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## Causal Explanation Is All There Is to Causation

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### RESUMEN

La ciencia trata los factores ausentes como si pudieran incluirse en relaciones causales. Los filósofos discrepan sobre problema de la “causación por ausencia” [*absence causation*]. Quienes entienden las causas como aquello que establece diferencias tienden a aceptar tal tipo de causación; quienes defienden perspectivas realistas o basadas en procesos tienden a rechazarla. En este artículo, defiendo que ninguno de los enfoques actualmente existentes tiene éxito. Ofrezco entonces una alternativa que entiende la explicación causal como conceptualmente prioritaria respecto a la causación y también un enfoque inferencialista de la explicación. Finalmente, muestro cómo mi propuesta sobre la causación se aplica a la causación por ausencia.

PALABRAS CLAVE: *causación, explicación, explicación causal, inferencialismo, causación por ausencia.*

### ABSTRACT

Science treats absences as though they can stand in causal relationships. Philosophers disagree on the issue of absence causation. Proponents of difference-making accounts of causation tend to accept; proponents of process or realist accounts to reject it. I argue in this paper that no existing treatment is successful. I then offer an alternative that understands causal explanation as conceptually prior to causation and an inferentialist account of explanation. Finally, I show how my account of causation applies to causation by absences.

KEYWORDS: *Causation, Explanation, Causal Explanation, Inferentialism, Causation by Absences.*

## I. INTRODUCTION

Can absences be causes? Scientific practice suggests they can. Here are examples from a variety of scientific disciplines:

- *Physics*: Bombarding a diamond with high-energy particles such as photons can cause electrons to be ejected from the bond between the carbon atoms, forming a ‘hole’, which is positively charged. If

an electric field is applied to the crystal, the freed electrons will tend to drift in the direction of the applied field, producing a current. The holes or absent electrons will flow the opposite way, contributing to the current [Shockley (1950), pp. 9-10].

- *Marine Geology*: Wherever the absence of oxygen causes anaerobic conditions, iron sulfide may form [Kuenen (1950), p. 218].
- *Biology*: As part of the mechanism of lactose regulation in *E.Coli*, the absence of lactose causes the Lac repressor to bind to the lac operator site and prevent the transcription of the lac operon [Griffiths et al. (1999)].
- *Nutritional science/physiology*: Prolonged starvation causes the body to fuel the brain with  $\beta$ -hydroxybutyrate instead of glucose [Cahill (2006)].
- *Psychology*: The absence of a noisy background makes trace discrimination so easy that genuine trace decay is masked by a ceiling effect [Baddeley and Scott (1971), p. 276].
- *Economics*: The absence in Islamic law of the concept of a corporation contributes to economic underdevelopment in the Middle East [Kuran (2004)].
- *Sociology*: Father absence negatively affects children's social-emotional development [McLanahan et al. (2013)].
- *International relations*: The absence of territorial threat causes a reduction in the likelihood of conflict in a dyad and is necessary for a dyadic democratic peace [Gibler and Tir (2010)].
- *Development studies*: 'The causal connection between democracy and the nonoccurrence of famines is not hard to seek [i.e., democracy causes the absence of famines/democracy prevents famines.]' [Sen (1999)].
- *World history*: In 17th century Asia Minor, the absence of strong government opposition together with the cooperation of local magnates, religious students, and corrupt officials, caused unemployed mercenary soldiers and provincial magnates to become leaders of semiautonomous regional power centres [Goldstone (2016), p. 385].

Examples like these can relatively easily be multiplied. I take it as my starting point that the sciences treat absences as if they can stand in

causal relationships.<sup>1</sup> An account of causation in the sciences should be able to make sense of this fact about scientific practice.

Philosophers of causation are divided on the issue of absence causation. Advocates of counterfactual or difference-making accounts of causation tend to accept it. Since causation consists in the whether or not a difference between a positive event and its absence makes a difference to an outcome, it does not matter whether the positive event is actual and the absence merely possible or vice versa. There is no structural difference between ‘My drinking of cheap wine caused my hangover the next morning’ and ‘My abstaining from drinking of cheap wine prevented me from getting a hangover the next morning’. By contrast, proponents of physicalist and realist theories of causation tend to reject causation by absences. They argue that *ex nihilo nihil fit* (nothing comes of nothing). David Armstrong, for instance, writes: ‘Omissions and so forth are not part of the real driving force in nature. Every causal situation develops as it does as a result of the presence of positive factors alone’ [Armstrong (1999), p. 177].

I argue in this paper that no existing account of causation that offers a treatment of absence causation is successful. Difference-making approaches tend to multiply causation beyond the acceptable. In other words, they encounter what I call the ‘problem of proliferation of causes’. Physicalist and realist approaches drive a wedge between positive causation and causation by absences that is solicited neither by ordinary language nor by scientific practice. I argue that the key to solving the problem of absence causation is to notice that it is explanatory considerations that enable us to judge which of a number of potentially relevant factors is a cause. Taking this idea as the starting point, I will argue that there is nothing beyond causal explanation in the concept of cause.

Proponents of causal explanation maintain that the explanans in a causal explanation provides information about the causal history of the event described in the explanandum [Lewis (1986)]. I argue that they have the conceptual order precisely upside down. Explanation comes first, causation second. There is no objective causal structure of the world, information about which is gathered and employed in causal explanations only at a later stage. In other words, the network model, according to which [Beebe (2004), p. 291]:

[t]he complete causal history of the universe can be represented by a sort of vast and mind-bogglingly complex “neuron diagram” of the kind com-

monly found in discussions of David Lewis, where the nodes represent events and the arrows between them represent causal relations...

is mistaken. Instead, I argue that causation and explanation are established jointly in a complex inquiry that does not neatly separate into a 'causal inference' and an 'explanation' stage.

## II. Existing Work on Absence Causation

This section reviews and criticises existing stances on causation by absences. To make things easy, and because most of the discussion is framed in terms of singular or token-level rather generic or type-level causation, let me introduce a toy example that has, nevertheless, some scientific content. Meet Hamlin, the heedless hermit. Hamlin lives reclusively in a little hut in a faraway forest. Hamlin is not too fond of people and leaves his hut only to replenish the pantry. A bit on the paranoid side too, he locks the only door to his hut at night. It is a long trek to the village stockist and so one summer Hamlin digs out a two-storey cellar under his hut to allow him to survive longer periods without going out. One day the next winter, Hamlin intends to go out to buy goods to fill the last morsel of space in his cellar but he finds that he cannot locate the key to his door. 'I might as well', he thinks to himself, and spends the next 24 years living off his inventory until a group of scouts note a strange smell emanating from the hut and alarm the authorities. Taken to a hospital, he is given a full medical check-up. His state of health is determined to be surprisingly good under the circumstances but he is extremely pale and appears to suffer from a softening of his bones.

This case illustrates diverse kinds of causation by and of absences, including the hermit's heedlessness that causes a *key to be absent*, an *absent key* that causes Hamlin's complete seclusion, the *deprivation* of sunlight, which causes his vitamin-D *deficiency*, which in turn may cause all sorts of afflictions such as osteomalacia, osteoporosis, rickets, and depression [Gillie (2004)].

