Can Interventionists be Neo-Russellians?

Interventionism, the Open Systems Argument and the Arrow of Entropy

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Abstract

Several proponents of the interventionist theory of causation have recently argued for a neo-Russellian account of causation. The paper discusses two strategies for interventionists to be neo-Russellians. Firstly, I argue that the open systems argument – the main argument for a neo-Russellian account advocated by interventionists – fails. Secondly, I explore and discuss an alternative for interventionists who wish to be neo-Russellians: the statistical mechanical account. Although the latter account is an attractive alternative, it is argued that interventionists are not able to adopt it straightforwardly. Hence, to be neo-Russellians remains a challenge to interventionists.

Keywords

Russell on causation, neo-Russellian views of causation, interventionist theories of causation, causation in the special sciences, statistical mechanical account of causation

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1. Introduction

A century ago, Bertrand Russell's paper "On the Notion of Cause" was published. Russell famously argues that it is an important lesson of fundamental physics that – contrary to the beliefs of philosophers – causation is not among the building blocks of the world. That is, causal relations are not part of the ontology of fundamental physics. Call this claim the orthodox Russellian claim. Especially in the past few years, several neo-Russellian philosophers have expressed agreement with Russell's view of the ontology of fundamental physics. Agreeing with Russell on the truth of the orthodox Russellian claim, Neo-Russellians argue for – what I call – the additional neo-Russellian claim that we have good reasons to believe in the existence of non-fundamental, higher-level causal facts.[2] In the context of philosophy of science, the neo-Russellian claim is primarily warranted by the observation that higher-level causes loom large in the special sciences. Usually a third widely held claim is added to the neo-Russellian account: the dependence claim, according to which higher-level causal facts metaphysically depend on acausal fundamental physical facts. That is, a neo-Russellian believes that the conjunction of the orthodox Russellian claim, neo-Russellian claim and the dependence claim is true.

The main puzzle that neo-Russellians wish to solve is this: how can we explain that the orthodox Russellian claim, the neo-Russellian claim and the dependence claim are all true in the actual world? I will refer to this request for an explanation as the neo-Russellian challenge. The resulting task for neo-Russellians is to provide a coherent physical explanation of why the following claims are true:

[2] Cf. Eagle (2007), Hitchcock (2007), Kutach (2007), Ladyman and Ross (2007), Loewer (2007), (2009), Ross & Spurrett (2007), Woodward (2007).

1. *Neo-Russellian claim*: there are higher-level causal facts.
2. *Orthodox Russellian claim*: there are no fundamental causal facts.
3. *Dependence claim*: higher-level causal facts metaphysically depend on acausal fundamental physical facts.

If such an explanation of why these three claims are true can be provided, then higher-level causal facts are physically kosher facts and the neo-Russellian challenge is met. The central question of this paper is whether proponents of James Woodward's (2003) interventionist theory of causation can meet the neo-Russellian challenge – a goal some interventionists, including Woodward (2007), explicitly wish to achieve. One of the main arguments, to which interventionist neo-Russellians refer for this purpose, is the open systems argument (henceforth, OSA). It will be argued that the OSA is not sound.

Let me add three clarifications and disclaimers:

First, the dependence claim is important because it prevents an easy way out: the constraint precludes the option to simply accept – without any need for further explanation – both (a) non-causal fundamental physical facts and (b) causal facts on the 'higher levels' of the special sciences. Such an 'easy way out' view would, for instance, treat higher-level causal facts as strongly emergent from acausal physical facts. Many philosophers believe that physics plays a special role, and that this role constrains the ontology of other sciences (for an overview cf. Price and Weslake 2009, section 1.2). A standard way of spelling out the special status of physics is that (particular and nomic) physical facts are the supervenience base for special science facts, including the non-fundamental causal facts of

the special sciences.[3] If one accepts the dependence claim, then one is inclined to ask how it can be explained that causal facts supervene on non-causal facts. That is, one accepts the neo-Russellian challenge.

Second, the dialectic goal of this paper is neither to argue for the neo-Russellian claim nor to argue for the orthodox Russellian claim. Instead, I will take neo-Russellianism to be an attractive position that other people have convincingly argued for (see footnote 1). Likewise I take the orthodox Russellian claim as a premise by assuming that some of the arguments in its favor are convincing (cf. Russell 1912/13, Albert 2000, Norton 2007, Ross & Spurrett 2007). It is assumed in the paper that a neo-Russellian account is a desirable view.

Third, it is helpful to note that Russell and the neo-Russellians ascribe characteristic features to causal relations such as the following ones[4]:

a. *Sufficiency*: causes are sufficient for their effects; it always is the case that if the cause occurs, then the effect occurs (Russell 1912/13: 7-12).
b. *Locality*: cause *c* and effect *e* are local and distinct events in a space-time region *r* where *r* is "something short of the whole state of the universe" (Russell 1912/13: 7).
c. *Causal Asymmetry*: the causal relation is asymmetric: if A causes B, then B does not cause A (Russell 1912/13: 10).
d. *Causal Time-Asymmetry*: causes precede their effects in time, but not vice versa (Russell 1912/13: 13-16).

[3] Alternative ways of spelling out metaphysical dependence are, for instance, the grounding relation (Schaffer 2009) and weak metaphysical emergence (Wilson 2010). Another – although controversial – option is the primacy of physics constraint (Ladyman and Ross 2007, 44).
[4] This list is not meant to be exhaustive.

In the current literature, these features of causal relations are thought of as the folk notion of causation (Ladyman and Ross 2007: 268f, Norton 2007: 36-38, Ross and Spurrett 2007: 13f).[5] The general line of argument for the orthodox Russellian claim is as follows: given that the folk features (a)-(d) characterize causal relations, Russell and the neo-Russellians argue that the relations of physics (especially nomic relations) lack precisely these features. Thus, Russellians argue, the relations posited by fundamental physical theories are not causal. One instance of such an argument is the directionality argument (Field 2003, Ney 2009, Farr & Reutlinger forthcoming), according to which the dynamical laws of fundamental physics are time-symmetric and express symmetric dependence relations, and, therefore, cannot be causal laws (because the laws lack the folk features of time-asymmetry and causal asymmetry).[6] Given that the laws are the only place to look for causes in fundamental physics and given that causes are characterized by folk features, the directionality argument aims to establish the claim that causal relation are not part of the fundamental physical ontology (which is expressed by the orthodox Russellian claim).

