Balkan Journal of Philosophy (2025), vol. 17, issue 2, 146–164

HOW CAUSAL REALISM SURVIVED RUSSELL'S ATTACK: OPPORTUNITIES TAKEN AND LESSONS LEARNED

Milan Z. Jovanović*

Đorđe Lazarević**

Abstract: In his seminal paper *On the Notion of the Cause*, Bertrand Russell famously attempts to show why the view that causation is a real and mind-independent feature of the world – called "causal realism" – is false. His arguments are often cited as a definitive challenge to the metaphysical tradition that takes causality as a fundamental principle of reality. Yet, despite the apparent plausibility and power of his arguments, causal realism is still a predominant view within philosophy of causation today. This paper seeks to explore how causal realism has endured Russell's attack, examining not only the weaknesses in his arguments, but also the ways in which contemporary philosophers have redefined and strengthened the realist position. By analyzing the responses to Russell's arguments, we will try to pinpoint the lessons learned from his critique and demonstrate how it has informed the development of more sophisticated theories of causation. Doing so will also contribute to a redefinition of causal realism, showing how the debate with Russell has enriched our understanding of what it means for causal theory to be realistic.

Keywords: Bertrand Russell, causation in science, causal realism, Lewis' counterfactual theory of causation, temporal asymmetry.

1. Introduction

Bertrand Russell's *On the Notion of Cause* stands as one of the most influential and radical critiques of the traditional philosophical understanding of causality. Written from a naturalistic perspective that acknowledges the authority of science in metaphysical inquiry, Russell's paper is typically understood as an attack on causal realism – the view that causation is an objective feature of the world, independent of human language and cognition. His arguments are often cited as a definitive challenge to the metaphysical tradition that takes causality as a fundamental principle of reality.

Yet, despite the apparent plausibility and power of his arguments, causal realism has not only survived but has also evolved in response to his critique. It still is a prominent view within philosophy of causation today.[1] This paper seeks to explore how causal realism

[1]It should be noted, however, that the study of causality has undergone a significant transformation – or even a *revolution* (Pearl & Mackenzie, 2019) – in recent decades, with developments that appear favorable to causal antirealism. Among the most influential recent theories are those that analyze causation using statistical models, graphs, and structural equations (e.g., Halpern & Pearl, 2005, Pearl, 2000, Spirtes, Glymour, & Scheines, 1993), which are at least difficult to reconcile with causal realism in the relevant sense. That said, these approaches do not so much endorse antirealism as they shift focus away from metaphysical

*Faculty of Philosophy, University of Niš, Serbia; milan.jovanovic@filfak.ni.ac.rs
**Faculty of Philosophy, University of Niš, Serbia; djordje.lazarevic@filfak.ni.ac.rs

has endured Russell's attack, examining not only the weaknesses in his arguments, but also the ways in which contemporary philosophers have redefined and strengthened the realist position.

By analyzing the responses to Russell's arguments, we will try to pinpoint the lessons learned from his critique and demonstrate how it has informed the development of more sophisticated theories of causation. Doing so will also contribute to a redefinition of causal realism, showing how the debate with Russell has enriched our understanding of what it means for causal theory to be *realistic*.

2. Russell's arguments against causal realism

The arguments offered in favor of Russell's radical conclusion are very diverse, and they vary with respect to the aspect of causality they are directed at, the strategy they are employing, the nature of the premises they rely on, and so on. However, we are not going to analyze Russell's argumentation in its entirety. A substantial part of Russell's objections is specifically directed to the questions of will, agency, determinism, and teleological systems – the questions, although relevant to his enquiry, still somehow peripheral to our investigation. Instead, since we are primarily concerned with causal realism, in what follows, we will be focused on the arguments typically recognized as central to his critique of the law of causation and causal realism.

As it is commonly assumed,[2] there can be identified two such arguments in Russell's paper that are directly relevant to causal realism (we will call them: A_1 and A_2, respectively). The first one (A_1) is implicit and consists of two separate objections – the first of which (O_1) is at the very beginning of Russell's paper, while the other (O_2) is somewhere in the middle.[3] The second argument (A_2) is more explicitly formulated and thoroughly discussed towards the end of the first third of the paper (Russell, 1959, pp. 185–188).

2.1. Russell's first argument

Let us start the analysis by considering the first objection within the first argument. O_1 is directed against (then) widespread philosophical conviction that – since every event has a cause – the main goal of natural science (as an enquiry into objective reality and its structure) is to look for causes. To that claim, which somehow transitioned from modern metaphysics to contemporary philosophy of science, and which puts an *a priori* restriction

debates, emphasizing instead operational definitions, causal modeling, inference, methodological concerns and applications.

[2]Most interpreters recognize that there are at least two anti-realist arguments in Russell's paper, but they differ with respect to specific formulations they offer, emphasis and relative strength of the arguments. For example, N. K. Shinod (2019) and Alyssa Ney (2009) take both A_1 and A_2 primarily as arguments against causal realism in *science*, with Shinod arguing for success of both arguments, and Ney for A_1 as being more persuasive, but still inconclusive. On the other hand, Corry (2006), Hitchcock (2007), Menzies (2007) and Eagle (2007) consider both, or at least A_2, as having a broader target of causal realism *per se*. In the interpretation that follows, we agree with the latter group with regards to the scope of the arguments and maintain that it is the second argument, A_2, that is stronger.

[3]In interpreting or rather "parsing" Russell's argumentation in this way, we are following Jovanović (2020, pp. 3–6).

on empirical science,[4] Russell responds by stating that "oddly enough, in advanced sciences such as gravitational astronomy, the word *cause* never occurs" (1959, p. 180).

Although it is easy to see how O_1 objects to the commonplace philosophical conception of science, it is nevertheless questionable how *plausible* it is *against*, or even *relevant to* the philosophical usage of the word cause (outside of the philosophy of science). Even if Russell is right in proposing that there is no causation in fundamental physics,[5] it is not apparent how that would disqualify the notion of cause as sensible and definable (which seems to be Russell's ultimate goal). Though it may be true that causation is not, to the best of our scientific knowledge, the part of the world inventory, that still does not prove impossible a project aiming to define causation (as a distinct relation) *on the* relations and entities recognized as the constituents of the fundamental reality by the best scientific theories. In that way, not only could the notion of the cause turn out to be meaningful and precisely defined, but it could also be claimed to be *real*, i.e. to be adequate for the position of *causal realism* – in the sense yet to be elaborated.[6]

But this is only a partial presentation of Russell's first argument. In the second objection,[7] he strengthens the critical comment just considered with philosophically more relevant insights. In O_2 Russell highlights that the theories of advanced fundamental sciences are not formulated in terms of causes and effects, but instead they state their laws by the means of specific equations. He writes:

> In the motions of mutually gravitating bodies, there is nothing that can be called a cause, and nothing that can be called an effect; there is merely a formula. Certain differential equations can be found, which hold at every instant for every particle of the system, and which, given the configuration and velocities at one instant, or the configurations at two instants, render the configuration at any other earlier or later instant theoretically calculable. That is to say, the configuration at any instant is a function of that instant and the configurations at two given instants. This statement holds throughout physics, and not only in the special case of gravitation. But there is nothing

[4] In his paper "Causation as Folk Science", John Norton offers a detailed argument against causal realism based on the problematic *apriority* of the causality principle – as typically formulated in philosophy, See Norton (2007).