### II.1 *David Lewis*

David Lewis defends a difference-making theory of causation according to which, roughly, C causes E if E counterfactually depends on C, i.e., if it is true that had C not been the case, E would not have been the case (either).<sup>2</sup> Lewis accepts that absences can be causes [e.g., Lewis (2004) [2000]].<sup>3</sup> But he immediately notes that doing so is not innocuous:

‘One reason for an aversion to causation by absences is that if there is any of it at all, there is a lot of it — far more of it than we would normally want to mention. At this very moment, we are being kept alive by an absence of nerve gas in the air we are breathing’ [*ibid.* p. 100]. Hamlin’s lack of exposure to sunlight caused his vitamin-D deficiency. But under a counterfactual account of causation, so did the fact that earlier groups of Scouts did not find him or the village stockist’s failure to carry vitamin-D supplements,<sup>4</sup> and a zillion other people’s failure to do something that would have prevented Hamlin’s vitamin-D deficiency. Let us call claims such as ‘The village stockist’s failure to carry vitamin-D supplements caused Hamlin’s vitamin-D deficiency’ ‘irrelevant absence causation claims’. Irrelevant absence causation claims are intuitively false, and I will argue below that there are good reasons for maintaining that they are false indeed. I call the problem posed by theories of causation that deem irrelevant absence causal claims true the ‘problem of proliferation of causes’.

Lewis’s solution to the problem of proliferation of causes is (a) to bite the bullet and accept that irrelevant absences are in fact causes; but (b) to argue that there are Gricean pragmatic reasons for not mentioning them in a conversation [*ibid.* p. 101]: ‘There are ever so many reasons why it might be inappropriate to say something true. It might be irrelevant to the conversation, it might convey a false hint, it might be known already to all concerned, and so on [Grice 1975]’. Thus, while it is true, according to this account, that the village stockist’s failure to provide vitamin-D supplements caused Hamlin’s deficiency, we don’t normally mention this because it would be inappropriate to do so, as it would be to mention to one’s partner, ‘You look fat!’ even though, indeed, they look fat. In the case of the grocer’s neglect an argument could be made that mentioning it in a conversation violates Grice’s maxim of relation as it is, while true, irrelevant in the context at hand.

The problem with Lewis’s suggestion is that we don’t just *fail to assert* irrelevant absence causation claims, we positively *deny* them [Beebe (2004), McGrath (2005)]. I certainly wouldn’t causally attribute Hamlin’s state to the grocer’s neglect, and there is some empirical evidence that indicates that ‘ordinary folk’ (i.e., students at elite universities) are largely in agreement about analogous cases [Livengood and Machery (2007)]. What makes matters worse is that pointing out to irrelevant absence causation deniers that under a counterfactual account of causation irrelevant absence causation claims are true does not appear to make them change

their judgement. They instead take this as a reason to doubt the counterfactual theory [McGrath (2005)].

Another reason for thinking that irrelevant absence causation claims are not merely inappropriate to make but false is that they do not have the usual connotations of causal claims. Causal claims normally support claims about predictions. But I will not, when notified of the village stockist's continued 'negligence' (and not much else), predict that other individuals in his trading area will develop vitamin-D deficiency. Causal claims normally support claims about interventions. But I will not ever propose a policy that mandates grocers to supply vitamin-D to hermits. Causal claims normally support claims about the attribution of blame and praise. But I will not travel to the village, enter the shop and reprimand the owner for his negligence. And if I get asked why Hamlin came down with vitamin-D deficiency, I will be met with incredulity if I answer 'The village stockist didn't give him food supplements. *That* absence does not explain.

## II.2 *Contrastive Causation*

Jonathan Schaffer works largely in the Lewis tradition but maintains that causation is contrastive, that is, the prototypical form of a causal claim is 'C rather than C\* caused E rather than E\*', where C\* and E\* are alternative events [Schaffer (2004b), (2005). Schaffer, like Lewis, accepts causation by absences [see in particular Schaffer (2004a)]. He gives four reasons in favour of doing so [Schaffer (2005), pp. 300-1]:

- (1) Absence causation is intuitive: intuition accepts some absences as causal.
- (2) Absences play the predictive and explanatory roles of causes and effects.
- (3) Absences play the moral and legal roles of causes and effects.
- (4) Absences mediate causation by disconnection.

I have already given examples that illustrate (1) and (3). All scientific examples given at the beginning of this paper are examples for (2). Schaffer gives a gory example for (4): decapitation causes death by preventing oxygenated blood from preventing brain starvation. Thus, the absence of blood mediates decapitation and death.

Schaffer, too, notes the problem of proliferation of causes. And he gives exactly Lewis's response [*ibid.* p. 302]:

The one aspect of the paradox of absences that the contrastive strategy does not directly resolve is... the problem of counterintuitive causal claims. That is, contrastivity allows that the queen's reigning on her throne

rather than watering my flowers causes my flowers to wilt rather than blossom. But perhaps this remaining implausibility can be explained away pragmatically. Perhaps the reason it sounds wrong to say that the queen's not watering my flowers causes them to wilt is that we never supposed that the queen would deign to water my flowers. Contrastivity helps explain why this affects the acceptability of the absence claim. We resist taking such an unrealistic supposition as a contrast. The queen's watering my flowers is not easily swallowed as a relevant alternative. At  $c^*$  sits an irrelevance. The contrasts trigger the pragmatics.

But how can we explain the making of false assertions on the basis of pragmatics in this case? We often make false claims that can be justified pragmatically. 'No, you don't look fat!' is a case in point. Apart from being hurtful, the truth may be too complex or irrelevant. A truth may not speak to the intended audience while the uttered falsehood does. None of these reasons apply with respect to irrelevant absence causation claims. It's certainly not hurtful to say that the grocer's failure to supply supplements caused the hermit's vitamin-D deficiency or that the Queen of the United Kingdom sitting on her throne caused Schaffer's flowers to wilt. It's not complex, at least not any more than the intuitively true causal claims about Hamlin's forgetfulness and lifestyle. As their name suggests, irrelevant absence causation claims are irrelevant, but the response to making one is not, 'That is irrelevant', but rather: 'That is false'. Pointing to the irrelevance of the contrast events therefore does not solve the problem.

Does the claim speak to the audience? I maintain that causal claims are not established, asserted, or defended for their own sake (Reiss 2015). Scientists don't pursue causal inquiries in order to add to our knowledge of the causal structure of the world. First and foremost, causal claims are useful claims. Correlatively, acceptability of a causal claim stands and falls with its usefulness. Causal claims are useful because they support predictions and explanations, interventions and the attribution of blame and praise. Not all causal claims are good at all these functions. The sentence 'Gravity causes stars to collapse' is not helpful to attribute blame or praise. Many causal relations are fragile and subject to interferences. Therefore, the corresponding claims are often not useful for predictions. If a causal claim mentions a factor on which we cannot intervene, we cannot exploit the relation to bring about a desired effect. An irrelevant absence causation claim is not useful for any of these purposes.

So here is a possible defence of the Lewis/Schaffer approach based on pragmatics. An irrelevant absence causation claim is true, but denied because ordinary folk and, in particular, scientists (as well as legal theorists, historians and so on) expect causal claims to be useful and, since it is not, it does not speak to them. When amongst each other, metaphysicians in the Lewis tradition make free use of such claims.

Of course, this won't work. When a teacher is explaining to a student that humans descended from apes, she is strictly speaking uttering a falsehood. But this falsehood might speak better to the student than the truer claim that human beings and the other great apes descended from a common hominid ancestor who was not, strictly speaking, an ape [this example is due to Elgin (2007)]. But the teacher would normally know that the simple claim is false and use it deliberately in order to enhance understanding or retaining. When we deny that the grocer caused the hermit's vitamin-D deficiency, we do not have such objectives in mind. We're convinced of the falsehood of the irrelevant absence causation claim ourselves.