I will proceed as follows: In section 2, I present the OSA in detail and I raise four objections to the argument. The conclusion of this section is that the OSA is not sound. In section 3, I explore a prima facie alternative for interventionists in order to meet the neo-

[5] As these philosophers point out, causation is often characterized by these features not only in ordinary discourse but also in special science discourse. In this respect it is misleading to call the notion of causation a 'folk' notion. However, I will adopt the term 'folk features' of causation, as it is an established and useful term in the debate.

[6] Time-symmetry is often understood in terms of time-reversal invariance in the sense that if the fundamental laws permit a sequence \$ of states of a physical system $S_1(t_1)$, …, $S_n(t_n)$, then they also permit the temporally reversed sequence $\$^{\#}$ of states $S^{\#}_n(t_n)$, …, $S^{\#}_1(t_1)$. See Albert (2000, 2-9), Earman (2002), North (2008), and Arntzenius and Greaves (2009) for a detailed discussion of interpretation of time-reversal invariance in various branches of physics.

Russellian challenge: the statistical-mechanical (SM) account of the metaphysics of causation. Section 4 shows that interventionists face problems if they appeal to the SM account. The source of this problem is the unclear relationship between the semantics and the metaphysics of causation. Three views of this relationship will be evaluated with respect to their usefulness for interventionists who would like to be neo-Russellians. Two of these views appear to be viable for interventionists (heavy-weight metaphysics and the Canberra plan). However, both views require revisions of some of the intuitions about the meaning of causal claims that Woodward entertains. One view (the Canberra plan) is especially promising as it preserves most of the intuitions, which interventionists hold. However, the Canberra plan suffers from internal problems when applied to the case of causation. The upshot is rather challenging for interventionists: at the present state of the debate, interventionists can neither rely on the OSA nor are they able to straightforwardly adopt the SM account in order to meet the Neo-Russellian challenge.

2. The Open Systems Argument

Advocates of the interventionist theory of causation propose the OSA as a response to the neo-Russellian challenge. The argument crucially depends on this theory of causation. For this reason, I will briefly summarize Woodward's version of the interventionist theory before presenting the details of the OSA.

According to Woodward's interventionist account of causation, essentially, *X* causes *Y* iff there is a possible intervention on *X* that changes *Y* (Woodward 2003, 59).[7] The interventionist theory is a special kind of a counterfactual theory, because if '*X* causes *Y*' is

[7] On notation: *X*, *Y*, ... denote variables, and *x*, *y*, ... represent values of variables. '$X = x$' is a statement, which expresses the proposition that the variable *X* takes the value *x*.

true, then the following interventionist counterfactuals have to be true: 'if there were an intervention $I = i$ on X such that $X = x$, then $Y = y$ would be the case', and 'if there were an intervention $I = i^*$ on X such that $X = x^*$, then $Y = y^*$ would be the case' (with $i \neq i^*$, $x \neq x^*$, $y \neq y^*$). An intervention on X is, roughly speaking, defined as a cause of X that exclusively influences X and any change of Y due to the intervention on X is mediated through X (Woodward 2003, 98). Moreover, Woodward requires that interventions be merely logically – not physically – possible (2003, 128, 132). This modal character of interventions is going to matter for the discussion in this section.

Woodward's interventionist theory of causation is conceptually non-reductive because it refers to interventions, which are explicitly introduced as causal notions.[8] Woodward is not concerned with the methodology of causation, i.e. the construction of algorithms that allow us to infer causal models from statistical data (Woodward 2003, 38).[9] The aim of interventionists is to provide a semantic account of causal statements. Woodward is very explicit about the semantic goal of his approach: "my aim is to give an account of the content or meaning of various locutions, such as X causes Y […]" (Woodward 2003, 38; cf. also 2003, 7-9; 2008, 194-196).

[8] One might worry that conceptually non-reductive explications of causation are viciously circular (Strevens 2007, 245). This is a serious challenge to interventionism. However, I will not address this problem here and suppose, for the sake of the argument, that this kind of circularity is not vicious as the proponents of the non-reductive explication argue (Woodward 2003, 104-107).

[9] "By contrast [to Pearl's and Spirtes, Glymour, and Scheines's work], I have nothing to say about issues having to with calculating quantitative magnitudes, estimation, identifiability, or causal inference. Instead, my enterprise is, roughly, to provide an account of the meaning or content of just those qualitative causal notions that Pearl (and perhaps Spirtes et al.) take as primitive. Because my project is semantic or interpretative, and is not intended as a contribution to practical problems of causal inference […]." (Woodward 2003, 38)

The basic idea of the OSA draws on the interventionist theory of causation as follows: (a) causal relations are not part of the ontology of fundamental physics because it is impossible to intervene on the systems described by fundamental physics (i.e. the interventionist theory of causation does not apply). (b) Higher-level causal facts obtain since it is possible to intervene on those kinds of systems that are described by the special sciences. According to proponents of the OSA, the possibility to intervene on a system depends on whether the system is open or closed (I will return to the distinction between open and closed systems shortly). Therefore, Woodward argues, the OSA provides a reason to believe that the orthodox Russellian claim and the neo-Russellian claim are both true. Hence, the Neo-Russellian challenge is resolved. If the OSA were sound, it would be a great success for interventionists, because the orthodox Russellian claim and the neo-Russellian claim would follow straightforwardly from the interventionist account of causation. However, I argue that the argument is not sound.

Let me now present the OSA in detail. Several interventionists who agree on the OSA are inspired by a claim by Judea Pearl (cf. Eagle 2007, 171; Hitchcock 2007, 53-54; Woodward 2007, 92-93)[10]:

> If you wish to include the entire universe in the model, causality disappears because interventions disappear – the manipulator and the manipulated lose their distinction. However scientists rarely consider the entirety of the universe as an object of investigation. In most cases the scientist carves a piece from the universe and proclaims that piece in – namely the focus of investigation. The rest of the universe is then considered out or background and is summarized by what we call boundary

[10] See also Price and Weslake (2009, section 6.3).

