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Why is there anything except physics?

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Abstract In the course of defending his view of the relation between the special sciences and physics from Jaegwon Kim's objections Jerry Fodor asks "So then, why is there anything except physics?" By which he seems to mean to ask if physics is fundamental and complete in its domain how can there be autonomous special science laws. Fodor wavers between epistemological and metaphysical understandings of the autonomy of the special sciences. In my paper I draw out the metaphysical construal of his view and argue that while in a sense it answers Fodor's question it is immensely implausible.

Keywords Fodor · Special sciences · Physicalism

> Only God gets to decide whether there is anything, and likewise only God gets to decide whether there are laws about pains; or whether, if there are, the pains that the laws are about are MR ... Here, for once, metaphysics actually matters. (Fodor 1997, p. 161)

> Everything is physical perhaps, but surely there are many different kinds of physical things. Some are protons; some are constellations; some are trees or cats; and some are butchers, bakers or candlesticks. For each kind of thing, there are the proprietary generalizations by which it is subsumed, and in terms of which its behavior is to be explained. For each such generalization, there is the proprietary vocabulary that is required in order for our discourse to express it. Nothing can happen except what the laws of physics permit, of course; but much goes on that the laws of physics do not talk about. It would not be entirely surprising if the explanatory apparatus that our higher-level theories require in order to say the sorts of thing that physics doesn't, cross-classifies the taxonomy that physical explanation employs. Maybe this kind of picture is a viable alternative to consilience. Or maybe it's not. Or maybe both are wrong. Or maybe it's still too soon to tell. LRB | Vol. 20, No. 21 dated 29 October 1998 | Jerry Fodor

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In the course of defending his view of the relation between the special sciences and physics from Jaegwon Kim's objections Jerry Fodor asks

> So then, why is there anything except physics? That, I think, is what is really bugging Kim. Well, I admit that I don't know why. I don't even know how to think about why. I expect to figure out why there is anything except physics the day before I figure out why there is anything at all, another (and presumably related) metaphysical conundrum that I find perplexing (Fodor 1997, p. 161)

Why are Fodor perplexed and Kim bugged by the existence of anything, i.e. any sciences, other than physics? I think the explanation may be this. Fodor and Kim both believe

(1) All items belonging to the ontology of the special sciences (all special science individuals, events, properties etc.) are constituted or realized by microphysical ontology (particles, fields, quantum states etc.)
(2) The dynamical laws of micro physics are complete in the domain of microphysics.

Fodor but not Kim also thinks that

(3) There are special sciences whose subject matters include natural kinds, laws, explanations, causal relations, confirmation relations etc. that are *not reducible* to those of physics.

Exactly what (3) comes to will be among the topics of this paper. But even before clarifying (3) one can see that there is a tension among the three claims. The tension bears a resemblance to what Kim calls "the exclusion problem."[1] According to (1) the subject matters of all the special sciences are ultimately constituted by and realized by microphysical entities (fields, elementary particles, etc.), events (changes in the positions, momenta etc. of particles, changes in field values, etc.) and properties (energies, densities etc. of systems of particles and fields).[2] The completeness of the dynamical micro physical laws in its domain means that the fundamental laws completely specify the dynamical evolution of the microphysical state of the universe (or of an isolated sub-system); i.e. for every time t if S(t) is the state of isolated system Σ at t and the laws are deterministic then S(t) and the laws determine a unique state S(t′) for Σ at t′; if the laws are indeterministic then for every t S(t) and the laws determine the chances

[1] The "exclusion problem" is the problem that if physical events are causally closed (all physical events have sufficient physical causes) and mental events are distinct from physical events then a mental event M causes a physical event E only if E is causally over determined, Kim thinks that such over determination is problematic and so concludes that for any mental even it either is identical to a physical event or is epiphenomenal with respect to physical events. His most recent discussions are Kim (2005) and Kim (2007).

[2] The natures of constitution and realization are complicated matters. Roughly, the idea is that macro entity X is *constituted* by configuration C of micro entities (particles or fields related in such and such ways) at time t if given the fundamental laws C's existence at t metaphysically necessitates X's existence at t. If X has property F at t then this instance of F is *realized* micro physically iff there is a history of microphysical states that given the laws metaphysically necessitates that X has property F at t.

at t of the evolution of future states.[3,4] It follows from (1) and (2) that whatever special science regularities (including probabilistic regularities) there may be are made true by physical facts and laws. It is hard to resist the conclusion that those regularities that are lawful derive their status as *lawful* from the fundamental laws of microphysics since the microphysical laws completely specify the evolution of microphysical systems that constitute special science entities. And this seems to mean that special science laws must be reducible to physics. On the other hand, reductions of special science laws to laws of physics are very scarce.[5] Although most biologists think that living organisms are constituted by microphysical entities obeying only microphysical laws no one has any idea of how, for example, the Hardy–Weinberg law (or any other biological law) is made lawful or even made true by physical facts and laws. The same is true for psychology, economics, and other special science laws.

