ISSN 2045-5577

ORDER: GOD'S, MAN'S AND NATURE'S

Excluding the Causal Exclusion Argument against Nonreductive Physicalism

Robert C. Bishop
Department of Physics
Wheaton College

Abstract
A much discussed argument in the philosophy of mind against nonreductive physicalism leads to the conclusion that all genuine causes involved in mental phenomena must be reductive physical causes because the latter exclude any higher-level causes from having genuine effects in human thought and behavior. Jaegwon Kim has been the chief exponent of this line of argument, calling it variously the causal exclusion argument or the supervenience argument against nonreductive physicalism. I will analyze this argument and show that some of its key assumptions are unwarranted. Two assumptions on which I will particularly focus are the causal closure of the physical and the prohibition against causal overdetermination when multiple sufficient causes are involved in some effect. The upshot will be that rather than lower-level physical causes always excluding or preempting possible mental causes, context plays a key role in determining what kinds of causation are at work in human behavior and how those causes cooperate.

1. Introduction

Jaegwon Kim (e.g., 1993, 1998, 2007) has developed and refined a line of argument aimed at showing that all genuine causes involved in mental phenomena must be reductive physical causes. The upshot of this causal exclusion argument is that the latter causes exclude any nonphysical causes from having genuine effects in a physical world. This argument is formulated in the context of physicalism, the view that mental states or events are ultimately physical states or events or are realized by physical states or events.[1]

Kim's argument takes place against a typical philosophical background where mental causation tends to be analyzed in terms of intentional states like beliefs and desires. Such states seem to allow one to apply causal analysis that is as close to the physical notion of efficient, event-event causation as possible to the mental domain. However, I take it that quintessential examples of mental causes or properties are things like conscious awareness, thinking, peer pressure, values, feelings and so forth (e.g., see Richardson and Manglos this issue) that, arguably, are not well represented by the machinery of intentional states. What counts as a mental cause turns out to be largely context dependent, so I will not presume that efficient, event-event causation is the only model for mental causation.

I will analyze the exclusion argument and show that some of its key assumptions are unwarranted. Two assumptions on which I will particularly focus are the causal closure of the physical and the prohibition against causal overdetermination when multiple sufficient causes are involved in some effect. The upshot will be that rather than physical causes always

[1]Defining the nature of "physical" is a notorious problem (e.g., Crane and Mellor 1990; Bishop forthcoming).

excluding or preempting possible mental causes, context plays a key role in determining what kinds of causation is at work in human behavior and how those causes cooperate. In turn, a contextual approach to mental causation implies that focusing on intentional states is likely too narrow for us to gain fuller insight into meaningful human action.

2. The Causal Exclusion Argument

Kim's exclusion argument makes use of two key yet questionable assumptions. One is the causal closure of the physical (also known as the completeness of physics):

> (CoP) If a physical event has a cause that occurs at *t*, it has a physical cause that occurs at *t*.

Effectively, CoP is a rule that all physical effects must have only physical causes. The second questionable assumption is his causal exclusion principle:

> (CEP) No single event can have more than one sufficient cause occurring at any given time–unless it is a genuine case of causal overdetermination.

Effectively, CEP is an adjudication rule for causal competition that Kim takes to be a general metaphysical principle. The intuition behind CEP is that a cause sufficient for its effects generates those effects. Kim gives no defense of these two principles other than that they "seem unexceptionable" (e.g., 2007, 15ff).

Kim (2007, pp. 41-44) lays out the structure his argument as follows:

(1) An instance of mental property M causes an instance of mental property M*
(2) Some physical property P* serves as the physical realizer ("supervenience base") of M*
(3) M caused M* by causing P*
(4) So M is a cause of P*
(5) But P* also has a physical cause, P, occurring at the same time M occurs
(6) Nonreductive physicalism maintains that M $\neq$ P
(7) P*, then, has two distinct causes, M & P, and is not causally overdetermined
(8) The causal exclusion principle implies either M or P must go
(9) Therefore, the putative mental cause, M, is excluded by CoP plus CEP

The first premise is a statement of mental-to-mental causation. Premise (2) represents Kim's view that all mental properties are ultimately realized by physical properties, while (3) expresses the possibility of mental-to-physical causation. Causal closure of the physical motivates (5), while (7) stipulates there is no causal overdetermination, hence triggering the exclusion principle. The conclusion, as Kim sees it, is primarily driven by the combination of CEP and CoP.