> conditions. This choice of ins and outs creates asymmetry in the way we look at things, and it is this asymmetry that permits us to talk about 'outside intervention' and hence about causality and cause-effect directionality. (Pearl 2000, 349f)

The explanatory targets in this quote are specific features of causality, most importantly the features of causal asymmetry and causal time-asymmetry. The notion of an 'outside intervention' apparently plays the key role in this explanation. So, what is the argument that Neo-Russellian interventionists advocate and which is inspired by Pearl? Let me focus on Woodward's OSA because it is the most elaborated version of the argument, and, further, because Eagle's and Hitchcock's formulations of the OSA seem to be in agreement with Woodward's OSA.

Woodward observes that the special sciences typically do not only use causal vocabulary. Moreover, the kinds of systems that these sciences describe by means of causal claims exhibit a common feature: special science systems typically are a small part of the entire world (as indicated in the quote by Pearl). Special science systems are open systems, as they are not isolated from the influence of their environment. By contrast, Woodward holds that the systems described by fundamental physics are global and closed because physical theories describe states of the entire universe.[11] Woodward argues that the successful application of causal notions is explained by the fact that special science systems are "non-global", "small", or "open" (cf. Woodward 2007, 91-92) because "such systems are typically only a small part of a much larger world or environment which is outside the scope of the inquirer's interest but which can serve as source of interventions" (Woodward

[11] One might oppose this view of the subject matter of fundamental physical theories. However, this concern will be ignored for the sake of the argument.

2007, 90). Woodward claims that the existence of possible interventions (as assumed in his account of causation) requires open systems (Woodward 2007, 92). If the possibility to intervene requires a larger environment outside of a system, he continues, then including the whole universe in a model (as he supposes physicists do) leaves no room for interventions. In other words, there is no room for the "potential source" of interventions in the case of closed systems. Given the interventionist theory of causation is true, which requires the possibility to intervene, Woodward argues, causal notions are not applicable to closed systems (Woodward 2007, 93). Putting all the pieces together, Woodward's OSA works as follows:

The Open Systems Argument (OSA)

1. The interventionist theory of causation is true.
2. If the interventionist theory of causation is true, then causal claims are true or false only of open systems – that is, systems which can be subject to a possible intervention from the outside, the environment of the system.
3. Therefore, causal claims are true or false only with respect to open systems.
4. Therefore, causal claims are not true or false with respect to closed systems.

Woodward argues that the OSA meets the neo-Russellian challenge since it supports

a. the neo-Russellian claim that there are higher-level causal facts of the special sciences, because the special sciences describe open systems, and
b. the orthodox Russellian claim that there are no causal facts according to fundamental physics, because fundamental physics is the science of closed systems.

If the OSA were sound, then the orthodox Russellian claim and the neo-Russellian claim would follow straightforwardly from the interventionist theory. The question arises whether the interventionist OSA is a convincing argument. I think it is not a convincing argument, based on the following four reasons.

First Objection

From a neo-Russellian stance, the OSA is question begging in at least two respects. First, the openness of a system seems to be characterized in causal terms: a system is open if it is not isolated from (actual or possible) causal influences coming from the spatial environment of the system (Woodward 2007: 91-92). Second, interventionists take it at least as a contingent fact that interventions on an open system influence only the future of the open system and not its past. This is no surprise since interventions are (an especially constrained kind of) causes with the characteristic folk features of causes. Interventions *qua* causes contingently occur before their effects. However, this contingent fact that interventions *qua* causes contingently influence the future of the system that is subject to the intervention is the *explanandum* for neo-Russellians. It is the ambition of neo-Russellians to explain why the influence of all kinds of causes (including interventions as a special kind of cause) is contingently directed from the past to the future and not vice versa. Therefore, characterizing openness in causal terms and relying on interventions fails to explain why there is higher-level causation in a fundamentally acausal world. However, this is precisely the challenge that Woodward as a neo-Russellian ought to meet.

Second Objection

It is not clear why interventions on closed systems are supposed to be impossible. It is hard to see why they should be impossible, if one recalls Woodward's definition of an intervention (section 2; Woodward 2003, 98f) and his additional assumption that interventions are required to be merely logically – but not physically – possible (Woodward 2003, 128, 132; Woodward 2007, 91). If one accepts Woodward's definition of an intervention and his assumption about the modal character of interventions, one can easily come up with a scenario, in which an intervention on a closed system is possible. The basic idea is that even if a system is in fact closed – because there is no actual environment – counterfactuals can be entertained about what would happen, if an environment and an intervention coming from this environment were introduced.

To take Woodward's own example, imagine a universe in which the motion of particles is governed by Newtonian mechanics (Woodward 2007, 93). The laws of this universe are deterministic, global and complete in the sense that, given some state of the entire universe S_1 at time t_1, the laws determine the state of the entire universe at any other past and future time. Let us assume that a state of the entire universe S_1 at t_1 is the cause of a distinct entire state of the universe S_2 at a later time t_2. According to the interventionist account, $S_1(t_1)$ is a cause of $S_2(t_2)$ iff, roughly, there is a possible intervention on $S_1(t_1)$ that eventually changes $S_2(t_2)$. Woodward often expresses the right-hand-side of the bi-conditional in the form of an interventionist counterfactual: 'if it were the case that an intervention occurs such that $S_1^*(t_1)$, then it would be the case that $S_2^*(t_2)$'; S_1^* is a counterfactual state at t_1 and S_2^* is a counterfactual state at t_2. In the framework of standard possible worlds semantics, this interventionist counterfactual is true iff $S_2^*(t_2)$ is the case in the closest $S_1^*(t_1)$-worlds. It is natural to think that, for interventionists, the closest

antecedent-worlds are those in which the antecedent is the outcome of an intervention. What could such an intervention be? For instance, the velocity of a particle is changed by the intervention event *i* in a possible Newtonian world w. Such an intervention event *i* could be the influence of an 'additional' counterfactual particle that does not exist in the actual universe. That is, the intervention on a closed system can be understood as a possible world, in which a hypothetical environment (including the 'additional' particle) interacts with a system that is actually closed, i.e. a system that has no environment in the actual world (Woodward's universe). I see no reason why such an intervention should be logically impossible (albeit maybe physically impossible) – and that is all Woodward requires. Prima facie, a world like w is – apart from intervention-event *i* – very close to the actual Newtonian universe, because its history before the intervention matches the actual history, the same Newtonian laws obtain after the intervention, etc. (if these criteria are used to measure closeness). Moreover, we have a good reason to think that the counterfactual in question is true in Woodward's Newtonian world, because the world w is governed by deterministic laws and a counterfactual state S_1* at t_1 evolves – in virtue of the deterministic laws – into a counterfactual state S_2* at t_2.