I conclude that the Lewisian two-stage picture of (1) there is a plethora of true claims of causation by absence, given by the appropriate relations of counterfactual dependence; and (2) only some of these are assertible, pragmatics determines which, is mistaken.

### II.3 *Physical Connection*

One of David Hume's criteria for causation was that a cause and effect must be contiguous. That is, there must not be spatio-temporal gaps between the cause and the onset of the effect. There are various theories of causation building on this idea [e.g., Aronson (1971), Ehring (1998), Fair (1979), Russell (1948), Salmon (1984), (1994)]. These accounts maintain, essentially, that for C to cause E C and E must be connected by a causal process of the right kind. The main difference between different physical connection accounts lies in their understanding of the notion of a 'causal process'.

Phil Dowe has addressed absence causation explicitly, and developed an account of absence causation within the framework of a causal process theory [Dowe (2004), (2007)]. According to Dowe (2007), p. 167:

C causes E iff

1. there is a set of causal processes and interactions... between C and E, and
2.  $ch_{Cq}(E) > ch_{-Cq}(E)$ , where  $q$  is an actual causal process linking C with E,



where [*ibid.* p. 90]:

CQ1, A causal process is a world line of an object that possesses a conserved quantity.

CQ2. A causal interaction is an intersection of world lines that involves exchange of a conserved quantity.

Absences are not physically connected to the events we sometimes speak of as their effects. Whatever Hamlin did when he forgot where he put his key did not issue in a causal process that interacted with lock on the door responsible for his captivity. Dowe consequently rejects causation by absences. What he offers instead is a novel concept, called ‘quasi-causation’ [Dowe (2004)] or causation\* [Dowe (2007)], to characterise these kinds of cases. Dowe calls causation by absence ‘omission’<sup>5</sup> and defines it as follows [Dowe (2007), p. 136]:

Omission: not-A caused\* B if

(O1) B occurred and A did not, and there occurred an  $x$  such that

(O2)  $x$  caused B, and

(O3) if A had occurred then B would not have occurred, and there would have been a causal relation between A and the process due to  $x$ , such that either

(i) A is a causal interaction involving the causal process  $x$ , or

(ii) A causes  $y$ , a causal interaction involving the causal process  $x$ ,

where A and B name positive events, and  $x$  and  $y$  are variables ranging over facts or events.

Cases of causation by absence are thus termed cases of causation\*. Lack of sunlight caused\* Hamlin’s vitamin-D deficiency. Vitamin D that is absorbed from food or supplements or synthesised in the skin after exposure to sunlight is converted by the liver into calcifediol. Calcifediol is then converted in the kidneys into calcitriol, the active form of vitamin D in the body and a secosteroid hormone. Calcitriol increases the uptake of calcium from the gut into the blood. When the blood serum level of calcium is low, calcium will leave the bones and if the vitamin-D deficiency is prolonged, this process leads to rickets and osteoporosis. Supposing that Hamlin did develop osteoporosis (B), the just mentioned process ( $x$ ) caused it, and (presumably) it is true that if he had been ex-

posed to sunlight (A), then osteoporosis would not have occurred. A would have interacted with  $x$ .

Dowe's account does not, however, solve the problem of proliferation. Anyone's providing the hermit with vitamin D would interrupt the decalcification process and thus 'The village stockist's failure to provide vitamin-D supplements to Hamlin caused\* his deficiency' (or any other irrelevant absence causation claim) is true. But irrelevant absence causation claims are false.

There is another problem with Dowe's account. In ordinary English there is no distinction between 'cause' and 'cause\*' or 'quasi-cause'. This does not immediately imply that there is no corresponding difference in nature. Ordinary language glosses over many important differences, and it evolves in response to changes in culture, the environment, and our knowledge of the world. Among Francis Bacon's 'Idols of the Mind' were the 'Idols of the Market Place', which concerned exactly the potential lack of correspondence between ordinary language concepts and the structure of the world [Urbach and Gibson (1994) Book I, Aphorism 43]:

There are also Idols formed by the intercourse and association of men with each other, which I call Idols of the Market Place, on account of the commerce and consort of men there. For it is by discourse that men associate, and words are imposed according to the apprehension of the vulgar. And therefore, the ill and unfit choice of words wonderfully obstructs the understanding. Nor do the definitions or explanations wherewith in some things learned men are wont to guard and defend themselves, by any means set the matter right. But words plainly force and overrule the understanding, and throw all into confusion, and lead men away into numberless empty controversies and idle fancies.

If there is a significant lack of correspondence between language and world, scientific investigation can reveal this and introduce more precise and accurate concepts. Thus, modern physics distinguishes instantaneous from average velocity [Kuhn (1981)/(1963)], modern biology between biospecies, ecospecies, and phylopecies, modern psychology between working memory, short term memory, iconic memory, and long term memory (for the second and third example, see Taylor and Vickers (2017)). There is no analogue with respect to absence causation. It is well understood that decapitation causes death by preventing oxygenised blood from flowing to the brain. No new concepts have been introduced in science to describe this fact.

And this is odd since there are thousands of concepts to describe acts of causing in ordinary and scientific language: smoking *kills*, increases in the money stock *inflate* the price level, Suzy *shoved* Billy, the storm *delayed* the plane, enzymes *phosphorylate* proteins. These are all causal relations, and the specific causative verb used provides more information about the kind of causal relation than would ‘cause’. ‘Kill’ provides information about the effect (death); ‘inflate’ about the direction (bigger); ‘shove’ about action (push) and the manner (forcefully); ‘delay’ about the timing (later); ‘phosphorylate’ about the mechanism (phosphorylation). There is no causative verb that expresses ‘causation by absence’ that would be more accurate to use than ‘cause’ or whichever causative verb that is used and that does not distinguish between positive and negative causation.<sup>6</sup>

Absence causation does not raise a scientific puzzle that scientists could solve by splitting the concept into two or more. Absence causation is a well-known phenomenon that does not seem to require that kind of conceptual manifestation. If it did, scientists would have long introduced novel terminology that works better for their purposes. Absence causation poses at best a metaphysical problem. But it does so only if one presupposes that causation must be a relation or for some other reason must originate in an event or some other metaphysical entity. Starting instead, as I do, with the view that philosophy should be continuous with scientific practice, certain metaphysical principles shouldn’t override well established knowledge and custom.<sup>7</sup>

#### II.4 Causation vs explanation

Helen Beebe agrees with Phil Dowe and many others who argue that effects must emanate from something real [e.g., Anjum and Mumford (2018), Armstrong (1999), Moore (2009), Mumford and Anjum (2011)] that there is no causation by absence [Beebe (2004), p. 291]. Unlike Dowe, however, Beebe recognises the problem of proliferation of causes. She therefore proposes to amend the definition of causation by absence with a clause stating that only those absences count as causes that deviate from the normal course of affairs [*ibid.* p. 296]:

- (I) The absence of an A-type event caused b if and only if b counterfactually depends on the absence: Had an A-type event occurred, b
  - (i) would not have occurred; and

- (ii) the absence of an A-type event is either abnormal or violates some moral, legal, epistemic, or other norm.