If the causal exclusion argument goes through then it would be the case that so-called mental-to-physical causation is excluded. Therefore, the only valid option for maintaining some form of "mental" causation would be reductive physicalism, where mental states and events are

reduced to or realized by physical states and events.

3. Causal Closure

Consider, first, the problems with Kim's assumption of CoP first. A more precise statement of the principle is

> For any distinct times t_1 and t_2, the physical property P at t_1, together with the fundamental physical laws, causes the (chances of) physical property P* at t_2.[2]

There are two ways of construing CoP relevant to the support of (5). The first construal is that nothing other than fundamental physics properties and laws determine the behavior of all physical properties (whence the alternative name "completeness of physics"). If nonphysical properties exist, they can have no effect on physical properties. However, this construal is too strong in that it is identical to a statement of reductive physicalism, so cannot serve as an independent premise in the causal exclusion argument. The second, weaker construal is that physical properties have physical causes and any other kinds of properties are ineffective or negligible in generating or influencing physical properties. Kim has this weaker construal in mind for the exclusion argument.

Since physics neither proves its own completeness nor needs such a principle, CoP clearly must be a metaphysical principle. Moreover, CoP makes no mention of anything but physical laws and properties. This feature of the metaphysical principle can be understood in two ways (Bishop 2006). First, CoP might be a statement that the laws and properties of physics are always sufficient to bring about physical effects. For example, perhaps laws and properties of physics serve as causes that necessitate physical effects. The alternative understanding of CoP's treatment of fundamental laws and properties is as a typicality condition. Essentially, it states that in the absence of nonphysical influences, the properties and laws of physics suffice for P at t_1 to produce P* at t_2 provided the system in question is appropriately isolated from any other kinds of influences during the time span from t_1 to t_2. By itself, then, CoP would not rule out possibilities for nonphysical interventions. Rather, it would only say what typically happens in the absence of such influences.

What are we to make of these two understandings of CoP? One thing to notice about the first understanding is that it seems to be too strong. If this construal is read along the lines of causal necessitation–as suggested above–CoP clearly would not be distinct from the conclusion of the causal exclusion argument, so could not serve as an independent premise for the argument. On the other hand, if we focus solely on the sufficiency of laws and properties in physics to bring about physical effects, mere sufficiency will not be strong enough for the causal exclusion to go through (see below). Moreover, the construal of CoP as a typicality condition is better supported by physics. For instance, physics (and other physical sciences) always deals with laws, symmetries and properties as highly qualified (see examples below) or heavily idealized (Teller 2004). As well the entire range of our experimental

---

[2] This formulation explicitly takes account of probabilistic causation as in quantum mechanics, but I will largely ignore such cases as they merely complicate the analysis.

methodologies are built on the idea of isolation where we remove or control various possible intervening factors. As a metaphysical principle about the physical world, CoP as a typicality condition is consistent with these features of physics. Therefore, the real question is whether the qualifications implied by typicality are always physical in nature, which leads us back to a discussion of causal sufficiency (see below). As a metaphysical principle, CoP by itself does not rule out the possibilities for nonphysical interventions, but only characterizes what happens in their absence (or when they make negligible contributions).

To be able to support (5), then, Kim must further presuppose what has been identified as a hidden premise in the causal argument for physicalism (compare Papineau 2002, and Bishop 2006):

(HP) The only efficacious states and causes are those from fundamental physics.

Essentially, to get the conclusion of physicalism–that all physical properties have only physical causes–HP must be added to the typicality condition CoP to get the result that only physical causes are efficacious for physical effects. But HP is identical to the conclusion of either the causal argument for reductive physicalism or the exclusion argument, so cannot serve as an independent assumption to support for (5). Hence, (5) is unsupported.

4. Causal Overdetermination

Now turn to the other problematic assumption of Kim's exclusion argument, the causal exclusion principle. This principle enters Kim's argument through (7) and (8). One might think that CoP and HP can be dropped and full weight placed on CEP to save the argument. After all, if this principle is true, then no property or event can have more than one sufficient cause occurring at any given time–unless it is a genuine case of causal overdetermination.