I anticipate a concern at this point. One might worry that referring to possible worlds semantics in order to understand Woodward's account of causation is wrong-headed, because Woodward explicitly rejects Lewis's possible worlds semantics for counterfactuals (Woodward 2003, 133-145). However, the worry is unjustified because taking a closer look reveals that Woodward merely objects to Lewis's similarity metric for the closeness of world (cf. Woodward 2003, 139 and 142, for counterexamples against Lewis's similarity metric). Woodward's view is entirely coherent with the general idea of Lewisian semantics: that is, a counterfactual is true at a world w iff the consequent is true in

the closest antecedent-worlds.[12] This general idea of Lewis's semantics can be distinguished from Lewis's specific proposal for selecting the closest worlds (i.e. Lewis's similarity metric). One appealing way to understand Woodward is to say that he deviates from Lewis by using a different measure for closeness of worlds. From Woodward's point of view, the most obvious candidate for such a measure is this: the closest antecedent-worlds are those in which the antecedent of the counterfactual in question is the outcome of an intervention and the same invariant generalizations (or laws) are true as in the actual world (Woodward 2003, 135-136, Woodward & Hitchcock 2003, 13-14).[13] The main point I would like to stress is that using standard possible worlds semantics in order to understand (a) existential claims about possible interventions and (b) interventionist counterfactuals is compatible with Woodward's theory of causation (including his objections to Lewis's similarity measure).

A proponent of the OSA could counter with the following rejoinder to the objection that interventions on closed systems are possible: it is a matter of metaphysical necessity that the actual universe is closed, because it is essentially constituted by the entities, of which it actually consists. So, if one 'added' an intervention-event *i* to the actual universe it would no longer be the same entity. In virtue of metaphysical necessity there is no intervention on the entity called 'the actual universe', because intervention-worlds would constitute another object that is not identical with the actual universe. However, even if this

[12] Woodward's worlds should be understood as model worlds or small worlds, i.e. assignments of values to variables in a causal model (Pearl 2000, 207). In this respect, Woodwardian worlds differ from Lewisian worlds because the latter are as detailed and concrete as the real spatio-temporal entity we inhabit (Hüttemann 2004, 113).

[13] For a more elaborate discussion of this point, including details of measures of closeness, and a discussion of other semantics for counterfactuals such as Goodmanian and suppositionalist approaches, cf. Reutlinger (2013: chs. 3 & 8). The arguments in this paper do not depend on any particular choice of semantics.

were the case, one could still maintain that a counterfactual universe w which is in the state S_1* at t_1 is similar enough – relative to the preferred interventionist measure of closeness – to the actual universe (though a different entity) in order to evaluate the counterfactual 'if it were the case that S_1*(t_1), then S_2*(t_2) would be the case'. Although this is a possible rejoinder, I doubt that most interventionists would be comfortable with endorsing claims about the essences of things.

This second objection raises the question whether Woodward is mistaken and there is, in fact, causation in closed systems, if interventions on closed systems are possible. If this were true, then it seems that the orthodox Russellian claim would be false. However, the third objection suggests that this is not the case.

Third Objection

According to the second objection, there is not a good reason to believe that it is (logically) impossible to intervene on closed systems. If this objection is correct, does it imply that causal claims are true with respect to closed systems such as Woodward's Newtonian universe? If the answer were 'yes', then it would contradict the orthodox Russellian claim. I will argue that this is not the case, because the possibility to intervene *simpliciter* does not establish a typical feature of causation: the time-asymmetry of causation. This claim might be surprising and requires clarification because – as I observed in the first objection – interventions *qua* causes have a future-directed time-asymmetric influence as a matter of empirical fact. However, if interventionists want to avoid the first objection, then they should not require that interventions can merely influence the future of the system that is subject of the intervention. I suggest that, in order to avoid the first objection, interventionists have to allow (i) synchronic interventions or (ii) backwards interventions.

A synchronic intervention on a variable *X* influences *X* without time-delay. A backwards intervention on *X* is a special case of backwards causation, as *X* occurs earlier than the intervention. My worry about this strategy of avoiding the first objection is the following: if interventionists accept synchronic or backwards interventions in order to respond to the first objection, then interventions do not help to establish the time-asymmetry of causation (and counterfactuals).

My argument is analogous to an argument by Adam Elga (2001) against David Lewis's semantics for counterfactuals. Let me provide a brief summary of Elga's main point. Elga argues against Lewis's claim that the time-asymmetry of counterfactual dependence can be justified if one selects the closest antecedent-worlds in virtue of being small miracle worlds. Suppose event *a* actually occurs at t_1 and event *c* actually occurs at a later time t_2. Now consider two counterfactuals: the *non-backtracking* counterfactual 'if non-*a* were the case at t_1, then non-*c* would be the case at a later time t_2' and the *backtracking* counterfactual 'if non-*c* at t_2 were the case, then non-*a* would be the case at t_1'. Elga claims that if one selects the closest antecedent-worlds of both conditionals in virtue of being small miracle worlds, both counterfactuals are evaluated as true. What is the argument supporting this claim? The argument rests on the premise that is shared by neo-Russellians: the dynamical fundamental laws of physics are time-symmetric. Elga argues that the closest antecedent-worlds for the non-backtracking counterfactual are like this: a small miracle occurs shortly before the antecedent-event non-*a*. The non-backtracking counterfactual is true if the small miracle leading to non-*a* at t_1 leads to non-*c* occurs at t_2 (instead of the actual event *c*) by 'running' the time-symmetric dynamical fundamental laws forward in time. This is just the kind of result Lewis desires.