[5] If the interpretation that Russell targets only causation in science is correct, as suggested by authors such as Loewer (2007) and Shinod (2019), Russell's response to this observation of the potential irrelevance of O_1 for causal realism would be that *this* is irrelevant to *his* argument. Alyssa Ney ascribes a slightly different view to Russell, according to which he follows the thesis she calls "foundationalism about causation." This is the claim that the existence of causes on any level of reality presupposes their existence on the fundamental level; and, since Russell argues against the latter, we should disregard the notion of causation in its entirety (Ney, 2009, p. 8). In what follows, we pursue a different interpretive strategy from that of Loewer and Shinod, and argue against Ney's foundationalism about causation thesis (see Section 2).

[6] This is an important point. Why this should be considered a kind of causal realism will be discussed in the second and third part of the paper.

[7] Corry and Ney regard the passage (that we labeled second objection) as the separate (and complete) argument and call it "the asymmetry argument" (Corry 2006, p. 263), or "the directionality argument" (Ney 2009, p. 11). Similarly, within our O_2 Blanchard – roughly following Field (2003) – recognizes two separate arguments: *the globality* and *the symmetry* argument (2016, p. 257).

> that could be properly called cause and nothing that could be properly called *effect* in such a system (1959, p. 194).

This critical remark stresses a worrisome structural "mismatch" between (even the broadest and most abstract) conception of causation in philosophy and the physical framework to which it should (according to the naturalistic approach endorsed by Russell) somehow coincide. It is typically assumed in contemporary philosophy of causation that causation is an asymmetric relation – closely related to determination, and closely tied to the natural laws – between a cause and an effect, often understood as events in temporal order in accordance with the direction of time (arrow of time). Events, themselves, are typically portrayed as some broadly construed happenings with certain duration, spatial occupation, and so on.

On the other hand, dynamical systems (similar to those explored by J. C. Maxwell) – as the best scientific description of what the philosophical notion of cause *potentially* refers to – evidently *do not coincide* with the aforementioned conception of causation (in a few relevant and significant respects). The equations expressing the laws in such systems do not support (or assume) the highlighted asymmetry inherent to the philosophical idea of causation. Instead, differential equations describing a dynamical system are *bideterministic* and perfectly indifferent with regards to the temporal dimension of its variables. Even worse, in contrast to the events as causal relata, those equations – as Russell points out later in his text – characterize *states of the system* at a given moment, by precisely specifying different physical properties of elementary particles (within the system). So, to the best of our scientific knowledge "causal relata" are precisely characterized (not loosely construed) instances (not intervals) of a given system. Hence, even the "best candidate" for causation within the fundamental science is far from being in accordance with the minimal philosophical conception of that relation.

This second objection complements the first one; O_2 picks up where O_1 left off – so to say. If a traditional metaphysician of causation responds to O_1 by stressing (as suggested earlier) that causation *doesn't have to be* a part of fundamental science in order to be *real*, then she commits herself to the exact position which O_2 is plausibly arguing against. This is the reason why these two objections should be seen to constitute *one* argument, which we will call A_1. That argument (A_1), compiled from O_1 and O_2, could be formulated like this:

Advanced science is our best guide to what is real. In theories of advanced science there is no such thing as causation; so, causation in philosophy does not simply refer to causation in science. Regularity and lawfulness of the phenomena within the system (which might be understood to give rise to a philosophical conception of causation) are best described by the natural laws which are bideterministic, symmetrical in the relevant sense, and have instances of the system's configurations as its relata. Given that *whatever* the philosophical notion of causation *refers to* seems to be an asymmetrical relation between broadly described events (seen as intervals), it is evident that *it is not referring* to those natural laws and regularity. Thus, within the philosophical vocabulary, the word "cause" does not refer (directly or indirectly) to anything real.

2.2. Russell's second argument

Nonetheless, Russell's key objection to causal realism is presented by his second argument (A_2).[8] His initial task here is to determine *what exactly* the principle of causality asserts or posits. After analyzing definitions of causal terms (using Baldwin's dictionary), Russell proceeds by supplementing those insights by citing relevant philosophical literature. He considers Mill's and Bergson's definitions of causation and notes that despite some (more or less subtle) idiosyncrasies, there is an evident consensus among philosophers regarding the principle of causality, which to some extent aligns with his analysis of dictionary definitions. However, Russell does not offer a specific formulation of that principle. Instead, he directs his forthcoming critique towards the implied generalization that a reader is expected to make from the various cited formulations (and his interventions on them).[9] For the purposes of this text, the implied version of the principle of causality could be formulated in a relatively uncontroversial manner as follows:

> (R_{cp}) Every event e is determined by some preceding event c, in the sense that all events resembling this earlier event (c), while subject to the laws of nature, are always (or necessarily) accompanied by events resembling that later event (e).[10]

The central components of the principle of causality are events, and the relation of determination (or rather: regularity). And it is exactly what Russell *aims at* with his second argument. It is evident from R_{cp} that an event is regarded as something that *can be repeated*. This implies that we would not consider an event to be *the state of the universe at a given time*. Such an event would either be unique, or the possibility of its recurrence would be negligible. Therefore, an event must be defined less specifically to avoid overly restrictive conditions for its (re)occurrence. Indeed, this is why we usually talk about events in such a way that they include things like striking a match or inserting a coin into a vending machine, without specifying the exact force with which the match was struck, or the force with which the coin was inserted into the machine, or the temperature of the coin, as well as without accounting for various circumstances (location, time, the person who did it, the hand used, etc.).

[8] This argument is typically presented as a dilemma, as we do here, although it is named differently depending on which facet of the argument is most relevant to the broader discussion. For example, Ney calls it "the localization argument" (2009) and Corry, perhaps most informatively, "the intervention argument" (2006).

[9] Hitchcock (2005, p. 46) argues that the reader is left with the impression that there are at least *three* targets of Russell's critiques: the notion of the cause, the word "cause", and the existence of causes. This is problematic because it isn't clear which argument is supposed to refute which of these targets. However, as Shinod notes, a charitable and most promising interpretation is to take Russell as arguing against the existence of causes, and that he assumes the principle R_{cp} – or something close to it – as the best approximation of the principle of causality normally presupposed by philosophical traditions. See Shinod (2019, p. 87).