The causal exclusion principle, however, turns out to fail because it frames our thinking about causation in terms of causal competition and ignores the extent to which causal cooperation is the rule rather than the exception in the actual world. Consider some examples of causal cooperation to produce particular effects. If an apple's stem breaks it will fall from the tree. The force of gravity is sufficient to bring about the effect of falling to the ground at a constant acceleration. Now suppose I stick my hand out and catch apple. The gravitational force is no longer sufficient to produce the effect; rather, gravity combined with my intentions and my hand are now sufficient causes to produce an effect: the apple resting in my hand exerting a particular force against my hand. The law of gravity has not been violated or overridden, but as a typicality condition, gravity is only sufficient to specify the possible range of motions of the apple in the absence of any other influences (e.g., heavy winds, human hands).

Suppose a hunk of iron is dropped from the top of a ladder. Again, the gravitational force is sufficient to specify the fall of the iron hunk to the floor. But suppose that right after the hunk is dropped, we switch on a magnetic field of appropriate strength and orientation such that the iron hunk comes to rest suspended above the floor. Typically, in the absence of the magnetic field, gravity would be sufficient to specify the motion of the iron hunk. The causal sufficiency of neither gravity nor the magnetic field has disappeared; rather, the causal sufficiency of the two forces has now combined to produce the particular levitating effect.

Again, no laws have been violated or overridden. Instead, they combine to produce a particular effect.

Consider a hydrogen atom. In isolation, the laws and properties of quantum mechanics are sufficient to specify the possibilities for the atom's motion. But if the hydrogen atom is located in my left elbow, then quantum mechanics plus various biomechanics principles (among other things) specify the motion of the hydrogen atom as my left arm swings while walking across campus. Again, the causal sufficiency of quantum laws has been neither violated nor suspended. Rather, they combine with biomechanics to produce the particular motion of the atom.

Such examples could be multiplied endlessly. For instance, biological constraints like chirality associated with DNA, and natural selection largely determine the development of DNA base pair sequences. Genes express themselves differently in isolation than in presence of other genes in a biological system and different environments (the causal effects of genes are entirely context-dependent!). In absence of intentions and desires, the autonomic nervous system is sufficient to determine the behavior of arms and legs. However, in a voting context such processes combine with my values and desires to raise my hand enthusiastically in favor of my preferred candidate.

What all these examples illustrate is that the general causal structure of our world is one of causal cooperation rather than causal competition. The idea of causal competition, as expressed by the causal exclusion principle, is underwritten by the belief that sufficient causes necessitate their effects (sufficiency alone is insufficient due to its contextual nature as illustrated above). The evidence from sciences like physics indicates that such a necessitarian view of sufficient causation does not apply to our world: context is crucial to conditioning how laws and properties come to expression.[3] The laws and properties investigated in science are always qualified by typicality conditions. The contingencies expressed by such typicality conditions are what enable multiple causes to cooperate to produce particular effects. Context matters at least as much as laws and properties because laws and properties always have a context into which they must come to expression. Hence, we almost always have causal cooperation, not the overdetermination implied by competition. Therefore, the causal exclusion principle almost never applies to the causal structure of our world. There is no support for (7) and (8), so the causal exclusion argument fails.

5. Causal Fundamentalism

A reason Kim and other reductive physicalists might find reductive physicalism compelling is because of a prior commitment to *causal fundamentalism*, the belief that all causal efficacy ultimately "drains down" to the fundamental laws and properties of physics irrespective of context. Causal fundamentalism requires the necessitarian view of sufficient causes criticized above (this is the only way the laws and properties of fundamental physics could produce all

---

[3]The causal necessitation view is an example illustrating my teacher John Wheeler's famous quip, "Philosophy is too important to leave to the philosophers!"

the effects in our world in a context-free manner rather than in a contextually qualified manner).