However, Elga shows that the backtracking counterfactual is also evaluated as true because the closest antecedent-world is a small miracle world. According to Elga, the closest worlds for the backtracking counterfactuals are worlds in which a small miracle occurs shortly after the consequent-event *c* – at t_3. The backtracking counterfactual is true if – by running the time-symmetric laws backwards in time from the miracle at t_3 on – the resulting course of events in the past of non-*c* differs from the actual past of *c*, i.e. non-*a* is the case at t_1.[14] Hence, the backtracking counterfactual can be evaluated as true, if the closest antecedent worlds merely required to be small miracle worlds. Elga draws the conclusion that "in this case there is no asymmetry of miracles, and hence in this case Lewis's analysis fails to yield the asymmetry of counterfactual dependence" (Elga 2001, 321f.)

An analogous argument can be directed against the attempt to establish the time-asymmetry of counterfactuals and – since Woodward's theory of causation is linked to interventionist counterfactuals – causation by relying on interventions. Consider Woodward's own example of a Newtonian universe (see second objection) to see why this is the case. Suppose that $S_1^*(t_1)$ is a counterfactual state of the universe that is the effect of a future-directed intervention that occurred at an earlier time t_0 (and assume further that the history of the universe prior to the intervention at t_0 is fixed). Accordingly, the counterfactual 'if it were the case that $S_1^*(t_1)$, then $S_2^*(t_2)$ would be the case' is true if, in the closest worlds, $S_1^*(t_1)$ is the result of the future directed intervention and – by running the laws forward in time – the universe evolves into the state S_2^* at t_2. The reason why we

[14] Note that Elga carefully observes that non-*c* is a time-reversed state (Elga 2001, 316). For the sake of brevity, I will skip the details of this point here (cf. Farr & Reutlinger forthcoming).

consider this counterfactual to be true is firmly tied to the assumption that interventions can only influence the future of Woodward's universe.

However, if we drop the assumption that the interventions may only have a future-directed time-asymmetric influence – in order to avoid the first objection – the picture drastically changes. Analogously to Elga's argument and in accord with Woodward's example, the fundamental dynamical laws governing the Newtonian universe are time-symmetric. Once we introduce synchronic or backwards interventions, the time-symmetric laws governing Woodward's universe allow that the following backtracking counterfactual is true: 'if it were the case that $S_2^*(t_2)$, then $S_1^*(t_1)$ would be the case'.[15] By analogy with Elga's argument, let us assume that $S_2^*(t_2)$ is the result of either a synchronic intervention at t_2 or of a backwards intervention at t_3 (and we assume that the future of the universe later than t_2, or respectively at t_3, is held fixed). Then we run the time-symmetric laws governing Woodward's Newtonian universe backwards from state S_2^* at t_2 to the earlier state of the universe at t_1. The backtracking counterfactual is true if the state at t_1 is S_1^*. If we do not already build a time-direction into the interventions, then we ought to accept that the counterfactual state $S_2^*(t_2)$ evolves – by running the time-symmetric dynamical laws backwards in time – into a counterfactual state $S_1^*(t_1)$ that differs from the actual state S_1 at t_1.

The upshot is that if the analogy to Elga's argument holds, then – contrary to the proponents of the OSA – it is possible to intervene on a closed system (such as Woodward's Newtonian universe) and it is not the case that time-asymmetric causal facts obtain with respect to this system. Therefore, the mere possibility to intervene fails to

[15] Ney (2009, 753) presents a billiard ball example of a less cosmological scale to illustrate the same point.

warrant a causal interpretation of interventionist counterfactuals and is, hence, insufficient for supporting the neo-Russellian claim and the orthodox Russellian claim.

Fourth Objection

It is worth noting that Pearl argues from a methodological point of view. Pearl's primary project is to develop algorithms to infer causal models from statistical data. In contrast to this methodological project, the interventionists pursue a semantic project: they aim at clarifying the truth-conditions of causal statements. If one cares about the (experimental) evidence for a causal statement and the methodology of inferring causal models, then the claim gains plausibility that the investigator has to be outside of the system that the causal statement in question is about. Especially, if intervening is an important part of one methodology of constructing causal models, then Pearl's claim that "causality disappears because interventions disappear – the manipulator and the manipulated lose their distinction" (Pearl 2000, 350) makes sense. However, even if Pearl's methodological claim were justified, it does not follow that the claim is also justified for regarding semantic project.

Summing up section 2, I conclude that the OSA is not a sound way for interventionists to meet the neo-Russellian challenge. The next section explores a potential alternative for interventionists.

3. An Alternative: the Statistical Mechanical Account

There is an alternative strategy for interventionists to argue for the neo-Russellian account: the statistical-mechanical account (henceforth, SM account). This alternative argument is suggested by the concluding remarks of Woodward's (2007) paper when he specifies the physical supervenience base for causal facts of the special sciences:

> Typically, the grounds or truth-makers for upper-level causal claims like '*C*s cause *E*s' or 'particular event *c* caused particular event *e*' will involve many additional factors besides laws (and besides facts about whether *C*, *E*, *c* and *e* instantiate laws or are parts of conditions that instantiate laws etc.). These additional factors will include very diffuse, messy, and non-local facts about initial and boundary conditions that do not obtain just as a matter of law and have little to do with whatever underlies or realizes *C, E, c* or *e* themselves. (Woodward 2007, 103)

Woodward's remark corresponds to a recent approach to the metaphysics of causation that philosophers of physics have presented as an argument for the neo-Russellian claim (cf. Albert 2000, Kutach 2007, Loewer 2007, 2009).[16] The important point regarding the SM account for my purposes is: if one follows Albert, Kutach and Loewer, then one is equipped with an argument in support of the neo-Russellian claim that does not rely on the troubled

[16] Woodward refers to Strevens's (2003) account of objective probabilities. I think the analogy with the account by Albert, Loewer, and Kutach is even more striking: they intend to account for the truth-makers of causal statements in a similar way as Strevens approaches the truth-makers of higher-level probability statements. It might be worth exploring the unique features of Strevens's account. However, this project has to be carried out on another occasion.

OSA. Prima facie, this argument seems to be useful for interventionists who do not want to rely on the OSA.

The basic idea of the SM account is that higher-level causal facts are physically kosher, because they can be explained by the fundamental time-symmetric dynamical laws plus additional non-causal assumptions. According to the SM account, the existence of (time-asymmetric) higher-level causal facts can be explained by the same set of premises that explains the macro-physical time-asymmetric behavior that is described by the second law of thermodynamics. In order to understand the SM-account of causation, let me first introduce the explanation of the second law of thermodynamics (henceforth, referred to as 'the second law').