[10] In this formulation, we have deliberately avoided engaging with various complexities – particularly the issue of a time interval existence between cause and effect – that Russell examines in his analysis of different formulations of the principle of causality. Additionally, following various philosophical articulations of the principle, as well as the maxim "same causes, same effects", Russell formulates the principle in terms of event types rather than token events. However, this simplification should have no bearing on the broader argument of this paper.

However, such a broad definition of causal relata brings us to another problem. If we define events in this way, if we characterize some given cause in this manner, then we *have not done enough to ensure* the occurrence of the effect. Although we take it that striking a match causes it to ignite, it is still true that not every strike of a match will be accompanied by ignition, as it can happen that the match is wet, or there is no oxygen in the room, or the angle at which it is struck over the rough surface is inadequate, or the surface itself is not rough enough to produce friction, and so on. There is no easy way out of this problem, which Russell describes as follows:

> But this means that the supposed cause is not, by itself, adequate to insure the effect. And as soon as we include the environment, the probability of repetition is diminished, until at last, when the whole environment is included, the probability of repetition becomes almost nil. (1959, p. 187)

So, we are faced with a dilemma in which both alternatives are unacceptable (if we are to preserve R_{cp}). If we take a cause to be a typically defined event – which means, as mentioned above, broadly specified and without including the circumstances – then it ceases to be sufficient for the occurrence of the effect, i.e., the regularity that underlies the principle of causality disappears. If, on the other hand, we wish to preserve that regularity, then we must take causes as highly specific events that include all the circumstances (accounting for the absence of potentially interfering factors), which leads to the conclusion that the regularity invoked by the principle of causality becomes vacuous, since there will be no instances to which it could be applied.

These two arguments form the backbone of Russell's famous attack on the principle of causality, with the clear intention of also undermining causal realism. Let us now turn briefly to the assumed *minimal* notion of causal realism, and then back to the problems with Russell's arguments and the potential response of contemporary causal realism to them.

3. Causal Realism and Modest Causal Realism

In the preceding discussion, we have examined Russell's arguments against *causal realism* with an implicit understanding of the concept. However, it is important to make this understanding explicit in order to ensure conceptual clarity. In both this work and broader philosophical discourse, causal realism is generally understood as the position that causation is an objective relation in the world, independent of human cognition or conceptual schemes. In its stronger formulation, causal realism asserts that causal relations are intrinsic to the world's ontological inventory, constituting fundamental and irreducible features of reality. However, as many of Russell's argumentative remarks suggest, causal realism can also take a *weaker form* while remaining committed to the core thesis that causation is independent, objective, and *tied to* the world.

This weaker version, which we may term *indirect causal realism* (or *light*, or *modest* causal realism), conceptualizes causation as a relation that is *defined on* fundamental entities, properties, and relations; it is not by itself fundamental, yet it is ultimately *reducible to* or *grounded in* something that is. Thus, a causal realist need not claim that causation exists as a *sui generis* entity – an approach that might be associated with certain classical

metaphysical traditions from antiquity, medieval philosophy, or early modern thought. Instead, this modest causal realism can accommodate more deflationary ontologies that explain causation in terms of facts, properties, forces, processes, etc. that are still tied to the world in some more or less uncontroversial way. Or, epistemically speaking, the modest causal realist can ground her causal theory in our best fundamental scientific theories, although those theories are themselves – *causationless*.

This more liberal or, in a sense, minimal conception of causal realism – that acknowledges both these forms of causal realism as legitimate – aligns with the working definition assumed in the previous discussion and will also serve as the framework against which Russell's objections will be evaluated in the next chapter.

Admittedly, there exists a long-standing practice of considering primarily these stronger and more committed positions as realism,[11] according to which many of the accounts we consider realist are consequently being perceived as closer to antirealism. Nevertheless, there are two important points to keep in mind here (both of which have been hinted at above). First, our approach critically depends on the notion of realism that is: a) in accordance with the proclaimed aim of Russell's critique, and simultaneously b) has a clear and coherent criterion for its application.

Regarding the first point, it is evident from his text that Russell conceives realism more broadly, offering arguments that concern this more minimal notion of causality – and, more importantly, believing that his arguments work even against these indirect forms of causal realism. As for the very notion of causal realism and the criterion for its application, it has been elaborated in the preceding paragraphs and will be used with that meaning – that is, with that specific intension – throughout the following chapter.

4. The Response of Contemporary Causal Realism

Now, with these clarifications in mind, we can ask – what is the outcome of Russell's critique? Does it succeed in achieving its stated goal? What is the epilogue regarding causal realism – is it really defeated? And what happened to the philosophical vocabulary – was causation eliminated from it?

4.1. Problems with Russell's first argument

Given that Russell appeals for changes in philosophical practice, it is useful to begin by assessing the current state of the relevant philosophical literature. The fact of the matter is that the concept of cause continues to play an equally significant role in philosophy today. Even worse (from the Russellian perspective), in contemporary philosophy of causation, realism remains the dominant position.

There are several reasons why the situation regarding causation and causal realism in contemporary philosophy is not surprising. In what follows, we will focus on those reasons that are *inherent* to Russell's critique and the problems in his argumentation that help casual realism survive.

[11] We are grateful to the anonymous reviewer for highlighting the need to clarify this point, as well as for other significant critiques addressed elsewhere in the paper.

Let us proceed step by step, starting with the first critical remark in Russell's text (O_1) – that causation is not mentioned in modern physical theories. According to some authors this claim is not true.[12] However, even if it is true that causation is not mentioned in modern physics, or were to be true, it would have only shown that: a) the philosophical speculative claim that science is essentially dedicated to investigating causation is mistaken, b) causation is not by itself (recognized as) a fundamental relation from the scientific point of view. Undoubtedly, Russell's argumentative aspirations were stronger than either of these two highlighted outcomes. He was after realism in the philosophy of causation,[13] and this is far from undermining causal realism.

To clarify, the absence of causation from fundamental natural science does not *necessarily* spell bad news for the causal realist. Even if modern physics does not use causal terms or explicitly discuss causation, it is still possible to ground (or define) causation in a way that satisfies all the desires of a causal realist – that it is objective, directly tied to the world, and independent of the human mind. As Peter Menzies (2007) observes and emphasizes, this is a serious problem for Russell's argument:

> Put this simply, the criticism is not completely persuasive. For a defender of the causal concept could well argue that, even though causation is not explicitly mentioned in fundamental physics, it is implicitly present in the picture of reality given in fundamental physics, since causal relations supervene on the pattern of fundamental physical facts and physical laws. This more sophisticated doctrine is one Russell certainly never formulated because he did not have the concept of supervenience to hand. (Menzies, 2007, pp. 191–192)

This theoretical possibility, not *fully* appreciated and covered by Russell,[14] has in fact been utilized to reformulate causal realism in contemporary philosophy of causation. By rejecting the implicit premise that causal realism requires our fundamental science to explicitly discuss causation, contemporary realists have built their theories around the concept of cause as (somehow) supervening on certain fundamental entities, properties, and facts. And that is the real reason causal realism survived Russell.