Hamlin's losing the key to his hut comes out as a cause of his vitamin-D deficiency because clause (ii) is satisfied: it is abnormal to misplace the key to one's house for 24 years, especially if that means that one cannot get out. At the same time, the grocer's failure to provide food supplements is not a cause as his behaviour is not abnormal.

Beebee then goes on to argue that this definition is fine as far as the ordinary concept of causation is concerned, but it is unsatisfactory as an account of the metaphysics of causation. Human-made norms should not be thought to affect what there is by way of causal facts.

Her account of the metaphysics of causation builds on a distinction between causation and causal explanation. In what she thinks of as ordinary cases of causation, causal explanation and causation go together. Why did the match light? Because it was struck. The striking of the match caused it to light. But in cases of causation by absence, no causal relation corresponds to the explanatory claim. We may answer the question, 'Why did Hamlin have vitamin-D deficiency?' by saying, 'Because of the lack of sunlight', but lack of sunlight did not cause the deficiency.

How can we make sense of the idea that causal explanations do not always describe causal relations, i.e., that it is not always the case that the explanans of a causal explanation describes a cause and the explanandum an effect? Beebee invokes David Lewis' account of causal explanation, according to which, 'to explain an event is to provide some information about its causal history' [Lewis (1986), p. 217] in support. In her view [*ibid.* p. 302]:

One can give information about an event's causal history in all sorts of other ways—by saying, for instance, that certain events or kinds of event do not figure in its causal history, or by saying that an event of such-and-such kind occurred, rather than that some particular event occurred.

According to the Lewisian account, 'JFK died because someone shot him' is a causal explanation in that it provides some information about JFK's death, but it does not describe a causal relation as 'someone shot JFK' is not an event — it is at best a disjunction of particular events. Similarly, citing that something that would have caused one outcome did not happen explains the occurrence of the alternative outcome because we learn that a particular event was not in the effect's causal history and we learn about the causal structure of a nearby world in which Hamlin was exposed to sunlight. Common sense is mistaken when it judges that some absence

caused an outcome. But that is understandable as causation and causal explanation are very similar and do overlap to a considerable extent.

There are various issues with Beebe's account. Let me focus on the main problem here: an appeal to Lewis' theory of causal explanation invites some classical counterexamples to older theories of scientific explanation.

Causes provide information about the occurrence of their effects; but effects also provide information about the occurrence of their causes. Take a standard counterexample to the deductive-nomological model of explanation [Hempel and Oppenheim (1948)]: We can infer the height of the flagpole from the length of the shadow (provided we have information about the position of the sun), but we'd be hard pressed to accept the length of the shadow as explaining the height of the flagpole. Now, as we have seen, Lewis explicitly allows causal explanations to be existential in character (e.g., 'There exists an individual who shot JFK' explains that JFK died). But as the length of the shadow *provides information about* height of the flagpole, the length of the shadow also provides information about the existence of *causes* of the height of the flagpole: *viz.*, that the causes of the height of the flagpole must have been exactly such that it could cast the shadow we have observed. Similarly in common-cause structures: the drop of the barometer reading provides information about the causes of the storm — but the barometer reading does not explain the storm [Hartsock (2010)].

So, we can't be quite as permissive as Lewis and, by extension, Beebe. Unless Beebe (or anyone else) succeeds in providing an account of causal explanation that allows non-causes to explain outcomes causally without running into counterexamples, we will have to come to the conclusion that her attempt to distinguish between positive and negative causation by declaring the latter to be non-causation but causal explanation fails because causal explanations need to cite causes.

### III. WHAT IS A SCIENTIFIC EXPLANATION?

I agree with Beebe that (some) absences causally explain outcomes. I also agree that (some) events causally explain outcomes. What I deny is that this explanatory equivalence between negative and positive causation, as well as the linguistic equivalence discussed in Section II.3 translate into a significant causal difference.

When no existing account can handle certain kinds of causal claim that are important to the sciences it is time to look for something new. I

do so in this section and the next, leaving my own treatment of absence causation to Section 5. To motivate my account, note that what's wrong with Dowe's and Beebe's accounts of absence causation is that they attempt to dichotomise causal statements into statements of causation proper and statements of second-class causation, be it quasi- or causation\* or causal explanation. I do not deny that there are important differences among causal relations. The following:

- (a) The father burped his child.
- (b) The father caused his child to burp.
- (c) The father made his child burp.
- (d) The father got his child to burp.
- (e) The father let his child burp.

are all expressions of causal relations (or of causings if one does not believe that causation is a relation) but they all provide different information about what precisely happened. (a) expresses a direct involvement; (b) is indirect; (c) expresses intentionality on the father's and some degree of resistance on the child's part; (d) expresses successful encouragement; and (e) permission. There is a difference between (a) burping and (e) letting burp but no more of a difference than there is between (b) causing to burp and (c) making burp.

What all these sentences have in common is that they explain the outcome. I suggest that this is all they have in common. Traditional accounts have the order of conceptual priority wrong. They maintain that causal concepts represent aspects of an objective causal structure of the world and that scientific explanations are successful to the extent that they cite information about this objective causal structure of the world. I maintain instead that scientific inquiry aims to establish explanations of phenomena of interest. A good explanation is one that serves its purpose (see below for an account of the purposes of explanations). Causal claims are articulations of science's inventory of explanatory knowledge.

Following Douglas Walton [e.g., Walton (2004)] I maintain that an explanation is a transfer of understanding from an explainer to an explainee, following a request. Explanations are thus certain kind of speech act [see also Achinstein (1983), Achinstein (2010), Donato Rodriguez and Zamora Bonilla (2012), Faye (2007)]. The explainee (who may be a single person or a group such as a scientific community) initiates a dialogue by asking a why-question. Such a request is based on an assump-

tion of a partially shared understanding or starting point [Walton (2004), p. 83]. For example, if we ask a physician why Hamlin was vitamin-D deficient, we share the starting point that only naturalistic explanations are admissible. Absent such starting points there is little chance that the dialogue will be successful. Starting points may include [see van Eemeren and Grootendorst (1992): Ch. 14]: particular facts ('Hamlin lost his key'), suppositions ('Hamlin would have continued to go out occasionally and would not have covered up completely had he not locked himself in'), generalisations ('Individuals who live at latitudes not too close to the polar regions, who follow a healthy diet and do not cover up fully whenever they are outside do not normally develop vitamin-D deficiency'), values ('it's a good thing to live healthily') and norms ('people normally leave their house at least occasionally').

By asking a why-question, the explainee indicates a gap in understanding it requests to be filled in by the explainer. A gap in understanding is often an inconsistency or incoherence between existing commitments.<sup>8</sup> If an explainee holds all of the commitments mentioned in the previous paragraph, she will expect the Hamlin to be healthy. But he has vitamin-D deficiency and osteomalacia or osteoporosis. She asks why he has these afflictions because her commitments entailed that Hamlin would be fine. More generally, the explainee is justified in asking, 'Why P?' if (a) both explainee and explainer are committed to P; and (b) some of the explainee's other commitments (most of which are shared with the explainer) entitle the explainee to expect not-P [*cf.* Donato Rodriguez and Zamora Bonilla (2012), p. 36]. The explanation is successful if and only if the contradiction or incoherence is resolved.