Building on the original idea by Ludwig Boltzmann, the explanation of the time-asymmetric second law is, most importantly, based on the time-symmetric laws of classical mechanics, the so-called past-hypothesis (PH), and a statistical postulate (PROB). The second law is a paradigmatic example of a time-asymmetric special science law for which such an explanation is available and this explanation relies on time-symmetric fundamental laws of motion. A seminal formulation of the second law is:

> The total entropy of the world (or of any isolated subsystem of the world), in the course of any possible transformation, either keeps at the same value or goes up. (Albert 2000, 32)

The behavior of physical systems described by the second law is not time-symmetric, because the second law – taken literally – does not permit a transition from higher entropy

states at a later time t_2 to a state of lower entropy at the earlier time t_1. The second law is a time-asymmetric physical macro-law.

According to the SM account (cf. Albert 2000, 96; Kutach 2007, 329-331; Loewer 2007, 298-304; Loewer 2009, 156-158), the time-asymmetric second law can be derived from the following premises:

1. (LAWS) the time-symmetric dynamical laws of fundamental physics[17],
2. (PH) a proposition that the initial macro state of the universe was a state of low entropy, and
3. (PROB) the assumption that there is a uniform probability distribution over the physically possible initial microstates of the universe compatible with PH (that is, the physically possible realizers of the initial macro state referred to in PH).

To be more precise, according to the SM account, these premises entail that it is highly probable (though not certain) that macroscopic systems evolve time-asymmetrically in accord with the second law. At first glance it might appear puzzling how a time-asymmetric law can be explained by the means of time-symmetric fundamental laws. According to the fundamental laws, the sequence from lower entropy (at t_1) to higher entropy (at t_2) could be time-reversed. Naturally, the fundamental laws by themselves cannot explain the time-asymmetry of the macro-law. The crucial explanatory import is due to the existence of a special initial macro-condition (PH) and the uniform probability distribution (PROB) over the realizers of this macro-condition. This is a highly interesting result because (a) the SM

[17] Albert and Loewer suppose, for simplicity's sake, that the fundamental laws are the laws of classical mechanics.

account provides an explanation of the second law, and (b) the SM account reconciles the claim that there are acausal time-symmetric laws on the fundamental level and the claim that there are time-asymmetric laws on the (physical) macro-level.

Now, the crucial question is: can the SM account also be used for explaining the existence of time-asymmetric higher-level causal facts? Proponents of the SM account suggest that the answer is 'yes' (cf. Albert 2000, 128-130; Kutach 2007, 338-342; Loewer 2009, 160). Suppose we want an account for the time-asymmetry of causation of a specific singular causal relation, say the fact that event *c* causes event *e*. Suppose that *c* and *e* are distinct macroscopic events. Further, assume that one adopts a counterfactual theory of causation (as Albert, Kutach, and Loewer do). According to the simplest[18] version of a counterfactual theory of causation, if *c* causes *e* (given that *c* and *e* are actual events), then the following counterfactual conditional has to be true: 'if it were the case that non-*c*, then it would be the case that non-*e*'. The truth of this counterfactual requires that there is in principle an 'SM argument' to the conclusion that the probability the non-$c(t_0)$ is followed by non-$e(t_1)$ is *very high*. In this cases, the SM argument for the conclusion non-$e(t_1)$ has the following premises:

1. (FACT) the event non-$c(t_0)$ occurs and the macro-condition of the entire world at t_0 is $M(t_0)$ as a contingent macro-fact
2. (LAWS)
3. (PH)
4. (PROB).

[18] Let us adopt this simple version in order to not complicate the argument unnecessarily.

This is a Goodmanian way of stating truth-conditions of counterfactuals in the SM-framework, because counterfactuals are nothing but 'condensed' SM arguments (cf. Goodman 1983, chapter 1). Albert seems to prefer this reading, when he states the truth-conditions of counterfactuals by deriving the consequent from the antecedent by "normal procedures of inference" (Albert 2000, 128-130). The latter amount to what I call the actual availability or, at least, the mere existence of an SM argument (cf. Albert 2000, 96, 129; cf. Loewer 2007, 317; Kutach 2007, 338-342, for alternative SM-based semantics for counterfactuals). By contrast, given the premises of the SM argument, the probability of the time-reversed sequence – that is, non-$e(t_1)$ evolves into non-$c(t_0)$ – is extremely low, although it is physically possible.

If there is, at least in principle, an SM account for every causal fact, then causation is physically kosher. Another way to formulate the SM account is that causal facts supervene on the history of the actual world which is constrained by acausal (nomic) facts such as (LAWS), (PH), and (PROB).[19] This supervenience base for causal facts is kosher with respect to fundamental physics (given that the orthodox Russellian claim is true of fundamental physics). Most strikingly for our purposes, a proponent of the SM account does not deny that the dynamical fundamental laws are time-symmetric – rather she claims that non-fundamental causal facts obtain in virtue of the time-symmetric laws, specific initial conditions and PROB.[20] This metaphysical interpretation is in accord with

[19] It does not matter for the problem at hand whether acausal nomic facts reduce to acausal particular facts, as Humean Neo-Russellians, such as Loewer, hold.

[20] Loewer (2007, 2009) argues that (PH) should be regarded as a law according to the best systems account of laws. (PH) is law, according to Loewer, because adding (PH) to a deductive system optimizes its simplicity and strength (cf. Roberts 2008, 20-24, for objections). However, it does not matter for the goal of this paper whether Loewer is correct about the lawhood of (PH). The crucial point is that Loewer and other Neo-Russellians who use the SM account believe that the fundamental dynamical laws (be they

Woodward's (2007, 103) remark quoted at the beginning of this section. Loewer points out that his thesis of "grounding" the existence of higher-level causal facts in the facts expressed by the premises of an SM argument is a purely metaphysical thesis (cf. Loewer 2009, 160). This metaphysical thesis implies neither that we learn causal facts by deriving them from SM arguments, nor that the SM account properly reflects the rules for the application of causal notions.