A good example of this are contemporary *process theories of causation* (Dowe, 2007; 2010). The causal relation in these theories is defined as supervening on facts about causal processes, their interactions, the persistence (Ehring, 1997) or exchange (transfer) of certain physical properties (Aronson 1971; Fair 1979) – all of which are ultimately reducible to the

[12]Patrick Suppes and Christopher Hitchcock point out that gravitational astronomy, which Russell took as an example of a theory devoid of the concept of cause, is a very specific discipline and, as such, inadequate for such a generalization. Moreover, both of them, at the time of writing their respective texts, citing the latest articles in prestigious professional journals in the field of physics, demonstrate that the concept of cause does in fact appear relatively frequently and in relatively diverse areas of physics. See Hitchcock (2007, p. 55), Suppes (1970, p. 6).

[13]Hitchcock (2007) understands the role of this critical remark in a very similar way.

[14]Nonetheless, Menzies' remark is likely too harsh, as Russell's next comment makes it clear that he, at least to some extent, understands and takes into account this variation of realism. Of course, this does not mean that he has in mind the idea of supervenience with all of its technicalities, but rather points to his awareness that realism can also be built around a causal relation that is indirectly connected to the world – one that is defined on some fundamental relations. This issue will be further elaborated in discussing O_2.

laws of modern physics. Interestingly, those theories can be seen to have their predecessor in the late Russell's theory of *causal lines* (1948). However, these accounts of causation rather elegantly avoid O_1, uncontroversially standing as causal realism without commitment to causation as fundamental entity.

Although very different from metaphysical theories mentioned above, so-called dependence theories of causation can still be seen to offer another good example of dealing with first Russell's objection. Among them we have the *counterfactual theory of causation*, that is *modestly realist* in the sense outlined earlier. According to them, causal relation is defined in terms of counterfactual dependence, which is an objective relation grounded in counterfactual conditionals – whose truth, in turn, is a function[15] of objective facts about the world and natural laws (Lewis, 1973a, 1979; Stalnaker, 1968).[16] Even probabilistic theories of causation (Hitchcock, 2018) can be seen as examples of causal realism in this sense, as long as the probabilities they operate with are defined as *objective* and *independent* of the human mind (cognition and language). In a bit more controversial manner, even Mackie's regularity theory (1974) and Woodward's *manipulability theory* (2003) could be seen as valid examples of realistic causal theory that aims to avoid Russell's objection.[17]

Although Menzies, as we have seen, notes that Russell (lacking the concept of supervenience) could not have anticipated more sophisticated versions of causal realism, it is interesting that the next critical remark in Russell's text (O_2) aims at exactly that back-up realist position. More precisely, Russell's observation about the bideterministic nature of the differential equations used in physics can be understood as a supplement to the previous critique, supporting the thesis that the concept of cause (is not only absent from the modern-day physics, but also) lacks a clearly defined content. This concept cannot directly refer to *causation in physics*, since causation is not explicitly used in physics (O_1), nor can

[15]This holds without reservation for so-called standard semantics of counterfactual conditionals, which is a unifying term for Lewis's and Stalnaker's theories (Lewis, 1973a; Stalnaker, 1968). However, it should be kept in mind that there are theorists of counterfactual conditionals who doubt that such sentences have truth values (for example: Edginton, 2008, van Fraassen, 1980) or have additional concerns regarding the semantics of counterfactual conditionals and their reference to objective reality (Price, 1997; Hájek, 2014). If a theory of causation were based on such theories of counterfactuals, it could not be properly called *causal realism*.

[16]In their analyses of the causal claims, those dependence theorists sometimes draw the line between semantic and pragmatic factors relevant to our causal statements. Although these "minor pragmatic elements in the causal concept", as Menzies cites them, can be seen to cast some doubt on the realist nature of dependence theories, authors of those theories aspire to show that "... causal concept has completely objective truth-conditions which can be stated in terms of conditions holding of the mind-independent substructure." (Menzies, 2007, p. 193)

[17]Menzies provides a more exhaustive list with a precise characterization of supervenience in each of the theories (Menzies, 2007, pp. 192–193), concluding his overview with the following comment: "Though these theories differ in detail, they all subscribe to the doctrine that causal relations depend completely on a substructure of mind-independent relations", thereby emphasizing the realist aspirations of all the mentioned theories. The situation regarding Woodward is probably a bit more complex. His position is famously non-reductive, yet closely tied to conditionals through the concept of possible interventions. Moreover, in the Introduction and chapter "Interventions, Agency, and Counterfactuals" he repeatedly insists that, according to his analysis, causal claims are *objective*, *real* and independent of our epistemic apparatus.

it refer to *what we have in physics instead of causation* – namely the regularities and pattern of dependencies expressed through physical laws (O_2) – because this regularity is, in an important sense, inadequate to support causal relation.

What motivates Russell to consider the regularity in science (primarily given through dynamical systems and expressed with differential equations) as a candidate for the basis of the concept of causation is fairly uncontroversial. There is, alongside a strong intuitive connection, a long tradition of linking regularity and causation. As mentioned earlier, Russell in his analysis adopts from the philosophical tradition the definition that causation is determination: some event c causes e when it determines it, i.e., when the occurrence of c (or events like c) together with the laws is sufficient to ensure the occurrence of e (or events like e). This is precisely why the determinism found in dynamical systems presents itself as a good candidate (or rather: best available). But, as Russell further argues, the determinism found in those specific domains of physics *lacks the temporal asymmetry* that is usually taken to be a necessary property of the causal relation. And this, according to Russell, is a serious problem. It seems apparent that this objection is essentially directed at more sophisticated theories of causal realism (indirect, light or modest causal realism) in which the causal relation is not fundamental but somehow defined on fundamental entities or properties. Especially with regards to those *indirectly realistic theories* this potential mismatch – between asymmetry that we have in causation and symmetry that we have in that potential causation bearing (or grounding) relation – becomes a pressing issue.

However, the plausibility and effectiveness of this objection should not be overstated. First, it should be noted that Russell's claim about the essentially time-symmetrical nature of evolution of physical systems in fundamental physics has been challenged in at least two respects. One direct way is to point out that physics has progressed since 1913 (when Russell's paper was originally published) and that certain symmetry-breaking phenomena are now widely postulated within the Standard Model of particle physics and quantum mechanics. For instance, time-symmetry violation in weak interactions (an experimentally confirmed fact) and the intrinsic asymmetry in the evolution of the wave function pre- and post-collapse (at least a theoretical possibility) are now part of mainstream physics (Field, 2003).