Once the contradiction or incoherence is resolved, the explainee has an improved ability to make new inferences. The following are some of the purposes a successful explanation can serve [Keil 2006]:

- to predict a similar event in the future (starving a person of sunlight will make her vitamin-D deficient);
- to diagnose the reason for failure in order to fix the system (providing large amounts of vitamin-D will help if vitamin-D deficiency is the reason for osteomalacia but not, or not alone, if it is due to kidney failure);

- to attribute praise or blame even when the outcome is singular (Hamlin, or Hamlin's forgetfulness, can be blamed for his poor health condition);
- to justify or rationalise an action (if Hamlin were to take action against forgetfulness this would be justified and rationalised by pointing to the harm he caused himself);
- to serve aesthetic pleasure (this does not apply in the hermit case; but: 'One can explain a work of art, a mystery of cosmology, or the intricacies of a poem with the sole goal of increasing appreciation in another, providing that person with a better polished lens through which to view the explanandum'; *ibid.* p. 234).

Understanding is simply the ability to make inferences of this kind [Newman (2012), (2013), (2017)]; there is a large literature in cognitive and development psychology on understanding and inference-making ability, for example: Cain et al. (2001), Oakhill (1984). Inferences include both formal (ones that are valid in virtue of their form such as *modus ponens*) as well as material inferences (ones that are 'valid' in virtue of the content of the concepts involved such as causal and other inductive inferences). In science and everyday life, the latter type is dominant. To understand better means to be able to make more useful inferences. To transfer understanding from explainer to explainee by addressing a gap in his understanding is to improve the explainee's ability to make useful inferences.

*Causal* explanations are transfers of understanding that not only make P expectable to the explainee, they also improve his capacity for causal inference. Causal inferences follow specific norms. For example, in order for an explainer to be entitled to assert the lack of sunlight as a cause of Hamlin's vitamin-D deficiency, he would need to be in the possession of some evidence that it is actually true that he was not exposed to sunlight while locked into his hut, and that, at least casually, rules out alternative explanations of the vitamin-D deficiency (such as malnutrition, obesity or short bowel syndrome). The norms characterising causal inference are context-dependent and therefore in part dependent on the situation in which the causal explanation is sought. There are many variables that affect these norms (for a more detailed treatment: see Reiss 2015). To cite just one: stakes. To give someone a life sentence requires higher evidential standards than blaming the neighbour for killing one's plants by starving them of sunlight.



Causal explanations can thus quite easily be distinguished from other kinds of explanations. Here is an example, due to Mark Lange, of a why-question that seeks a *mathematical* explanation [Lange (2016), p. 7; quoted from Khalifa et al. (2018)]:

Consider the fact that at every moment that Earth exists, on the equator (or on any other great circle) there exist two points having the same temperature that are located antipodally (i.e., exactly opposite each other in that the line between them passes through the Earth's center). Why is that?

To establish an explanation of this phenomenon, we do not engage in causal reasoning. Instead we construct a mathematical proof, in this case one based on the intermediate value theorem. Deriving a theorem follows norms different from those of causal inference.

The counterexamples that plague other views sometimes referred to as 'explanation-as-inference' do not affect the account presented here because of the nature of causal reasoning. In order for a description of an event or factor to come out as a causal explanation of some phenomenon, its assertibility has to be established by the norms for causal inference. These norms include the precept to rule out alternative (causal and non-causal) explanations of the phenomenon of interest, and 'there is reverse causation from putative effect to putative cause' and 'there is a common cause' is on any list of standard alternative explanations for an association. In the stock examples of the shadow and the flagpole, and the barometer and the storm, we cannot rule out reverse causation and a common cause, respectively. Thus, if a speaker offers the length of the shadow as an explanation of the height of the flagpole or a drop in the barometer reading as an explanation of the storm, he would make utterances to which he is not entitled. My interest here is primarily in causation and causal explanation, which is why I offered a solution to the counterexamples to 'explanation-as-inference' accounts in terms of causal explanation. Khalifa et al. (2018) have shown that the asymmetry problem can also be solved within an inferentialist account of explanation without appeal to *causal* asymmetry.

#### IV. A NEO-HUMEAN ACCOUNT OF CAUSATION

David Hume is usually credited with the regularity account of causation, according to which C causes E if and only if C and E regularly co-occur, E temporally follows C, and C and E are spatio-temporally

contiguous [e.g., Psillos (2002)]. According to this account, (a) causation is a relation in the world; and (b) this relationship is one of regular association. There is nothing beyond regular association ‘in the objects’.

It has been argued that Hume also maintained an alternative account (or that his writings can be interpreted as defending such an account) according to which causal claims are expressions of our habits of inference. Observing C, we infer that E will happen, and that inference is projected onto the world. It is that inference that is the source of the idea of a necessary connection. This account has therefore also been called the ‘necessitarian’ or ‘projectivist’ account [Beauchamp and Rosenberg (1981), Beebe (2007)].

According to this view, then, causation is a property of the mind, a kind of reasoning. Causal claims do not refer to any objective relations (or other things) in the world. My own account is very similar to Hume’s in this respect — albeit different in its understanding of the reasoning involved. Causal claims are inter-subjective in that their assertibility depends on beliefs, values, and norms of reasoning that are shared among the members of a community and thus not entirely subjective or arbitrary.

To help build my account, let me invoke Peter Achinstein’s notion of an *epistemic situation*. According to Achinstein, an epistemic situation ‘is an abstract type of situation in which, among other things, one knows or believes that certain propositions are true, one is not in a position to know or believe that others are, and one knows (or does not know) how to reason from the former to the hypothesis of interest, even if such a situation does not in fact obtain for any person’ [Achinstein (2001), p. 20]. For an agent to be in an epistemic situation ES is to share certain beliefs, values, and norms of the kind referred to above as ‘starting points’. Among the norms particularly noteworthy are norms of causal reasoning, which, among other things include the injunction to rule out alternative causal hypotheses before asserting a causal claim, evidential standards that allow the agent to trade off type-I and type-II errors and so on.

**Causation.** For any two distinct agents in an epistemic situation ES, a causal claim that relates cause C and effect E is assertible if and only if one agent’s citing C in ES successfully causally explains E to the other.<sup>9</sup>

Let me add two qualifications to this definition. First, I am not fully committed to a definition of causation in terms of causal explanation. In other work I have defended an account that invokes inferential relationships directly, without going through causal explanation [Reiss (2015)]. A

disadvantage of invoking explanation is that doing so might open a Pandora's box of issues related to explanation such as whether all explanations are contrastive, what to make of the difference between explanations-how, explanations-that and explanations-how possibly, how to deal with the goal- and/or context-relativity of explanations and so on. The development of answers to these potential problems will have to wait for another paper. However, going through causal explanation allows me to offer necessary and sufficient assertibility conditions which the inferentialist account prevents. The inferential networks that are associated with causal claims are far too varied to allow the formulation of such conditions. The account proposed here shifts that variability to the notion of causal explanation. Causal claims have very little in common, but, I suggest, they all have in common that they causally explain. On this point I am in full agreement with Michael Scriven who argued a very long time ago that [Scriven 1966], p. 256]:

When we are looking for causes, we are looking for explanations in terms of a few factors or a single factor; and what counts as an explanation is whatever fills in the gap in the inquirer's or reader's understanding.

My account can be understood as an elaboration of this idea of Scriven's.