One might push back against my argument by supporting the necessitarian view in the following way (cf. Ellis 2002). It is rather common in causal fundamentalism to conceive of the fundamental laws as causal laws, where causes nomologically necessitate their effects (e.g., Kutach 2007). Consider the oft discussed law-like example that all salt dissolves in water. This has the form of a universal law, All Fs are Gs, moreover it expresses a causal relation. If this is a contingent law, then salt necessarily dissolves in water in our world but there are possible worlds where water does not dissolve salt. But why identify these features of such other possible worlds as 'salt' and 'water?' If all salt dissolves in water is a law, then presumably in all possible worlds containing salt, it must have the same properties as salt in our world (similarly for water). And if salt and water have their same respective properties across all such possible worlds, then all salt dissolves in water must express a nomically necessary rather than contingent connection because the law is an expression of a necessary relationship that must hold between salt and water in virtue of the properties salt and water possess. In essence, the law must be necessary in virtue of the fact that the respective properties of salt and water are necessary to what they are.

Such an objection in support for the necessitarian view is not very convincing, however. The necessary connection expressed in causal laws evidently depends on the essential properties of the relata of these laws. But why think there are such essential properties? Take the examples of salt and water. The solubility of salt in water turns crucially on the respective molecular structures of the two kinds of molecules. These molecular structures, in turn, depend on a delicate and contingent expression of the quantum mechanical laws and properties in macroscopic contexts (Bishop 2010a). So salt and water have the properties they do as a contingent matter rather than a necessary one. The general lesson, here, is that supposed fundamental laws and properties, like those of quantum mechanics, always represent typicalities rather than context-free necessities (the latter is needed to ground the kinds of necessitarian claims needed for the causal exclusion argument). To establish the necessitarian view a supporter would have to successfully argue that causal laws and properties always act in a context-free manner. It is hard to see how such an argument could succeed given that our experience manifested in our best sciences runs contrary to the context-free conclusion of the argument.

That the necessitarian view of causation fails for causal laws should not be surprising. After all, fundamental physics neither implies nor needs a necessitarian view for it to do its descriptive and explanatory work. The necessitarian view is an intuition that might hold for some possible worlds that philosophers can construct but not for the actual world. And in the absence of support for the necessitarian view of causation, the causal exclusion principle fails to do the work Kim needs to secure the causal exclusion argument.

6. Making a Go of It with the Hidden Premise

Another possible avenue for securing the conclusion of the exclusion argument would be to take HP as a default truth that stands as justified unless some appropriate reasons can be

deduced to suspect its truth.[4] One might imagine this as a Popperian bold conjecture and then see how it fares.

So how does HP fare on the evidence? *Prima facie* things do not look encouraging for supporting HP. Laboratory experiments in physics, for example seem to suggest the world behaves approximately as if HP is true. At least until we take into account that such experiments are not only built on a methodology of isolation and intervention, but also experimental approaches in physics are dependent on the ingenuity and freedom of the physicists who devise and execute the experiments.[5]

Evidence from human and social action *prima facie* strongly suggests the world does not behave as if HP is true. For example, social policies–such as mandatory de-segregation of primary and secondary schools–have clear physical effects: physical systems such as school buses move in different patterns than they otherwise would. But social policies are not physical causes, let alone fundamental physics! Instead, social policies are ideas and ethical ideals providing the fundamental reasons for the particular motions of buses. A similar point can be made for scientific ideas such as hypotheses, models and theories. Such ideas provide the reasons for why the pens and pencils, calculators, keyboards and other physical apparatus of physicists execute the particular motions that we observe in offices and laboratories.

So HP is not particularly well-supported if we look at such *prima facie* counter evidence as well as taking into account the contextual character of physics discussed above. Are there good arguments in face of this counter evidence? The most convincing argument seems to be David Papineau's (2001) argument that the inductive evidence has progressively closed the door on any nonphysical influences in our world. However, this argument begs the question on the status of nonphysical influences by subtly presupposing HP (Bishop forthcoming).[6] I conclude, then, that HP fails on the evidence as a bold conjecture about the structure of our world.

7. Fundamental Laws, Context and Causal Cooperation

The upshot of my line of argument is that numerous features of our physical world are qualified or shaped by context and, furthermore, that some of these contextual features are nonphysical. One might still ask about the status and role of fundamental laws–after all, a fairly standard way of thinking about fundamental laws is that they determine everything they govern.

---

[4]See Michael Williams (2001) for a discussion of the default and challenge model of justification–with which I have great sympathy–that is implicitly being invoked in this strategy.

[5]The free choices of scientists in experiments have several important implications telling against CoP and HP (Bishop 2010b; Bishop in press; Bishop and Atmanspacher in press).