Another, philosophically more significant reply, is to notice that it is not clear if Russell is right in taking the *mathematical formalism* of such theories, even if it does imply the mentioned symmetry, as a complete description of this level of reality. For example, Esfeld argues that it is precisely *causation* that is the best candidate for a qualitative property of physical structures that distinguishes them from mathematical structures that (only quantitatively and necessarily imperfectly) describe them (Esfeld, 2011, pp. 5–6). Donald Lipkind makes the same remark when discussing this argument and brings an example from Hans Reichenbach in order to explain the difference.[18]

[18]If we imagine a light beam going from point A, passing through a red filter and arriving at point B as red light, this description of the process seems far more intuitive than the one of light being originally red and becoming white after it passes the filter, even though the second description is compatible with the time-symmetric mathematical formulation of the laws of electrodynamics. This example has its limitation, in that fundamental physics may lack an analogous "filter" or "mark" that breaks the symmetry, but, Lipkind concludes, "nevertheless, the persuasiveness of Reichenbach's interpretation of the beam of experiment points

However, let us, for the sake of argument, assume that Russell is correct that laws of fundamental physics are time-symmetrical. We can still ask why should the symmetry of a given relation of determination (as typically found in the laws of physics) be an *a priori* problem, let alone an *insurmountable* one, for the project of analyzing causation in terms of that relation? There is a possibility that this analysis need not be *entirely reducible* to the determinism given by a specific relation in fundamental physics alone; it doesn't have to be a *function* of it. The analysis in question could include other determinants that help *align it* with the properties of the (philosophically defined) causal relation. As Eagle suggests, addressing this very objection of Russell:

> ... [A]lthough it might be true that the causal asymmetry is not an asymmetry of determination, causation still might be defined from a relation of determination combined with an asymmetrical relation, where the asymmetry comes from somewhere else. (Eagle, 2007, p. 158)

And again, this is not *merely* a theoretical possibility; the theoretical space that Russell overlooks in his argumentation has indeed been utilized by contemporary realism. The asymmetry of the causal relation is achieved in various ways in contemporary causal theories. A direct way to introduce asymmetry into a system described by symmetric laws is to rely on something present in physics itself – the famous second law of thermodynamics and the principle of entropy, which is mentioned in its formulation (Annila 2023). Thus, one way to formulate causal realism while circumventing Russell's objection is to combine the principle of entropy with the symmetric determination given by other (domain specific) laws (Albert 2000).

It is also possible to define causation in such a way that asymmetry is derived not by directly appealing to entropy but through contingent facts about our world that are related to the second law of thermodynamics. This solution is the one proposed by David Lewis (1979), for whom the asymmetry of counterfactual dependence reduces to the asymmetry between small and large miracles, or the asymmetry of overdetermination.[19]

To be clear, the mere possibility of formulating this kind of (*indirect*) causal realism would, theoretically speaking, pose a problem for Russell's first argument. However, the fact that there are *existing positions* employing that possibility – that accept his premises while effectively bypassing his conclusion – explicitly and convincingly demonstrates the serious shortcomings of his argument.

Let us briefly address a potential worry here. Given the sophistication and idiosyncrasies of contemporary causal realism, one might argue that the proclaimed survival of causal realism is merely nominal rather than substantive. This concern stems from the sense that *much has been lost* in the transition from the traditionally conceived notion of causal realism to this current *weak*, *indirect*, or *light* realism.

---

to the fact that although physical laws may not be formally asymmetrical, the processes they describe often are in fact physically asymmetrical" (Lipkind, 1979, p. 719).

[19] Lewis himself emphasizes that this asymmetry is a contingent fact and a local characteristic of our world (see Lewis, 1979, p. 475). However, Adam Elga (2000) argues that even in Lewis' theory, certain restrictions related to entropy must be explicitly added to ensure asymmetry, as he believes that, considering insights from modern quantum physics, Lewis's original solution is not sufficiently robust. For an analysis of the asymmetry of counterfactual dependence within Lewis's theory, see: Đorđević & Ostojić (2015).

While our analysis does involve revising and redefining the term *causal realism*, two points must be emphasized. First, this intervention is not all that uncommon, and we are not alone in this revisionist endeavor; many authors are inclined[20] – against the traditional conception of causal realism that gives rise to these worries – to understand causal realism in terms nearly identical to those we propose.

Second, the basis for our redefinition is not *ad hoc* but instead it aims to capture what is arguably *central* to realism. By only giving up on the claim that causation is *de facto* part of the world's inventory (a part of our best scientific explanation of the world, or otherwise posited as a primitive, irreducible relation) we still insist on holding to all those remaining features of the realist causal relation that justify its realist status in the relevant sense. Abandoning the traditional metaphysical view of causation as a fundamental worldly relation does not entail conceding that it is a mere *pragmatic reconstruction* or that it is *divorced from reality*. On our adopted view, theories cannot qualify as causally realist if they are *projectivist* in any sense, if they treat causal relations as inherently dependent on our cognition, mind, language, or pragmatic considerations. Moreover, the example we have emphasized – David Lewis's counterfactual theory – has been analyzed precisely to highlight how the weakly realist position remains *tied to the world*.[21]

It would also be mistaken to dismiss this as a merely semantic dispute over *what to label realism*. Realism entails certain *ontological commitments*, and these – if we are correct – are fully preserved here. Only the *manner* in which these commitments were traditionally upheld has been rejected. A fitting analogy is a famous story from the history of science regarding the *theory of heat*. After discarding the (proper realist) idea of heat as a *distinct substance* (Lavoisier's *caloric fluid*), physicists did not become antirealists about the nature of heat; rather, they eventually settled for theories defining it as a property grounded in the behavior of elementary particles (as manifestation of their kinetic energy). Such theories in no way imply that temperature is a *projection*, a *pragmatic reconstruction*, or a property *divorced from reality*. So, to make the analogy complete, *heat realism* survived the counterargument (or rather crucial experiments) laid against early (boldly) realistic accounts, to continue to live as indirectly realistic, which is still undoubtedly realistic in any sense *worth wanting* (to put it in Dennett's words).

4.2. Lessons from Russell's second argument

Let us now turn to the second argument that Russell has proposed. In presenting his critique of causal realism, we highlighted that his most compelling argument is likely the one that directly attacks the principle of causality. This second argument (A_2) addresses the dilemma concerning the level of specificity in defining events and thrives on the unacceptable

[20] Some of them are cited in this paper: Menzies (2007), Esfeld (2018); and there are still more of those authors which aren't directly relevant to our endeavors but are more or less in sync with us concerning the understanding of causal realism: Paul and Hall (2013), Schaffer (2015), and others.