The second qualification is that I only formulate assertibility conditions, not truth conditions. The assertibility conditions laid out above are implausible as truth conditions. A scientist living in the first half of the 18th century will have been entitled to assert causal claims involving phlogiston in the explanation of combustion. But we don't want to say that such claims are true. My hunch is to define the truth conditions in terms of an ideal epistemic situation in which all knowable facts are actually known, and all agents agree on values and norms of reasoning. The full development of this idea too will have to wait for another occasion.

The assertibility condition for a sentence such as 'The father caused his child to burp' in some epistemic situation ES is that if in ES an explainee asks 'Why did the child burp?' by stating 'The father pressed her lightly on the belly', the explainer would resolve a tension in the explainee's reasoning and improve his inferential abilities.

The account offered here is similar to Hume's but very differently motivated. Hume did not think we could have knowledge of or speak meaningfully about causation in the objects or 'objective causation' because of his associationism. With no sense impression to be associated

with the word ‘cause’, there was no place for objective causation in our image of the world.

This motivation has lost much of its pull. Today it is at least controversial to claim that causal relations are never directly observable (for positions against this claim, see for instance Anscombe (1971), Beebe (2009), Cartwright (2000), Ducasse (1926)[1993]); Beebe cites some evidence about the observability of causation from psychology). And I don’t think there’s anyone left who thinks that we can’t meaningfully talk about something we can’t see (the death blow to this idea may have been Quine (1953) but I won’t argue).

My own motivation for developing an inferentialist account of causation derives from the inability of representationalist accounts — accounts maintaining that ‘cause’ refers to some objective feature of world — to come to grips with the way in which causal language is used in science, legal, historical and clinical practice, and in everyday life (for some arguments to that effect and a review of the literature, see Reiss (2015), Ch. 1]. There simply doesn’t seem to be any single property all causal relations ‘in the objects’ share, and disjunctive theories (which define causation as a disjunction of properties) don’t seem to fare much better. It is therefore that I believe we should try something new.

Apart from solving the problem of proliferation of causes (see next section), the account I favour has a number of other desirable properties. One is that it can provide a situation-specific account of the difference between causes and conditions. We would not normally cite the presence of oxygen in the air as a cause of the forest fire. This is a problem for difference-making accounts of causation such as Lewis’ because the presence of oxygen in the air certainly makes a difference to whether or not the fire occurs. But in most epistemic situations citing oxygen explains nothing and thus, on the view of causation presented here, it does not cause the fire. By contrast, if there is an epistemic situation where, say, the absence of oxygen is a condition for the proper working of some production process, a leak in a pipe and ensuing presence of oxygen does explain and therefore does cause the fire (to cite an example due to Mackie (1980)).

We can define a causal condition as follows:

**Causal Condition.** It is assertible that C is a causal condition for E if and only if there exists an (actual) epistemic situation in which an agent’s citing C successfully causally explains E to another agent.

It is thus easy to see why some speakers might confuse causes and causal conditions.

More generally, because of the way it is constructed, it is quite impossible for any counterexample to affect the account. For any causal claim, if the claim is assertible, there will be norms determining that this is so. As the explanatory account of causation makes use of just these norms, it will not count a genuine case of causation as non-causation and vice versa. Of course, it may be the case that any given speaker is unaware of certain norms or misapplies them, that there is disagreement about what are the correct norms or how to apply a norm, that a norm does not completely determine correct usage, that competing norms provide different answers to a causal question and that norms evolve over time. Two things follow from this. First, it is possible for a speaker to make false causal claims. There are inter-subjective facts about inferential practice a speaker can ignore or misapply. ‘The village stockist caused Hamlin’s vitamin-D deficiency’ is false in world that shares our inferential norms. Second, the boundaries of the concept of cause are blurry. I don’t think, for instance, that the norms describing ordinary language use are able to decide whether in cases of symmetric overdetermination (in which two factors C1 and C2 are able to bring about an effect E and both come to completion) each factor should be called a cause. This is different in legal practice where when two persons are equally causally involved in a third person’s death, the actions of either will be regarded as a separate cause of the death, even if the death would have occurred without the action of either (but not without the action of both). The lesson here is: at any point in time there will be indeterminate cases but they will be resolved over time or, when a resolution is required immediately, we can (and will) plump for one.

#### V. ABSENCE CAUSATION ON THE EXPLANATORY ACCOUNT

On the shared understanding that (a) ‘Hamlin lost his key’; (b) ‘Hamlin would have continued to go out occasionally and would not have covered up completely had he not locked himself in’; (c) ‘Individuals who live at latitudes not too close to the polar regions, who follow a healthy diet and do not cover up fully whenever they are outside do not normally develop vitamin-D deficiency’; (e) ‘it’s a good thing to live healthily’; and (f) ‘people normally go out occasionally’, ‘lack of sunlight causes vitamin-D deficiency’ the explainee could expect Hamlin not to be vitamin-D deficient on the basis of the shared understanding. He is

therefore justified in asking why Hamlin did get sick. Citing the causal claim resolves that tension. It also allows further inferences, for instance about the attribution of blame or the justification of an utterance of disapproval. Thus, we can blame Hamlin's condition on his forgetfulness, as the latter caused him to be locked in, and being locked in caused him not to be exposed to sunlight.

The explanation 'Hamlin developed vitamin-D deficiency because of lack of sunlight' is a causal explanation in part because in order to be entitled to making the explanation, the explainer must be in the possession of evidence that no other risk factors such as malnutrition or obesity explains the deficiency. The inferences the explanation permits are also typical of causal inferences. In other words, the inferences that permit the explanation and that are licensed by the explanation are causal inferences.

Contrarily, the village stockist's failure to provide vitamin-D supplements does not explain the outcome. There is no shared understanding for instance of his having made a promise to provide the vitamin or there being a general norm to that effect. Suppose instead that we lived in a world in which everyone covered up completely and so in order to receive sufficient amounts of vitamin-D they buy supplements. If in that world the village stockist failed to supply the vitamin to Hamlin, his failure and not Hamlin's forgetfulness or the lack of sunlight would explain, and therefore cause, the outcome.

Importantly, the account presented here does not drive a conceptual wedge between positive and negative causation. All causal claims are true in virtue of the explanations in which they are used. There is no 'real' connectedness in some cases and no or 'pseudo' connectedness in others. This does not mean that there are no differences. Via explanations, different causal claims are related to different kinds of inferences. To use an example introduced above, 'The father *made* the child burp' entails intention on the father's part and resistance on the child's whereas 'The father *let* the child burp' entails permission, i.e., the removal of (or refusal to introduce) an obstacle. Similarly, we can make different inferences when we hear that someone lets a pet die by neglect than when we hear that someone killed his pet by direct involvement. But there is no dichotomy such that all cases of positive causation fall on one side of some border and all cases of negative causation on the other.

## VI. CONCLUSIONS

Let me concluding by way of offering some responses to possible objections. One objection might be that, against what was argued in Section 2.4, there are causal explanations that don't cite causes after all. Might Lewis be correct in saying that 'JFK died because someone shot him' is a causal explanation but 'Someone shooting him caused JFK to die' is a false causal claim? The account of causal explanation offered here agrees with Lewis that the former claim is a causal explanation. The account of causation described in Section 4 entails that the associated causal claim is true (both judgements presuppose that there are situations in which the claim 'Someone shot JFK' is offered as an explanation of JFK's death, but this is of course not hard to imagine). Is this a counterexample to the proposed account?

