was conducted with the GFCI vignette:

Mark is a scientist conducting a very important experiment on an unusual species of plant. His experiment requires growing his plants under a special light, which is plugged into an outlet with a ground fault circuit interrupter (GFCI) safety mechanism. The pipes running to Mark's laboratory were correctly manufactured and installed, and the system was protected from any changes in weather condition. Nonetheless, one day a pipe burst in Mark's laboratory. Water ran into the outlet powering the special light. A properly functioning GFCI is supposed to interrupt the circuit so that no power flows through its outlet. And indeed, the GFCI interrupted the circuit. The special light turned off, and the experiment was ruined.

4.3.1 Replication

As with the other vignettes, we tried to replicate the findings from L&S (2020) first. Hence, the subjects of our first study ($N = 60$, male: 30, female: 30, mean age: 50.667) had to rate the following statements:

- (1) THE PIPE BURSTING CAUSED THE EXPERIMENT TO BE RUINED.
- (2) THE GFCI BREAKING THE CIRCUIT CAUSED THE EXPERIMENT TO BE RUINED.

Whereas the mean agreement of subjects in the study of L&S (2020, 63) was at 5.48 and 3.67, respectively, for these two statements, we obtained means agreements of 5.483 (95% $CI = [4.902, 6.065]$) and 4.117 (95% $CI = [6.285, 6.922]$), as depicted in figure 3a (also see figures 46 and 47 in appendix C for relative frequencies). Similar to the original data from L&S (2020), Wilcoxon signed-rank tests showed that the first statement was significantly different from the neutral value of 4 ($p \leq 0.001$); the second one, however, was not ($z = 0.403$, $p = 0.687$). Hence, the findings from L&S (2020) seem to be replicable with a German-speaking sample and a German translation of their vignette.

4.3.2 Exclusion of the intermediary-ontology confusion (IOC)

Trying to avoid the IOC by focusing on the events did not have much of an effect on the mean agreement with statement (2). Subjects ($N = 64$, male: 38, female: 26, mean age: 50.000) had to rate the following two statements:

- (1) THE PIPE BURSTING CAUSED THE EXPERIMENT TO BE RUINED.
- (2) THE BREAKING OF THE CIRCUIT BY THE GFCI CAUSED THE EXPERIMENT TO BE RUINED.