Let me clarify the dialectic at this point: the SM account supports the neo-Russellian claim. However, it does not show that the orthodox Russellian claim is true. The latter claim is established by Russellian arguments such as the directionality argument (see section 1). The (LAWS) assumption states that the dynamical laws of fundamental physics are not causal laws (for instance, because the laws express time-symmetric dependence relations). In other words, the orthodox Russellian claim figures in the second premise of the SM argument, because the dynamical laws of fundamental physics are characterized as non-causal. (LAWS) in conjunction with (FACT), (PH) and (PROB) is intended to be an argument to the conclusion that higher-level causal facts (as stated by the special sciences) and higher-level nomic facts (as the second law) obtain.

To sum up, the SM-account reconciles (1) the orthodox Russellian claim, (2) the neo-Russellian claim, and (3) the dependence claim. Thus, the SM account meets the neo-Russellian challenge. The crucial question is now whether the SM account is a viable alternative for interventionists. I turn to this question in the next section.

Newton's laws of motion, Einstein's field equations, or the Schrödinger equation) are non-causal because they are time-symmetric.

4. Is the SM Account *Really* an Alternative for Interventionists?

Suppose you are an interventionist, you accept the neo-Russellian challenge, and you are convinced by the SM account and its ability to support the neo-Russellian claim. You seem to be in an awkward position: on the one hand, the interventionist theory of causation is conceptually non-reductive (because it analyzes causal notions such as 'direct cause' in terms of other causal notions such as 'intervention'). On the other hand, the SM account provides a reductive metaphysics of causation, because it grounds the higher-level causal facts of the special sciences in acausal facts such as (LAWS), (PH), and (PROB). The crucial question for interventionist who are attracted to the SM account is whether a conceptually non-reductive theory is incompatible with a reductive metaphysics of causation. Well, it depends. To be precise, whether the SM account is an option for interventionists depends on how they view the relationship between semantics and metaphysics. Unfortunately, this relationship is highly controversial in the philosophy of causation and in metaphysics in general. It is also not transparent how interventionists think of this relationship. I will present and discuss three ways of viewing this relationship.[21]

First Option: Identification. Woodward (2008, 193-196) insists that he does not pursue a metaphysical project. Instead, he argues, the interventionist theory is solely dedicated to a conceptual and semantic project: it explicates causal notions used in the

[21] Strevens (2007: 246) suggests a fourth option – a "two-factor semantics" inspired by Putnam's work. I will not discuss this option (and Strevens's objections to it) because, as Strevens correctly observes, adopting two-factor semantics implies that the interventionist account is an epistemic account of causation. Similarly, I omit alternative accounts of meaning that do not rely on truth-conditional semantics, such as accounts of meaning in terms of acceptability or testability conditions. These accounts require more radical departures from Woodward's actual intuitions about meaning. However, this does not imply that it is impossible (or even unattractive) to frame an interventionist theory in terms of, say, acceptability conditions.

sciences (and, partly, those of everyday discourse) by providing truth-conditions for causal statements. Strevens replies to Woodward that it is hard to understand how the metaphysical and the semantic project can come apart if one relies on a truth-conditional semantics:

> In modern times, such a project [i.e. Woodward's declared goal of providing an account of the meaning of causal statements] is invariably interpreted as aiming to provide truth conditions for the sentences or thoughts in question, and therefore as aiming to specify those representations' truthmakers. It may look like semantics, but it is also a kind of metaphysics. (Strevens 2008, 184)

Strevens ultimately objects that if Woodward's project is semantic and if semantics is truth-conditional semantics, then Woodward is "inevitably, unavoidably, ineluctably committed to producing an account of the truthmakers for causal talk" (Strevens 2008, 184). For Strevens, the distinction between a semantic and a metaphysical project with respect to causation collapses. Suppose that Strevens is correct about the relation between semantics and metaphysics, i.e. providing truth-conditions is nothing but doing metaphysics because the truth-conditions are (fundamental) objective, mind-independent truth-makers of causal statements (for a commitment to "modest realism" about truth-makers of causal statements, see Woodward 2003, 121-122). This raises a problem for interventionists: if Strevens's view of the relationship between semantics and metaphysics is true, then the interventionist account is a metaphysically non-reductive account of causation because it refers to causal facts about the occurrence of interventions. Thus, the interventionist theory is no longer compatible with the SM account, because the SM account is committed to a reductive

metaphysics of causation. This result cannot be satisfying for Woodward because – if Strevens is right – he cannot entertain the orthodox Russellian claim. Moreover, Woodward lacks an argument for the neo-Russellian claim, as (a) the OSA is not sound (as argued in section 2), and (b) the SM account is not viable.

Second Option: Independence. In opposition to Strevens's view, Woodward could adopt a stance that is known as 'heavy-weight metaphysics' in the debate about meta-metaphysics (as voiced by Fine 2009, Schaffer 2009, Sider 2009). Heavy-weight metaphysicians claim that semantics does not have any straightforward metaphysical import. The advocates of heavy-weight metaphysics hold that, for instance, providing truth-conditions for causal statements is an enterprise that is completely independent of the metaphysics of causation. These metaphysicians hold, roughly, that a truth-condition is a semantic value, and that truth-conditions are not (necessarily) 'real' (Fine), 'fundamental' (Schaffer) or about 'fundamental structure' (Sider). What they are looking for when they talk about the metaphysics of causation is how (and whether) causation is grounded by fundamental entities (Fine, Sider) or located in the fundamental structure of the world (Sider). Schaffer most prominently defends the view that a non-reductive analysis is compatible with a reductive (in his case, Humean) metaphysics of causation (cf. Schaffer 2004, 308; 2008, 87).

Suppose Woodward would (a) adopt the stance of heavy-weight metaphysics and (b) maintain that he is devoted to a semantic project. This meta-metaphysical view enables Woodward to avoid the objection that interventionism qua semantic project is incompatible with a Neo-Russellian reductive metaphysics of causation. It is a consequence of this meta-metaphysical view that the interventionist theory itself (as a semantic enterprise) is simply not suited to deal with the metaphysical problem that Russell and the Neo-Russellians raise,

because providing truth-conditions does not answer the question, which fundamental facts ground causation. However, interventionists could claim that the solution to the Neo-Russellian challenge is external to their semantic theory: that is, they could adopt the SM account for these purposes. So, the second option is viable but it also leads to a revised view of the metaphysical weight of the truth-conditions as provided by Woodward's theory. I imagine that interventionists might even consider this fact to be a virtue of their theory.