No. It is mere metaphysical prejudice that leads to refusing 'Someone shot JFK' to figure as a cause in causal claims. Lewis and his followers accept only events as causes. Natural and scientific language is a lot more flexible than that. Causes can be events, states, factors, variables, substances, processes, agents and probably a host of other things I cannot think of at present. My account does not place any restrictions on what kinds of entities can figure in causal claims as any restriction would lead to cases that look and waddle and quack like causation but would not come out as cases of causation on the account. As far as I can see, there is no problem in accepting 'gunshot' as a cause of death, and forensic and medical practice agrees.

A more serious objection is that reasoning and inference are not something *in* the world but rather *about* the world. In Jonathan Bennett's words, reasoning cannot play 'the role of a puller and shover and twister and bender' [Bennett (1988), p. 22]. My answer to this worry is to ask what difference it would make if, for each and every true causal claim, there was 'a thing' (an event, a property, a state of affairs...) in the world that would make the claim true? It obviously wouldn't make a difference to our inferential practices. Scientific, legal, clinical and historical practice as well as everyday discourse would proceed in the exact same manner. 'But these practices must be grounded in something — in the causal structure of the world!', the objection might continue. To which I'd respond: yes, inferential practices are grounded in something. But this something is not the causal structure of the world. It is inferential success. As we have seen above, there are a variety of more ultimate pur-

poses for offering causal explanations. To the extent that existing practices are successful at achieving these purposes, they are justified. If specific norms fail to advance our purposes, they will be changed over time. 'But how do you explain their success?', the objection goes on.

Well, that is asking one question too many.

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#### NOTES

<sup>1</sup> Most of the examples mentioned above involve causation *by absences*. There is also causation *of absences* (or prevention: see the example from development studies) and causation by absences of absences (see the example from biology). Since it makes no difference to anything I am going to say in this paper, the focus will be primarily on causation by absences.

<sup>2</sup> For simplicity I only provide a sufficient condition. The necessary condition is harder to formulate because of redundant causation: if events C', C'' etc. compete with C to bring about E, that is, presuming C and E are actual events and C caused E, if E would have obtained in the absence of C because of any of the other events, then E is not counterfactually dependent on C. I do not think that the problem of redundant causation is solvable within a counterfactual framework. To avoid having to deal with the complexities redundant causation bring with it, I omit the necessary condition here.

<sup>3</sup> Strictly speaking, it is propositions that enter relations of counterfactual dependence, not events. The proposition 'Hamlin developed vitamin-D deficiency' is counterfactually dependent on the proposition 'Hamlin lacked exposure to sunlight for 24 years'. But that doesn't mean that an absence literally does the causing [Lewis (2004) [2000], p. 100]: 'So I have to say that when an



absence is a cause or an effect, there is strictly speaking nothing at all that is a cause or effect. Sometimes causation is not a relation, because a relation needs relata and sometimes the causal relata go missing<sup>7</sup>.

<sup>4</sup> I'm supposing here, not unreasonably I hope, that village stockists don't have a legal or moral duty to carry vitamin-D supplements.

<sup>5</sup> Dowe distinguishes cases of omission, which have the absence on the side of the cause from cases of preventions, which have the absence on the effect side, and from cases of prevention by omission, which have absences on both sides. Since the philosophical worries are exactly the same between all three kinds of case, throughout the paper I focus on omissions.

<sup>6</sup> One might argue that ordinary (and legal) language sometimes does draw important distinctions between positive and negative causation. The difference between killing and letting die is of course very important, in legal practice and elsewhere. Distinguishing killing from letting die won't solve the problem, however, since 'letting die' is still a (periphrastic) causative verb expressing causal sufficiency [Lauer (2010)]. That is to say, 'letting die' is causing, not quasi-causing.

<sup>7</sup> My own account does not in fact violate ancient metaphysical principles such as *ex nihilo nihil fit*. As long as one does not presuppose that 'cause' always represents some real entity, activity, power or relation, absence causation does not pose any metaphysical conundrum either.

<sup>8</sup> I say 'contradiction or incoherence' because the tension between existing commitments and P is often not as strong as a contradiction in the logical sense.

<sup>9</sup> I use the locution 'causal claim that relates cause C and effect E' rather than 'C causes E' in order to allow for causative verbs other than 'cause' to figure in causal claims.

## REFERENCES

- ACHINSTEIN, P. (1983). *The Nature of Explanation*; Oxford, Oxford University Press.  
 — (2001), *The Book of Evidence*, Oxford, Oxford University Press.  
 — (2010), *Evidence, Explanation, and Realism. Essays in the Philosophy of Science*; New York, Oxford University Press.
- ANJUM, R. L. and S. MUMFORD (2018), *Causation in Science and the Methods of Scientific Discovery*; Oxford, Oxford University Press.
- ANSCOMBE, E. (1971), *Causality and Determination: An Inaugural Lecture*; Cambridge, Cambridge University Press.
- ARMSTRONG, D. (1999), "The Open Door"; in *Causation and Laws of Nature*, Howard Sankey (ed.); Dordrecht, Kluwer, pp. 175-185.
- ARONSON, J. (1971), "On the Grammar of 'Cause'"; *Synthese* 22, pp. 414-30.
- BADDELEY, A. D. and D. SCOTT 1971, "Short Term Forgetting in the Absence of Proactive Interfering"; *Quarterly Journal of Experimental Psychology* 23(3): 275-283.
- BEAUCHAMP, T. L. and A. ROSENBERG (1981), *Hume and the Problem of Causation*; Oxford, Oxford University Press.

- BEEBEE, H. (2004). "Causation and Nothingness", in *Causation and Counterfactuals*. J. Collins, N. Hall and L. Paul (eds.); Cambridge (MA), MIT Press: pp. 291-309.
- (2007), "Hume on Causation: The Projectivist Interpretation"; in *Causation, Physics and the Constitution of Reality*, H. Price and R. Corry (eds.), Oxford, Oxford University Press, pp. 224-249.
- (2009), "Causation and Observation"; in *The Oxford Handbook of Causation*. H. Beebee, C. Hitchcock and P. Menzies (eds.), Oxford, Oxford University Press, pp. 471-497.
- BENNETT, J. (1988), *Events and Their Names*; Indianapolis (IN), Hackett Publishers.
- CAHILL, JR., G. (2006), "Fuel Metabolism in Starvation"; *Annual Review of Nutrition* 26, pp. 1-22.
- CAIN, K., J. OAKHILL, M. BARNES and P. BRYANT (2001), "Comprehension Skill, Inference-Making Ability, and Their Relation to Knowledge"; *Memory & Cognition* 29(6), pp. 850-859.
- CARTWRIGHT, N. (2000), "An Empiricist Defence of Singular Causes"; in *Logic, Cause and Action: Essays in Honour of Elisabeth Anscombe*, Roger Teichmann. Cambridge, Cambridge University Press, pp. 47-58.
- DONATO RODRIGUEZ, X. and J. ZAMORA BONILLA (2012), "Explanation and Modelization in a Comprehensive Inferentialist Account"; in *Epsa Philosophy of Science: Amsterdam 2009*, H. de Regt, S. Hartmann and S. Okasha (eds.), Dordrecht, Springer, pp. 33-42.
- DOWE, P. (2004) "Causes Are Physically Connected to Their Effects: Why Preventers and Omissions Are Not Causes"; *Contemporary Debates in Philosophy of Science*. Christopher Hitchcock. Oxford, Blackwell: 187-196.
- 2007. *Physical Causation*; Oxford, Oxford University Press.
- DUCASSE, C. J. (1926) [1993], "On the Nature and the Observability of the Causal Relation"; in *Causation*, E. Sosa and M. Tooley (eds.), Oxford, Oxford University Press, pp. 125-136.
- EHRING, D. (1998), *Causation and Persistence*. Oxford, Oxford University Press.
- ELGIN, C. Z. (2007), "Understanding and the Facts"; *Philosophical Studies* 132, pp. 33-42.
- FAIR, D. (1979), "Causation and the Flow of Energy"; *Erkenntnis* 14(3), pp. 219-250.
- FAYE, J. (2007), "The Pragmatic-Rhetorical Theory of Explanation"; in *Rethinking Explanation*, J. Persson and P. Ylikoski (eds.), Dordrecht, Springer, pp. 43-68.
- GIBLER, D. and J. TIR (2010), "Settled Borders and Regime Type: Democratic Transitions as Consequences of Peaceful Territorial Transfers"; *American Journal of Political Science* 54(4), pp. 951-968.
- GILLIE, O. (2004), "Sunlight Robbery: Health Benefits Are Denied by Current Public Health Policy in the Uk"; London, Health Research Forum.
- GOLDSTONE, J. (2016.), *Revolution and Rebellion in the Early Modern World: Population Change and State Breakdown in England, France, Turkey, and China, 1600 – 1850*; New York (NY), Routledge.
- GRICE, P. (1975). "Logic and Conversation"; in *Syntax and Semantics*. Vol. 3. P. Cole and J.L. Morgan (eds.); New York (NY), Academic Press.