[21] And tied to *this* world – Lewis's infamous modal realism is not the requirement for the realist interpretation of his theory. As Esfeld and Deckert (2018, pp. 44–5) put it: "[T]he Humean can go for a sophisticated regularity theory [of causation] in terms of counterfactuals [...]. The decisive issue then is that the truth-value of the counterfactuals expressing causal relations supervenes on the configuration of matter and its change in the actual world. To put it differently, no realism about other possible worlds is required to obtain truth-makers for counterfactuals in Humeanism."

consequences of both potential solutions to this problem. This argument has become a classic issue for all theorists of causation who have, in one way or another, sought to adopt the idea of causation as determination or aim to refute it.[22]

Contrary to the discussion of the previous argument – where the goal was to show how realism could be defended by pointing out its problems – this second argument will be examined primarily from the perspective of the lesson that causal realism draws from its plausibility and persuasiveness. Even more specifically, in the following passages, we will present how Lewis' causal theory (serving as a good example of modest causal realism) avoids the problem highlighted by this Russellian argument.[23]

Lewis's theory of causation (Lewis 1973b, 1986a, 2004), mentioned above more than once, is undoubtedly among the most significant contemporary causal theories. In the context of analyzing Russell's critique of causal realism, two things are particularly noteworthy: 1. this theory unequivocally has a realist character and represents a version of – what we called – light (or minimal, or indirect) causal realism, and 2. the central definition of causation in this theory is surprisingly similar to the principle of causality that Russell so persuasively critiques. With this second point in mind, it is certainly a good question – how has this version of causal realism managed to avoid Russell's second and more compelling argument?

First, let's note that the similarity between Lewis's analysis of causation and the causality principle attacked by Russell (R_{cp}) lies in their shared origin. Both statements are openly inspired by the positive part of David Hume's famous analysis of causation from his *Enquiry Concerning Human Understanding*. In the part where he addresses causation, we have these two prominent definitions:

> (H_{cp1}) . . . [W]e may define a 'cause' to be an event followed by another, where all events similar to the first are followed by events similar to the second. (H_{cp2}) Or in other words where if the first event hadn't occurred the second wouldn't have occurred either. (Hume 2008: 38)

Although Hume himself clearly thinks that H_{cp2} merely paraphrases what is said in the H_{cp1}, that is surely not the case. In fact, the difference turns out to be extremely important. Lewis famously attends to these "other words" (H_{cp2}) in building his theory of causation, while maintaining that the principle given in H_{cp1} is problematic and unfruitful for contemporary causal theories.[24] In other words, Lewis's utilization of Hume's *other words* very effectively addresses Russell's objection that we are examining here. However, Lewis himself does not emphasize (neither here nor elsewhere), how analysis based on H_{cp2} actually avoids those insurmountable problems that trouble theories (e.g. the regularity theory) associated with the first definition (H_{cp1}). On the other hand, we believe that here we have an important lesson with regards to contemporary causal realism that should be elaborated.

[22] In his overview text on the regularity theory of causation, Psillos (2009) writes about this problem and points to significant commentaries on it by John Venn (1889) and Arthur Pap (1952).

[23] In that, we will be roughly following the analysis offered in Jovanović (2020, pp. 8–11).

[24] As an important shortcoming that suggests the irreparability of the regularity theory (built upon H_{cp1}), Lewis points out its failure to effectively distinguish causes from the effects, epiphenomena, and preempted potential causes (Lewis, 1973b, pp. 556–7).

It is important to note two significant differences between the two cited Hume's sentences. First, in the later sentence (H_{cp2}), causation is defined in terms of singular events, as opposed to the first definition, which is based on the relation between classes of events (or between types of events, since the classes are formed based on similarity to a given event). Second, and equally important: in the second sentence, there is a specific dependence between the non-occurrence of singular actual events, while the first gives an implicative statement between the occurrence of events of one type and the occurrence of events of another type.

These two differences are central to avoiding Russell's objection. Following Hume's second definition, Lewis ties causation to counterfactual dependence between actual singular events. In the most rudimental definition, this Lewisian principle of causality would read: an actual event c is the cause of an actual event e iff it is true that had event c not occurred, event e would not have occurred either.[25] Lewis defines events as properties of spatiotemporal regions, whose identity is not (necessarily) maximally specific, but whose specificity can vary in different conversational contexts (Lewis 1986b). Lewis seeks to preserve, within the theory, the practice of ordinary language, where we typically do not speak of events as being extremely fragile. Thanks to this, the theory allows events to be repeatable, i.e. a given event can occur in different places, at different times, or in slightly different ways or with different surroundings. In this way, the theory seems to be heading towards the problems with the lost determination.

The second significant difference: the type of dependence we have here (between events c and e) is not the same kind of determination we have within first definition, and which led to the problems. Instead of nomological dependence, closely connected to H_{cp1} we now have counterfactual dependence, built upon counterfactual conditionals with their respective semantics and further restrictions (Lewis 1973a, 1973b). Counterfactual conditionals are tied to actuality, in the sense that certain circumstances from the actual world are presupposed and held fixed during their evaluation (including natural laws, but also various contingent facts). When we say of a singular actual event c: "had event c not occurred, then ...," we indeed presuppose much of the circumstances in which c actually occurred. And this is precisely what was missing and causing the problem in the formulation of the principle of causality (both R_{cp} and H_{cp1}). Lewis's theory does not claim "whenever c, then (assuming the laws) always e," because this statement is not tied to actuality in an adequate way, and during evaluation, it allows for variation in circumstances, and changes in circumstances can prevent the occurrence of the effect – as already discussed. In contrast, his definition of causation through counterfactual conditionals inherits from these conditionals a certain "freezing" of circumstances and natural laws (in the sense of holding them fixed),[26] which (in an indirect way) saves it from the second horn of Russell's dilemma as given in A_2.

[25] This is, of course, an oversimplification, for the sake of clarity.

[26] It must be noted – with regards to standard semantics for counterfactuals – that there is no "freezing" and "holding fixed" in the *strict sense*, since nothing that is contingent in any sense (and both circumstances and laws are contingent) is fixed and true throughout the *whole modal horizon*. Only necessary truths are true in all possible words, disregarding their *distance* from the actual world. However, having in mind standard semantics for counterfactuals and the role that comparative similarity of worlds plays in it, there is a sense in which in the nearest and (for the evaluation of the given conditionals) relevant possible worlds those circumstances and certain facts *are* being held fixed (Lewis, 1973a, 1979).

Eagle (2007) insightfully captures this from a formal perspective. For him, the central difference between the two definitions of causation must be seen in the fact that counterfactual implication, unlike the material implication tied to the principle of causality (H_{cp1} and R_{cp}), does not allow the *strengthening of the antecedent* as a valid rule of inference. If it is true that a implies b, then it should hold that a and c together also imply b.[27] In contrast, this law does not hold for counterfactual conditionals.[28] Therefore, the fact that with a change in some circumstances we would no longer have (counterfactual) dependence between cause and effect does not oblige us to say that this dependence does not hold between cause and effect.