[6]A similar circularity problem arises for Andrew Melnyk's (2003) inductive argument in support of physicalism.

This standard way of thinking about the governance of fundamental laws is overly simplistic, however, as fundamental laws never determine everything by themselves. First, a detailed specification of initial and boundary conditions is needed for any law-governed behavior to be realized in the actual world and such conditions are nontrivial (e.g., Wilson 1990). Second, and more importantly, in our world fundamental laws always come to expression in concrete contexts which include constraints not given by fundamental laws. This is essentially the situation described by *contextual emergence* (see Bishop 2010a; Bishop and Atmanspacher 2006):

> The laws, properties and behaviors of one domain offer necessary but not sufficient conditions for the properties and behaviors (and possibly laws) of another domain.

The meaning of necessary conditions is that properties and behaviors of components of a system in one domain imply the laws, properties and behaviors of the second domain (sometimes thought of as the "underlying," "reducing," or "more fundamental" domain). However, the converse is not true as the laws, properties and behaviors of the latter domain do not offer sufficient conditions for the properties and behaviors exhibited in the former domain. Contingent conditions specifying the context for the transition from the latter to the former domain are required to provide such sufficient conditions.[7]

On the contextual emergence view, fundamental laws are conceived along the following lines (figure 1). Certainly, the fundamental laws of physics defines a space of physical possibilities, in other words they define the possible physical transitions in contrast to those possibilities that are logically possible but would violate the fundamental laws (e.g., levitating myself against the force of gravity by means of pure thought). This space of physical possibilities is then further constrained by concrete instantiations of initial and boundary conditions along with the contexts into which the laws and conditions come to expression. In the absence of any other contextual constraints and properties, then, fundamental physics supplies

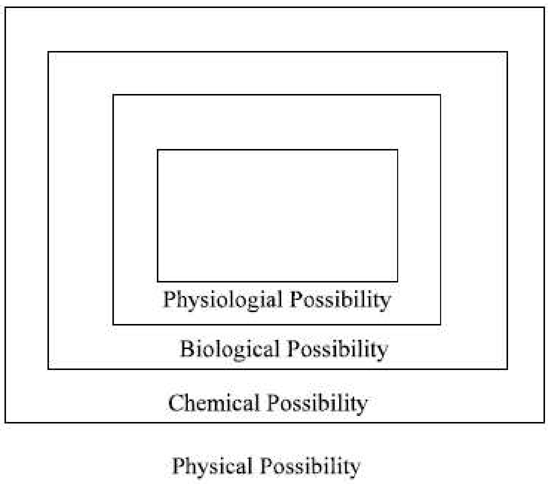

Figure 1 The space of physical possibilities set by the fundamental laws of physics is progressively enriched and restricted by constraints placed upon it from chemical, biological and other domains. These further domains represent possibility spaces that are consistent with but not fully determined by physical possibility.

---

[7] Even appropriate conditions for specifying a candidate reduction of one domain to another are not well defined until an appropriate contingent context is properly specified (Hooker 2004, pp. 467-468).

conditions defining the space of possibilities for matter's behavior and interactions.

The space of physical possibilities is then further constrained by the contexts and conditions associated with chemical possibility, which have a nontrivial overlap with the domain of physics (Bishop 2010a). In the absence of any other constraints and properties the domains of physics and chemistry cooperate to determine the possibilities for matter's behavior and interactions. This latter space of possibilities is further constrained by the contexts and conditions associated with biological possibility, which have a nontrivial overlap with the domains of chemistry and physics. In the absence of any other constraints and properties, then, the domains of biology, chemistry and physics cooperate to determine the possibilities for matter's behavior and interactions. This latter space of possibilities, in turn, is further constrained by psychological and social realities.

The chemical, biological, psychological and social realities do not violate the space of physical possibility. That is to say, such factors never produce possibilities outside the physical space of possibilities. Rather, chemical, biological, psychological and social features of reality are always consistent with fundamental physics. On the other hand, fundamental physics never fully determines the precise behaviors in the chemical, biological, psychological and social domains. Instead, fundamental physics provides necessary conditions for making such behaviors possible. For example, the physical space of possibilities places relatively mild constraints on the motion of arms while my values and desires in a voting context dictate when and how I will raise my arm (enthusiastically for my favored candidate, say). Likewise, the physical space of possibilities sets various constraints on the possible motions of metal while the blueprints of designers, plans of engineers and purposes of human operators enable metal formed into buses, trains and planes to execute precise motions that they do.