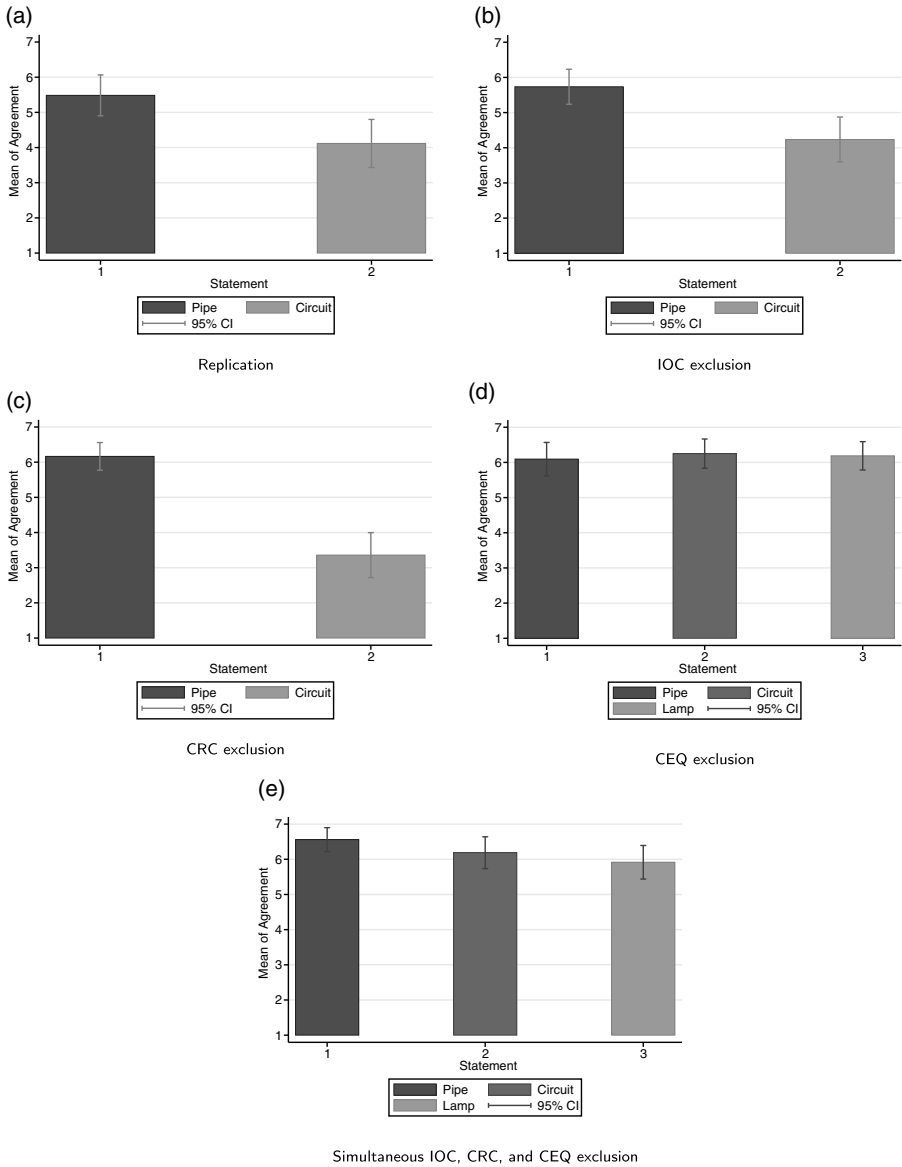


Figure 3. Means of agreements for the replication (3a); the IOC exclusion (3b); the CRC exclusion (3c); the CEQ exclusion (3d); and the simultaneous IOC, CRC, and CEQ exclusion (3e) with the GFCl vignette.

The mean agreement with the second statement was 4.234 (95% CI = [3.596, 4.873]), as can be seen in figure 3b (also see figures 48 and 49 in appendix C for relative frequencies). Again, a Wilcoxon signed-rank test indicated that the second statement was not different from the neutral value ($z = 0.658$, $p = 0.511$), showing practically no effect ($r = 0.082$). That is, for the intermediary event, we found almost the same

result as for the intermediary in the poisoned cup vignette expressed by statement (2) and for the intermediaries in the revolver vignette expressed by statements (2) and (3). Replacing individuals with events led to a neutral response to the respective statements.

4.3.3 Exclusion of the causality-responsibility confusion (CRC)

When we avoided the CRC by omitting talk of “causation,” we obtained a result that is, at first sight, surprising compared to the other vignettes. Here, subjects ($N = 67$, male: 37, female: 30, mean age: 46.267) had to rate the following statements:

- (1) THE EXPERIMENT WOULD NOT HAVE BEEN RUINED IF THE PIPE HAD NOT BURST.
- (2) THE EXPERIMENT WOULD NOT HAVE BEEN RUINED IF THE GFCI HAD NOT BROKEN THE CIRCUIT.

The second statement was rated at 3.358 (95% $CI = [2.720, 3.996]$), as represented in figure 3c (also see figures 50 and 51 in appendix C for relative frequencies). A Wilcoxon signed-rank test showed that it was not significantly different from the scale’s neutral value ($p = 0.073$). The effect size was accordingly low ($r = 0.254$). At first sight, this result might seem surprising. For the other vignettes, the CRC exclusion led to highly significant agreements with the statements depicting intermediaries as causes. But in this case, the agreement with statement (2) decreased compared to the second statements of the replication and the IOC exclusion. However, the story of the GFCI vignette makes the results plausible. Let us reconsider what happens in the vignette: the pipe burst; water ran into the outlet and made the GFCI break the circuit. What would have happened if there had been no GFCI installed in the circuit? The water in the outlet would have led to a short circuit, the special light would have turned off, and the experiment would have been ruined nevertheless. We take this to be commonsense knowledge. However, the GFCI safety mechanism reacts faster. Therefore, if there is a GFCI, then it breaks the circuit, but if there is no GFCI, the circuit breaks anyway. This means that we have a special case of *preemption*, with the GFCI safety mechanism breaking the circuit being the preempting cause and the short circuit being the preempted cause. As is well known, preemption is a major challenge for the counterfactual theory of causation (Lewis 1973): The breaking of the circuit by the GFCI causes the experiment to be ruined. However, subjects tend not to agree with statement (2) because the experiment would also have been ruined even if the GFCI had not broken the circuit (because of the short circuit). In light of this, we actually should have expected the results we obtained for the CRC exclusion. In general, confusing responsibility with causation because of the ambiguous meaning of the word *cause* cannot be ruled out by using counterfactual conditionals for cases including preemption.¹² However, as we will see in the next section, the CEQ exclusion alone is sufficient for doing so.

¹² We are aware of the fact that explaining our results with preemption is rather hypothetical at the moment. We think that more empirical research on preemption is required (for a brief overview, see Henne [forthcoming](#)).