We can illustrate this by an example. After inserting money into a coffee machine, a person pressed a button, and shortly afterward, the machine made a cup of coffee. Was that button-pressing the cause of the coffee being made? Undoubtedly, it was. But what do the two mentioned analyses say about this? The principle that Russell critiques (R_{cp}) shows the expected weaknesses. Simply put, not all instances of pressing the button are followed by the preparation of coffee. Conditional: If the person presses the button, the machine will make the coffee – is problematic. Pressing the button is insufficient in various circumstances, ranging from cases where there is not enough money in the machine, or the machine is unplugged, or it malfunctions, etc. So, the expected regularity does not seem to hold.

On the other hand, the counterfactual dependence seems to hold. The conditional: had the person not pressed the button, the coffee machine would not have made coffee – should turn out true. We can attempt to formulate an analogous objection to the one given above – that, with altered circumstances, this second statement would also not be true; for example: had the person in question not pressed the button, but someone else had, the machine would still have made coffee. But this objection is not relevant, since in the actual world these circumstances do not exist, and our counterfactual statement and the way we evaluate it do not oblige us to say that this would hold in all circumstances (i.e. does not commit us to accepting strengthening of the antecedent).

Thanks to this, Lewis's position effectively circumvents Russell's dilemma. In that dilemma, we had two alternatives: either we have local and broadly described events but no determination, or we have regularity and determination but instead of typical events we need to take the states of the world at a given moment as causal relata. Both alternatives, as we have seen, led to the refutation of the principle of causality. By redefining the relation between events by means of counterfactual dependence, the counterfactual theory allows us both to have a definition of causation and for it to refer to local events.

[27] Strengthening the antecedent, as a law of classical logic (where we are dealing with material implication), can be expressed in the form of a valid argument: $(a \supset b) \vDash a \wedge c \supset b$. Such an argument, however, is not valid for counterfactual conditionals: $a \succ b \nvDash a \wedge c \succ b$. (In these formal notations we used the symbol "$\succ$ to denote counterfactual implication. The symbols for conjunction and material implication are, respectively: $\wedge$ and $\supset$; furthermore, the double turnstile, regular ($\vDash$) or negated ($\nvDash$), is used to indicate that the formula on the right (respectively) is, or isn't a semantic consequence of the formula, or set of formulas, on the left.)

[28] This holds for standard semantics that is relevant for our paper. However, as a more general claim this would not be true. Indeed, there are authors who defend the thesis that strengthening the antecedent is still a valid pattern of inference even for counterfactual conditionals. For a detailed analysis of this problem, see (Nute & Cross, 2001).

The other previously mentioned theories that we have considered as causal realism successfully addressed this dilemma in various ways. Woodward's manipulability theory (2003), for instance, does so very similarly to Lewis's – mainly through formal properties of counterfactual dependence. Theories relying on probability (e.g. Hitchcock 2018) could easily accommodate the problem of the absence of determinism when viewed from the perspective of necessity, as long as these patterns of regularity were stochastically identifiable. Process theorists (as well as energy transfer theorists and those similar to them), however, had a somewhat different task. Their way of bypassing Russell's objections did not involve tweaking the principle of causality or redefining causal dependence,[29] but was more focused on modeling the causal relation *on the* laws and entities from fundamental science in a way that at least roughly correlates with the philosophical concept of cause.[30] This plethora of options, together with the Lewisian solution presented in detail above, demonstrates that Russell's second argument, initially deemed intractable, can be successfully met in multiple ways.

5. Conclusion

In this paper, we have analyzed Russell's critique of causal realism and explored how this philosophical position has not only survived but also evolved in response to his arguments. Russell's two central arguments were intended to dismantle the traditional metaphysical commitment to causation as an objective feature of the world. However, as we have seen, causal realism has endured, thanks to both the limitations of Russell's arguments and the innovative and insightful responses developed by contemporary causal realists.

The first argument, which questioned the role (and the possibility of grounding) of causation in fundamental physics, left room for a more modest form of causal realism to emerge. Contemporary theories, such as process theories, counterfactual theories, and interventionist approaches and so on, have redefined causation in terms of supervenience on fundamental physical facts, thereby avoiding the direct confrontation with Russell's critique. Also, those theories somehow find the way around the so-called asymmetry problem. This shift toward a more indirect or modest causal realism has allowed the position to withstand Russell's objections, demonstrating that his critique, while insightful, was not fatal.

The second argument, which focused on the conceptual difficulties in defining causal relations – particularly the problem of specifying events and ensuring the regularity required by the principle of causality – has also been addressed by contemporary theories. Russell's diagnosis of the dilemma faced by causal realists, where broadly defined events fail to ensure regularity and highly specific events render the principle of causality vacuous, was astute. However, modern theorists, such as David Lewis, have circumvented this problem by redefining causation in terms of counterfactual dependence. By focusing on singular events

[29] However, their lack of attention to this exact problem (especially when it comes to causal relata) is, according to Eagle, the reason why process theorists must face the same problems that Russell attributes to the principle of causality. See Eagle (2007, p. 162).

[30] As Bernstein notes, these theories have a somehow problematic "success condition" especially with regards to everyday intuitions (2017, pp. 80–81). Their authors tend to describe causal relations in ways that: 1) can diverge from everyday folk intuitions about causation but also 2) do not directly correspond to our best scientific theories. As Bernstein suggests, their specific project of analysis of causation is rather complex since the goals of scientific accuracy and intuitive plausibility may not always align.

and holding fixed the circumstances in which these events occur, Lewis's theory and others like it have provided a way to preserve the reality of causation without falling into the traps Russell identified.

As we have tried to show, the survival of causal realism can be attributed to a combination of Russell's oversights and the resourcefulness of contemporary realists. By redefining what it means for causation to be *real* and by developing theories that are responsive to the challenges posed by Russell's plausible points, causal realism has not only endured but also thrived. As a consequence, causal realism lives to see another day, not as the naive metaphysical doctrine Russell attacked, but as a refined position that continues to play an important role in the philosophy of causation.

Acknowledgments

This paper was prepared as a part of the project *Philosophical research in the digital sphere – public and scientific aspects*, conducted at the University of Niš – Faculty of Philosophy (No. 423/1-3-01). Also, this study was supported by the Ministry of Science, Technological Development and Innovations of the Republic of Serbia (Contract No. 451-03-137/2025-03/ 200165).

References

Albert, D. Z. (2000). *Time and chance*. Harvard University Press.

Annila, A. (2023). Philosophy of thermodynamics. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 381*(2252). https://doi.org/10.1098/rsta.2022.0281

Aronson, J. (1971). On the grammar of 'cause'. *Synthese, 22*, 414–430.

Bernstein, S. (2017). Intuitions and the metaphysics of causation. In D. Rose and J. Schaffer (Eds.), *Advances in experimental metaphysics* (pp. 45–65). Bloomsbury Publishing PLC. Retrieved from https://www3.nd.edu/~sbernste/Intuitions_penultimate.pdf

Blanchard, T. (2016). Physics and Causation. *Philosophy Compass, 11*(5), 256–266. https://doi.org/10.1111/phc3.12319

Corry, R. (2006). Causal realism and the laws of nature. *Philosophy of Science, 73*(3), 261–276.