Third Option: Roles and role-fillers. According to the Canberra plan, one can draw a distinction between conceptual roles and role-fillers (cf. Chalmers 1996, Jackson 1998). Consider the concept 'president of the US'. The conceptual role of 'president of the US' consists in typical features of this office: this person resides in the White House, is the leader of the government, etc. The project of determining the conceptual role of 'president of the US' is an a priori enterprise. The conceptual role of this office picks out the office-holder in the actual world (say, today's office-holder, to keep things simple): Barack Obama. Obama is the actual role-filler of the president-role. The project of determining the role-filler is empirical – as opposed to the a priori project of determining the conceptual president-role.

The distinction of role and role-filler suggests the following characterization of the interventionist explication of causal concepts. Interventionists describe a particular feature of the folk concept of causation (see section 1): interventionists focus on the feature that causal relations can be exploited for interventions. This feature is usually neglected in the literature but interventionists could be understood as making a strong case for adding the 'manipulability' feature to the list of folk features. Other features of the folk concept (e.g. causation being time-asymmetric, asymmetric, local, etc.) seem to be taken for granted in interventionist definitions. By analogy to the president case, determining the actual role-

filler of the causal role is an empirical project. If the SM account is true, then the actual role-filler is the conjunction of facts such as (FACT), (LAWS), (PH), and (PROB). If interventionists describe a feature of the conceptual role of causation and the SM account specifies the role-filler, then one can draw a distinction between conceptual analysis (or explication) and metaphysics. The conceptual project is concerned with the conceptual role while metaphysics is concerned with the role-filler.

Is the third strategy convincing? The distinction between role and role-filler seems to establish a distinction between the conceptual and metaphysical questions. This is just what interventionists need. A framework in which such a distinction can be maintained is the methodological basis or precondition for interventionist neo-Russellians: only under the assumption that conceptual analysis and metaphysics are separable, interventionists can argue that conceptually non-reductive theories of causation are compatible with a metaphysics which does not take causation to be a fundamental feature of the world.

However, although the Canberra plan appears to be an attractive option, it suggests two amendments regarding the interventionist account. Firstly, this proposal has consequences for how interventionists describe their own theory: when they talk about providing an account of the meaning of causal claims they should restrict this talk to explicating the 'manipulability' feature of the conceptual role of causation. This project has to be distinguished from specifying the role-filler by proving an account of the mind-independent truth-makers for causal claims. This requires a change in the way interventionist describe the goal of their project, because Woodward often seems to be occupied with an account of truth-conditions and "modest realism" about truth-makers (Woodward 2003, 7-9, 122-124; 2008, 193-196). However, Woodward could just accept that the relevant sense of 'meaning' he is interested in is an explication of the conceptual

role.

Secondly and more importantly, it is a controversial matter whether the conceptual role of causation indeed picks out a role-filler as demanded by the Canberra plan (cf. Lewis 2004 for a discussion of the problems).[22] This dialectic situation amounts to a challenge for interventionists: they have to provide a positive argument for the claim that the conceptual role of causation indeed picks out a role-filler. If such an argument can be established, interventionists could choose the third option in order to adopt the SM account. However, this argument still has to be fully established, although there is reason to be optimistic about the prospects of a successful defense of the Canberra plan (cf. Liebesman 2011). Therefore, interventionists cannot fully rely on the SM account as a sound way of supporting the neo-Russellian claim at the present stage of the debate regarding the Canberra plan (as applied to causation). Furthermore, it remains to be shown that Woodward's account of causation is satisfied if and only if the SM account's conditions are. If this turns out not to be the case, then the facts picked out by the SM account do not fill the role that Woodward identifies. It seems to be a stimulating question for future research to find out whether this is so.

In sum, all of the three options require changes of the interventionist theory if interventionists want to be neo-Russellians. The first option leads into trouble as it precludes that a proponent of any conceptually non-reductive theory of causation can be a neo-Russellian. The second option is compatible with the SM account. However, interventionists can no longer maintain that their theory of causation responds to

[22] The Canberra plan faces two major problems when applied to causation: (a) the conceptual role does not pick out a unique causal relation; it picks out miscellaneous, disjunctive facts. (b) The role does not appear to pick out anything in cases where omissions and absences are allowed as causes.

metaphysical questions (such as the neo-Russellian grounding-question). The third option, the Canberra plan, preserves most the intuitions that interventionists have about the meaning of causal statements and the separability of conceptual explication and metaphysics. However, although the third option is compatible with non-reductive theories of causation, it requires an additional argument in its favor (when applied to causation) instead of solving the interventionists' initial problem of reconciling a conceptually non-reductive account of causation with a neo-Russellian reductive metaphysics of causation. In defense of interventionists, one can maintain that it is still an open research question whether the Canberra plan can be defended.

5. Conclusion

In section 1, I started out with the neo-Russellian challenge. The main question in this paper was whether interventionists are able to take up the neo-Russellian challenge. In section 2, I discussed the open systems argument (OSA) that interventionists employ in order to meet the challenge. The result of the discussion was that the OSA is not sound. Therefore, interventionists cannot meet the neo-Russellian challenge by using the OSA. Section 3 explored a prima facie alternative for interventionists who wish to be neo-Russellians: the SM account. In Section 4, I examined a problem for interventionists who want to adopt the SM account: interventionists cannot straightforwardly make use of the SM account because of the unclear relationship between the (non-reductive) semantics and the (reductive) neo-Russellian metaphysics. I considered three alternative views of this relationship. Two of these views appear to be viable for interventionist neo-Russellians (heavy-weight metaphysics and the Canberra plan). However, both views require revisions

of some of the Woodward's intuitions about the nature of the meaning of causal claims. Moreover, one view (the Canberra plan) is in substantial need of further arguments.

Where does this leave us with regard to the question whether interventionists are able to meet the neo-Russellian challenge? The overall result is that I can only draw a conditional conclusion: provided that interventionists find a way to separate analyzing concepts (and providing truth-conditions) from doing metaphysics, the SM account is an option for interventionists to respond to the neo-Russellian challenge. In other words, the burden of argument is shifted to the interventionists' side: it is a challenge – and by no means a hopeless one – for interventionists who want to be neo-Russellians to develop a lucid picture of how conceptual, semantic, and metaphysical matters relate according to their theory of causation. I believe that interventionists can only gain by pursuing this task.

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