Given the structure of reality just sketched, let us return to the idea of causal overdetermination. A standard philosophy classroom paradigm for causal overdetermination is that of a double assassination. Suppose there are two assassins who shoot at the President at the same time and from the same distance with perfect aim. Given the fundamental laws, both bullets will not only be individually sufficient to kill the President but will also reach the President simultaneously. Given the abilities, plans and purposes of the two assassins, their individual choices of when to pull the trigger leads to the simultaneous firing of the two sniper rifles.

On the standard analysis of this example, the President's death is overdetermined by the presence of two kill shots arriving simultaneously. However, the paradigmatic example and its standard analysis overlook crucial contextual differences between the case of one assassin versus two. In particular, a death by one bullet is a different event than a death by two bullets. The usual presentation of the double assassin example and the standard analysis frame the event in question as a death-by-one-bullet event, hence leading to the judgement that such an event is causally overdetermined. In contrast, the actual context as described is clearly a death-by-two-bullets event, where the two sufficient causes cooperate to produce a structurally different event than a death-by-one-bullet event (despite the fact that each bullet by itself is sufficient for the President's death-by-one-bullet). Just as we have fundamental laws of physics combining with the domain of biology (e.g., bodily abilities of the assassins)

and psychology (e.g., plans and purposes of the assassins), to produce a complex event (death of the President), so the two bullets cooperate to produce a complex event (death-by-two-bullets).

Moving to richer example can shed additional light on why the causal overdetermination on which Kim relies is not compelling. Consider a voting context, where we have causal cooperation involving the domain of fundamental physics all the way up to that of social reality. As mentioned earlier, in the absence of any other influences, the autonomic nervous system sufficient to govern arm motions (e.g., limp, motionless arm, or reflex action if sudden heat applied is applied to a hand). Such situations already involve an interplay between fundamental physics (e.g, the quantum mechanics of fundamental particles) and biology (e.g., muscle contractions in response to autonomic nervous system stimulation). In a voting context where I'm considering voting for a range of policies, there are further influences at work alongside the ones just mentioned. Suppose I have decided to vote for a given policy because I see it as the just thing to do. My choice, conditioned by the social context in which it takes place, provides the sufficiency for my arm to rise at the appropriate moment whereas the underlying physics and physiology provide some of the necessary conditions for voting to be possible. Fundamental physics, my autonomic and my value-driven choice combine together in an appropriate social context to produces the raising of my arm to vote (a very different event from raising of arm in response to applied heat!).

The upshot of contextual emergence, then, is that context partially defines what the cooperative effects of an entire set of sufficient causes will be. Put differently, context shapes or influences networks of sufficient causes into specific outcomes. However, one might object that the role attributed to contexts in my argument has been overblown because those contexts *just are* the resulting effects of the fundamental laws and properties of physics. So the only qualifications or constraints on fundamental laws and properties comes from the consequences of those very same fundamental laws and properties.

In response, I would argue that this objection either presupposes CoP + HP along with CEP or it is based on a metaphysical intuition about how our world is structured. If it presupposes the former, then it clearly begs the question as the metaphysical principles being presupposed stand in need of support (and I believe that support is sorely lacking as I have indicated in this essay). On the other hand, if the objection simply amounts to a citation of metaphysical intuitions, then there is nothing here to trouble the nonreductionist. The burden is clearly on a reductive physicalist like Kim to provide non-question-begging defenses of these metaphysical intuitions without relying on the problematic principles CoP and CEP.

8. Conclusion

The causal exclusion argument fails to prove that nonreductive physicalism is either incoherent or false. I have traced the failure of Kim's argument to misunderstandings and failures of CoP and CEP to fulfill their appointed functions. The fundamental reason for these failures is the missing out an appropriate account of the role of contexts. Most philosophical discussions of laws and causation take place at a very abstract level. However, the notion of a law or a sufficient cause in the actual world cannot be determined at the level of abstraction or generalities. Rather, we have to focus on how the sufficiency of particular laws and causes

is conditioned by the particular contexts in which they come to expression.