Dowe, P. (2007). Causal processes. In E. N. Zalta (Ed.), *The Stanford encyclopedia of philosophy* (Summer 2010 Edition). Retrieved from https://plato.stanford.edu/archives/sum2010/entries/causation-process/

Dowe, P. (2010). Causal Process Theories. In H. Beebee, C. Hitchcock, & P. Menzies (Eds.), *The Oxford Handbook of Causation* (pp. 213–233). Oxford University Press.

Eagle, A. (2007). Pragmatic causation. In H. Price & R. Corry (Eds.), *Causation, physics, and the constitution of reality: Russell's republic revisited* (pp. 191–223). Oxford University Press.

Edgington, D. (2008). Counterfactuals. *Proceedings of the Aristotelian Society, 108* (part 1), 1–21. https://doi.org/10.1111/j.1467-9264.2008.00233.x

Ehring, D. (1997). *Causation and persistence: A theory of causation*. Oxford University Press.

Esfeld, M. (2011). Causal realism. In D. Dieks, W. Gonzalez, S. Hartmann, M. Stöltzner, & M. Weber (Eds.), *Probabilities, laws, and structures* (pp. 435–460). Springer.

Esfeld, M. & Deckert, D.-A. (2018). *A Minimalist Ontology of the Natural World*. Taylor & Francis Ltd.

Fair, D. (1979). Causation and the flow of energy. *Erkenntnis, 14*, 219–250.

Field, H. (2003). Causation in a physical world. In M. Loux & D. Zimmerman (Eds.), *Oxford handbook of metaphysics* (pp. 435–460). Oxford University Press.

Hájek, A. (2014). Probabilities of counterfactuals and counterfactual probabilities. *Journal of Applied Logic, 12*(3), 235–251. https://doi.org/10.1016/j.jal.2013.11.001

Halpern, J. Y., & Pearl, J. (2005). Causes and explanations: A structural-model approach. Part I: Causes. *The British Journal for the Philosophy of Science, 56*(4), 843–887. https://doi.org/10.1093/bjps/axi147

Hitchcock, C. (2005). What Russell got right. In H. Price & R. Corry (Eds.), *Causation, physics, and the constitution of reality: Russell's republic revisited* (pp. 45–65). Oxford University Press.

Hitchcock, C. (2007). How to be a causal pluralist. In P. K. Machamer & G. Wolters (Eds.), *Thinking about causes* (pp. 200–221). University of Pittsburgh Press.

Hitchcock, C. (2018). Probabilistic Causation, *The Stanford Encyclopedia of Philosophy* (Spring 2021 Edition), Edward N. Zalta (ed.), Retrieved from https://plato.stanford.edu/archives/spr2021/entries/causation-probabilistic/

Hume, D. (2008). *Enquiry concerning human understanding*. Retrieved from www.earlymoderntexts.com. (Original work published 1748)

Jovanović, M. Z. (2020). *Causation, conditionals and pluralism* [Unpublished Doctoral Dissertation]. https://nardus.mpn.gov.rs/handle/123456789/17796

Lewis, D. (1973a). *Counterfactuals*. Blackwell.

Lewis, D. (1973b). Causation. *Journal of Philosophy, 70*, 556–567.

Lewis, D. (1979). Counterfactual dependence and time's arrow. *Noûs, 13*, 455–476.

Lewis, D. (1986a). Events. In *Philosophical papers II* (pp. 241–269). Oxford University Press.

Lewis, D. (1986b). Postscripts to 'Causation'. In *Philosophical papers II* (pp. 172–213). Oxford University Press.

Lewis, D. (2004). Causation as influence. (Extended version). In J. Collins, N. Hall, & L. Paul (Eds.), *Causation and counterfactuals* (pp. 75–106). MIT Press.

Lipkind, D. (1979). Russell on the notion of cause. *Canadian Journal of Philosophy, 9*(4), 701–720.

Loewer, B. (2007). Counterfactuals and the second law. In H. Price & R. Corry (Eds.), *Causation, physics, and the constitution of reality: Russell's republic revisited* (pp. 293–326). Oxford University Press.

Mackie, J. L. (1974). *The cement of the universe*. Oxford University Press.

Menzies, P. (2007). Causation in context. In H. Price & R. Corry (eds.), *Causation, physics, and the constitution of reality: Russell's republic revisited* (pp. 191–223). Oxford University Press.

Nay, A. (2009). Physical causation and difference-making. *Philosophical Studies, 145*(1), 101–120.

Nute, D., & Cross, C. B. (2001). Conditional logic. In D. M. Gabbay & F. Guenthner (Eds.), *Handbook of philosophical logic* (Vol. 4, pp. 1–98). Springer.

Pap, A. (1952). Philosophical analysis, translation schemas, and the regularity theory of causation. *Journal of Philosophy, 49*, 657–666.

Paul, L. A., & Hall, E. J. (2013). *Causation: A User's Guide*. Oxford: Oxford University Press.

Pearl, J. (2000). *Causality: Models, reasoning, and inference*. Cambridge University Press.

Pearl, J., & Mackenzie, D. (2019). *The Book of Why: The New Science of Cause and Effect*. Penguin Books.

Price, H. (1997). *Time's Arrow and Archimedes' Point*. Oxford University Press.

Psillos, S. (2009). Regularity theories. In H. Beebee, C. Hitchcock, & P. Menzies (Eds.), *The Oxford handbook of causation* (pp. 131–157). Oxford University Press.

Russell, B. (1948). *Human knowledge: Its scope and limits*. Simon and Schuster.

Russell, B. (1959). On the notion of the cause. In *Mysticism and logic* (pp. 174–201). Allen and Unwin LTD.

Schaffer, J. (2015). Grounding in the image of causation. *Philosophical Studies, 173*(1), 49–100. https://doi.org/10.1007/s11098-014-0438-1

Shinod, N. K. (2019). There, Russell was right: On the status of causality in modern science. *Synthese, 196*(11), 4551–4573.

Spirtes, P., Glymour, C., & Scheines, R. (1993). Causation, Prediction, and Search. In *Lecture notes in statistics*. Springer New York. https://doi.org/10.1007/978-1-4612-2748-9

Stalnaker, R. (1968). A theory of conditionals. In N. Rescher (Ed.), *Studies in logical theory* (*American Philosophical Quarterly Monographs, 2*, pp. 98–112). Blackwell.

Suppes, P. (1970). *A probabilistic theory of causality*. North-Holland.

van Fraassen, B. (1980). *The Scientific Image*. Oxford University Press.

Venn, J. (1889). *The principles of empirical or inductive logic*. MacMillan.

Woodward, J. (2003). *Making things happen: A theory of causal explanation*. Oxford University Press.

Đorđević, V., & Ostojić, J. (2015). Transition periods and miracles. *Belgrade Philosophical Annual, 28*, 89–112.