4.3.4 Exclusion of the cause-end questioning (CEQ)

As for the other vignettes, we also constructed a causal chain to avoid the CEQ, using the following statements:

- (1) THE BURSTING OF THE PIPE CAUSED THE GFCI TO BREAK THE CIRCUIT.
- (2) THE BREAKING OF THE CIRCUIT BY THE GFCI CAUSED THE SPECIAL LIGHT TO TURN OFF.
- (3) THE SPECIAL LIGHT TURNING OFF CAUSED THE EXPERIMENT TO BE RUINED.

In this case, subjects ($N = 64$, male: 29, female: 35, mean age: 47.516) evaluated the second statement at 6.250 (95% $CI = [5.835, 6.665]$), as can be seen in figure 3d (also see figures 52–54 in appendix C for relative frequencies). A Wilcoxon signed-rank test showed that this evaluation was significantly different from the neutral value ($p \leq 0.001$), with a large effect ($r = 0.790$). Compared to the disagreements with statement (2) of the replication, subjects in this case strongly agreed that the breaking of the circuit by the GFCI was a cause in the causal chain that, in the end, led to a ruined experiment. The reason for this is that subjects did not consider the responsibility of the intermediary for the end link of the causal chain because of the CEQ exclusion. The CEQ, as applied by L&S (2020), supported the CRC and thus led subjects to consider the responsibility of the intermediary for the ruined experiment. Thus, excluding the CEQ showed a clear effect in support of the CCAC.

4.3.5 Simultaneous IOC, CRC, and CEQ exclusion

Lastly, a combination of the previously described variations introduced the following statements:

- (1) THE GFCI WOULD NOT HAVE BROKEN THE CIRCUIT IF THE PIPE HAD NOT BURST.
- (2) THE SPECIAL LIGHT WOULD NOT HAVE TURNED OFF IF THE GFCI HAD NOT BROKEN THE CIRCUIT.
- (3) THE EXPERIMENT WOULD NOT HAVE BEEN RUINED IF THE SPECIAL LIGHT HAD NOT TURNED OFF.

Similar to the causal chain in section 4.3.4, subjects ($N = 59$, male: 38, female: 21, mean age: 51.356) evaluated statement (2) at 6.186 (95% $CI = [5.734, 6.639]$), as can be seen in figure 3e (also see figures 55–57 in appendix C for relative frequencies). A Wilcoxon signed-rank test showed that, again, it was significantly different from 4 ($p \leq 0.001$), with a large effect ($r = 0.775$). Again, we found a very high agreement for the GFCI safety mechanism breaking the circuit being a cause in the causal chain, contrary to the results of L&S (2020). Apparently, the modifications of the IOC exclusion and the CRC exclusion, which both did not lead to an agreement with the respective second statements independently, were overruled by the CEQ exclusion. In sum, the simultaneous exclusion of the IOC, CRC, and CEQ strongly supports the CCAC, contrary to L&S (2020).

4.3.6 Summary

Figure 3 shows the means of our subjects' agreements with the respective statements for the replication (figure 3a); the IOC exclusion (figure 3b); the CRC exclusion (figure 3c); the CEQ exclusion (figure 3d); and the simultaneous IOC, CRC, and CEQ exclusion (figure 3e). Additionally, table 3 summarizes the statements presented in our studies on the GFCI vignette. For the CEQ exclusion and the simultaneous IOC, CRC, and CEQ exclusion, we found highly significant agreements with the respective second statements, which were evaluated significantly differently from our replication. However, we found an interesting pattern for the CRC exclusion that diverged from our results for the poisoned cup vignette and the revolver vignette, which we hypothesize resulted from the GFCI vignette involving a case of preemption. Hence, testing the concept of causation by counterfactual conditionals should have been expected to fail for this vignette. Nevertheless, the CEQ exclusion alone presents strong evidence supporting the CCAC for the same vignette as used by L&S.

5 Conclusion

In this article, we argue that the results of L&S (2020) are caused by three interrelated problems: the IOC, the CRC, and the CEQ. The design of L&S (2020) suffers from all of them. Hence, it generates effects leading subjects to confuse causality with responsibility. We hypothesized that excluding the IOC, the CRC, and the CEQ would lead to results supporting the CCAC for the same vignettes originally used by L&S (2020) to challenge the CCAC.

In order to investigate this assumption, we replicated the results of L&S (2020) and successively tested modifications that aimed at excluding the IOC, the CRC, and the CEQ. In a last step, we tested all modifications simultaneously. Our results focus on the intermediaries of the causal chains presented in the vignettes because the results of L&S (2020) seem to show primarily that laypeople tended to disagree that the intermediaries of the causal chains were causes.

Excluding the IOC, according to our studies, led to less disagreement that the intermediaries were causes for all vignettes. We assume that the reason for this is that replacing individuals with events reduced responsibility considerations triggered by individuals. For the poisoned cup vignette, L&S (2020) obtained similar results. Hence, we expected our findings to apply to all three vignettes.