- GRIFFITHS, A., GELBART W., J. MILLER and R. LEWONTIN (1999), *Modern Genetic Analysis*, New York (NY), Freeman.
- HARTSOCK, M. (2010), *Absences as Causes: A Defense of Negative Causation*; PhD, University of Missouri-Columbia.
- HEMPEL, C. and P. OPPENHEIM (1948), "Studies in the Logic of Explanation", *Philosophy of Science* 15, pp. 135-175.
- KEIL, F. (2006), "Explanation and Understanding"; *Annual Review of Psychology* 57, pp. 227-264.
- KHALIFA, K., J. MILLSON and M. RISJORD (2018), "Inference, Explanation, and Asymmetry", *Synthese* (online first).
- KUENEN, Ph. H. (1950), *Marine Geology*. New York (NY), John Wiley & Sons.
- Kuhn, T. (1981)/(1963), "A Function for 'Thought Experiments'"; in *Scientific Revolutions*, I. Hacking (ed.) Oxford, Oxford University Press, pp. 6-27.
- KURAN, T. (2004), *Why the Middle East Is Economically Underdeveloped: Historical Mechanisms of Institutional Stagnation*, University of Southern California, Los Angeles (CA). <http://eppam.weebly.com/uploads/5/5/6/2/5562069/kuran.0130.pdf>
- LANGE, M. (2016) *Because without Cause: Non-Causal Explanations in Science and Mathematics*; New York (NY), Oxford University Press.
- LAUER, S. (2010), "Periphrastic Causative Verbs in English: What Do They Mean?"; Stanford University Department of Linguistics. <http://www.sven-lauer.net/output/Lauer-QP-causatives.pdf>
- LEWIS, D. (1986), "Causal Explanation"; *Philosophical Papers*. II. Oxford, Oxford University Press: 214-240.
- (2004) [2000], "Causation as Influence"; in *Causation and Counterfactuals*. J. Collins, N. Hall and L. A. Paul (eds.), Cambridge (MA), MIT Press: pp. 5-106.
- LIVENGOOD, J. and E. MACHERY (2007), "The Folk Probably Don't Think What You Think They Think: Experiments on Causation by Absence"; *Midwest Studies in Philosophy* XXXI, pp. 107-127.
- MACKIE, J. (1980), *The Cement of the Universe: A Study of Causation*; Oxford, Oxford University Press.
- MCGRATH, S. (2005) "Causation by Omission"; *Philosophical Studies* 123, pp. 125-148.
- MCLANAHAN, S., L. TACH and D. SCHNEIDER (2013). "The Causal Effects of Father Absence"; *Annual Review of Sociology* 39, pp. 399-427.
- MOORE, M. (2009), *Causation and Responsibility: An Essay in Law, Morals, and Metaphysics*; Oxford, Oxford University Press.
- MUMFORD, S. and R. L. ANJUM (2011), *Getting Causes from Powers*; Oxford, Oxford University Press.
- NEWMAN, M. (2012), "An Inferential Model of Scientific Understanding"; in *International Studies in the Philosophy of Science* 26(1), pp. 1-26.
- (2013). "Refining the Inferential Model of Scientific Understanding"; *International Studies in the Philosophy of Science* 27(2), pp. 173-197.
- (2017), "Theoretical Understanding in Science"; *British Journal for Philosophy of Science* 68(2), pp. 571-595.

- OAKHILL, J. (1984), "Inferential and Memory Skills in Children's Comprehension of Stories"; *British Journal of Educational Psychology* 54(1), pp. 31-39.
- PSILLOS, S. (2002), *Causation and Explanation*; Stocksfield, Acumen.
- QUINE, W. v. O. (1953), "Two Dogmas of Empiricism"; in *From a Logical Point of View*, W. v. O. Quine. Cambridge (MA), Harvard University Press, pp. 20-46.
- REISS, J. (2015), *Causation, Evidence, and Inference*; New York (NY), Routledge.
- RUSSELL, B. (1948), *Human Knowledge: Its Scope and Limits*; New York (NY), Simon & Schuster.
- SALMON, W. (1984). *Scientific Explanation and the Causal Structure of the World*; Princeton, Princeton University Press.
- (1994), "Causality without Counterfactuals"; *Philosophy of Science* 61, pp. 297-312.
- SCHAFFER, J. (2004a), "Causes Need Not Be Physically Connected to Their Effects: The Case for Negative Causation"; in *Contemporary Debates in Philosophy of Science*, C. Hitchcock (ed.), Oxford, Blackwell, pp. 197-216.
- (2004b), "From Contextualism to Contrastivism"; *Philosophical Studies* 119(1), pp. 73-103.
- (2005), "Contrastive Causation", *Philosophical Review* 114(3), pp. 327-358.
- SCRIVEN, M. (1966), "Causes, Connections and Conditions in History"; in *Philosophical Analysis and History*, W. Dray (ed.), New York (NY), Harper and Row, pp. 238-264.
- SEN, A. (1999); *Development as Freedom*, Oxford, OUP.
- SHOCKLEY, W. (1950), *Electrons and Holes in Semiconductors (with Applications to Transistor Electronics)*; Princeton (NJ), van Nostrand.
- TAYLOR, H. and P. VICKERS (2017), "Conceptual Fragmentation and the Rise of Eliminativism"; *European Journal for Philosophy of Science* 7, pp. 17-40.
- URBACH, P. and J. GIBSON, Eds. (1994), *Francis Bacon: Novum Organum*, Chicago and La Salle (IL), Open Court.
- VAN EEMEREN, F. and R. GROOTENDORST (1992) *Argumentation, Communication, and Fallacies*; London, Routledge.
- WALTON, D. (2004), "A New Dialectical Theory of Explanation"; *Philosophical Explorations* 7(1), pp. 71-89.