Abstracting from context as Kim and other metaphysicians like to do leads to an under appreciation of realities involved in CoP and causal cooperation. Contexts shape the realities that Kim and others treat as largely context-free. Such context-free treatments of causation distort the structure of our world more than they illuminate it. Many metaphysicians and philosophers of mind fail to recognize that causation turns out to be a much richer and messier affair in the actual world. Physical causes are often qualified by specific features and constraints from the chemical and biological domains. Meaningful human action is always shaped by our cultural context as well as by our values and aspirations. Rather than excluding nonphysical causes, Kim's exclusion argument illustrates how reductionism only appears plausible when abstracted away from context.

In a recent review in *Science*, Nick Enfield (2010) nicely illustrates how important context is for properly characterizing linguistic phenomena and the actual behavior of language users. A number of approaches to linguistics and language evolution are deficient in their abstracting away from concrete contexts. As Enfield points out, the closer we get to the concrete context, the richer our understanding of the evolution and role of language becomes. There is an analogous lesson to learn for our metaphysical predilections towards abstraction in our pursuit of understanding mental causation.

References

Bishop, R. C. (2006), "The Hidden Premise in the Causal Argument for Physicalism," *Analysis* 66: 44-52.

__________(2010a), "Whence Chemistry? Reductionism and Neoreductionism," *Studies in History and Philosophy of Modern Physics* 41: 171-177.

__________(2010b), "Free Will and the Causal Closure of Physics," in *Visions of Discovery: New Light on Physics, Cosmology and Consciousness*, Raymond Chiao, William Phillips and Charles Harper eds. Cambridge: Cambridge University Press, 601-611.

__________(in press), "The *via Negativa*: Not the Way to Physicalism," *Mind and Matter*.

__________(in press), "Chaos, Indeterminism and Free Will," in *The Oxford Handbook of Free Will*, 2nd ed., Robert Kane ed. Oxford: Oxford University Press.

Bishop, R. C. and Atmanspacher, H. (2006), "Contextual Emergence in the Description of Properties," *Foundations of Physics* 36: 1753-1777.

__________________________(in press), "The Causal Closure of Physics and Free Will," in *The Oxford Handbook of Free Will*, 2nd ed., Robert Kane ed. Oxford: Oxford University Press.

Crane, T. and Mellor, D. H. (1990), "There Is No Question of Physicalism," *Mind* 99: 185-206.

Ellis, B. (2002), *The Philosophy of Nature: A Guide to the New Essentialism*. Montreal: McGill-Queen's University Press.

Enfield, N. J. (2010), "Without Social Context?", *Science* 329: 1600-1601.

Hooker, C. A. (2004), "Asymptotics, Reduction and Emergence, " *British Journal for the*

Philosophy of Science 55: 435-479.
Kim, J. (1993), *Supervenience and Mind.* Cambridge: Cambridge University Press.
______ (1998), *Mind in a Physical World: An Essay on the Mind-Body Problem and Mental Causation*. Cambridge, MA: MIT Press.
______ (2007), *Physicalism, or Something Near Enough.* Princeton: Princeton University Press.
Kutach, D. (2007), "The Physical Foundations of Causation," in H. Price and R. Corry (eds.), *Causation, Physics, and the Constitution of Reality: Russell's Republic Revisited*. Oxford: Oxford University Press, pp. 327-350.
Melnyk, A. (2003), *A Physicalist Manifesto: Thoroughly Modern Materialism*. Cambridge: Cambridge University Press.
Papineau, D. (2001), "The Rise of Physicalism," in C. Gillett and B. Loewer (eds.), *Physicalism and Its Discontents*. Cambridge: Cambridge University Press, pp. 3-36.
___________(2002), *Thinking about Consciousness*. Oxford: Clarendon Press.
Teller, P. (2004), "The Law-Idealization," *Philosophy of Science* 71: 730-741.
Williams, M. (2001), *Problems of Knowledge: A Critical Introduction to Epistemology*. Oxford: Oxford University Press.
Wilson, M. (1990), "Law Along the Frontier: Differential Equations and Their Boundary Conditions," *PSA 1990, Vol. 2*, pp. 565-575.