Excluding the CRC led to strong evidence that—contrary to the results of L&S (2020)—intermediaries were conceived to be causes for the poisoned cup vignette and the revolver vignette. Asking about the concept of causation without using the ambiguous word *causation* prevented subjects from confusing causality with responsibility. The modification of CRC exclusion did not work for the GFCI vignette. In hindsight, the reason for this seems to be obvious: the GFCI vignette contains a case of preemption, and counterfactual conditionals should be expected not to work for cases of preemption because preemption is a major problem for the counterfactual theory of causation. However, we leave this question open for future research in the experimental philosophy of causation.

Excluding the CEQ provided strong evidence supporting our hypothesis that intermediaries that are presented as direct causes of the undesirable and awful end links of the chains trigger the confusion of causality and responsibility. If an

Table 3. Summary of Statements for the GFCI Vignette

Study	Statement	N	M	95% CI	Versus Neutral Value			Versus Replication	
					z	p	r	z	p
Replication	(1) "The pipe bursting caused the experiment to be ruined."	60	5.483	[4.902, 6.065]	4.369	< 0.001***	0.564	—	—
	(2) "The GFCI breaking the circuit caused the experiment to be ruined."		4.117	[3.434, 4.799]	0.403	0.6871	0.052	—	—
IOC	(1) "The pipe bursting caused the experiment to be ruined."	64	5.734	[5.236, 6.232]	5.310	< 0.001***	0.664	−0.556	0.5781
	(2) "The breaking of the circuit by the GFCI caused the experiment to be ruined."		4.234	[3.596, 4.873]	0.658	0.511	0.082	−0.122	0.9028
CRC	(1) "The experiment would not have been ruined if the pipe had not burst."	67	6.164	[5.771, 6.557]	6.484	< 0.001***	0.917	−1.760	0.0785
	(2) "The experiment would not have been ruined if the GFCI had not broken the circuit."		3.358	[2.720, 3.996]	−1.794	0.0728	0.254	1.566	0.1173
CEQ	(1) "The bursting of the pipe caused the GFCI to break the circuit."	64	6.094	[5.619, 6.568]	6.039	< 0.001***	0.755	−2.155	0.0312
	(2) "The breaking of the circuit by the GFCI caused the special light to turn off."		6.250	[5.834, 6.665]	6.317	< 0.001***	0.790	−4.842	< 0.001***
	(3) "The special light turning off caused the experiment to be ruined."		6.188	[5.785, 6.590]	6.628	< 0.001***	0.828	—	—
Combination	(1) "The GFCI would not have broken the circuit if the pipe had not burst."	59	6.559	[6.220, 6.899]	6.780	< 0.001***	0.883	−3.391	< 0.001***
	(2) "The special light would not have turned off if the GFCI had not broken the circuit."		6.186	[5.734, 6.639]	5.949	< 0.001***	0.775	−4.619	< 0.001***
	(3) "The experiment would not have been ruined if the special light had not turned off."		5.915	[5.438, 6.393]	5.508	< 0.001***	0.717	—	—

N gives the number of participants for each study. Thereafter, the mean agreement (M) and 95% confidence intervals (95% CI) are given for every statement. Furthermore, the results of Wilcoxon signed-rank tests comparing the agreement to each statement with the neutral value of 4 are reported, followed by the effect size (r), calculated by dividing the z value by the square root of N. Additionally, two-sample Wilcoxon rank-sum tests are reported comparing the statements from subsequent studies to those from our replication. Asterisks denote significance levels: ***p < 0.001.

intermediary d_1 is presented as a cause of a further intermediary d_2 , then d_1 is not judged to be something that is responsible for an awful event but is perceived as a cause in a chain of causes and effects. Hence, excluding the CEQ led to a high agreement that intermediaries were causes, contrary to the findings of L&S (2020).

Excluding the IOC, the CRC, and the CEQ simultaneously led to a highly significant agreement that the intermediaries of the replications were causes for all vignettes. The effect sizes for the respective statements were high or very high in all cases, which means that the same intermediaries that were all assessed *not* to be causes in L&S (2020) were assessed to be causes. We take this to be strong evidence in support of the CCAC.

Lastly, we think that our results challenge the RV, which takes *responsibility* to be part of the concept of causation. However, this point is not the subject of this article and deserves further investigation—as does the problem of preemption.

Supplementary material. The supplementary material for this article can be found at <https://doi.org/10.1017/psa.2023.1>

Acknowledgments. We are thankful to Mark Siebel, Ewgenia Baraboj, Jonathan Livengood, and Justin Sytsma.

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