And yet Fodor thinks that nothing is more obvious than that the special sciences contain many laws expressed in their proprietary vocabularies. One of his examples, Gresham's law[6], says that the introduction of bad money into an economy leads to the hoarding of good money. It allegedly explains the hoarding of gold ("good money") in Germany in the 1920s in terms of the introduction of quantities of paper money ("bad money") into the German economy. Fodor observes that special science laws like Gresham's are implemented by many distinct physical processes that have little in common "from the point of view of physics" (or other sciences distinct from economics). Money can be made of no end of physically distinct materials (and also be electronically and psychologically realized) and monetary transactions can involve no end of physically distinct processes (writing checks, making verbal promises, over the internet etc.). Other than providing the matter out of which the various kinds of money are made it looks (to Fodor) like physics has little to do with explanations in economics, psychology, biology or any of the special sciences. What makes Gresham's law *a law*—what provides it with explanatory powers, endows it with the ability to support counterfactuals, and enables it to be confirmed by its instances—seems to be outside the purview of physics.

Fodor goes on to observe that

[3] This characterization needs to be modified for relativistic space-times (in which there is no "state at a time") and to take into account various other complications. These complications are not relevant to the issues in this paper.

[4] Whether or not our world is "governed" by nomologically complete microphysical laws is, of course, controversial. Laplace thought that the Newtonian laws (with the complete set of force laws) are correct and complete and toward the end of the nineteenth century classical mechanics together with electromagnetic theory was thought to be a candidate for completeness. These theories have been supplanted by quantum mechanics and relativity but these have not yet been successfully combined into a candidate complete theory. Some philosophers (e.g. Papineau 2001) think that the successes of physics support the completeness of microphysics while others (e.g. Cartwright 1999) think that the failures support skepticism.

[5] The best cases of reductions are laws of chemical combination to quantum mechanics and thermodynamics to classical or quantum mechanics. We will discuss the latter example later in this paper.

[6] Gresham's law says that if two kinds of money in circulation have the same denominational value but different intrinsic values, the money with higher intrinsic value will be hoarded and eventually driven out of circulation by the money with lesser intrinsic value. It is named after Sir Thomas Gresham (1519–1579).

> The very existence of the special sciences testifies to reliable macro-level regularities that are realized by mechanisms whose physical substance is quite typically heterogeneous .... Damn near everything we know about the world suggests that unimaginably complicated to-ings and fro-ings of bits and pieces at the extreme micro-level manage somehow to converge on stable macro-level properties. (1997, p. 160).
> ..... the 'somehow, really is entirely mysterious, and my guess is that that is what is bugging Kim. He just doesn't see why there should be (how there could be) macro level regularities *at all* in a world where, by common consent, macro level stabilities have to supervene on a buzzing, blooming confusion of micro level interactions. (1997, p. 161)

One can easily join Fodor in the mood of feeling that it is "*molto mysterioso,*" that the motions of particles (and fields) to-ing and fro-ing in accordance with F = ma (or whatever the fundamental dynamical laws prove to be) lawfully end up converging on the regularities of the special sciences. How do the particles that e.g. constitute an economy "know" that their trajectories are required (*ceteris paribus*) to enforce Gresham's law?

As Fodor says, "This is all very puzzling."

In view of the puzzle and the absence of successful reductions of special sciences to physics it is understandable that there are some philosophers who doubt that the laws of micro-physics are dynamically complete even within the domain of micro-physics. This is the response of those emergentists who think that there is nomological structure characterized in the special sciences that is in additional to the nomological structure determined by the laws of physics.[7] One variety of emergentism has it that there are special science laws that override the laws of physics in certain circumstances.[8] Another, apparently distinct, variety claims that there are gaps left by the laws of physics that are filled by special science laws. If either of these is correct then there are genuinely irreducible special science laws that govern special science entities by "directing" the motions of their constitutive particles and fields. In my view these kinds of emergentism are not plausible. There is no evidence that in the domains of the special sciences the fundamental laws (as they are now thought to be) can be overridden or are gappy and good reason to think that they are not.[9] In any case, it is

[7] I understand emergentism as a form of dualism that says that there are properties (or instantiations of properties) or laws whose existence is not metaphysically determined by physical entities, properties, laws etc. but in some way emerge from complexes of physical entities perhaps via bridge laws and causal relations. Emergentism differs from the usual understandings of Cartesian dualism in that Cartesian dualism claims that there are non-physical fundamental individuals (e.g. mind, souls etc.). Most emergentists reject the nomological completeness of microphysics and posit dynamical laws connecting emergent properties with microphysical states that override or fill in gaps left by the microphysical laws But some emergentists accept the microphysical completeness of physics and so grant that emergent phenomena is epiphenomenal with respect to physical events, others avoid epiphenomenalism by accepting nomological over determination.

[8] On this view the laws of physics hold only as these circumstances don't obtain.

[9] On the other hand some philosophers e.g. Cartwright (Cartwright 1999) claim that that evidence for fundamental physical laws is obtained only in very special circumstances for very simple systems and doesn't provide support for the nomological completeness of physics. I can't get into this issue in this paper except to remark that a Nobel Prize is waiting for the scientist who demonstrates that the laws of physics that hold for microscopic systems fail for macroscopic systems.

clear that Fodor does not hold either of these varieties of emergentism.[10] Instead he proposed (Fodor 1974) an account of how special science laws are related to laws of physics that he thinks reconciles the irreducibility and autonomy/irreducibility of the special sciences with the dynamical completeness of physics. His account is a version of what is now called "non-reductive physicalism" (NRP). I will discuss Fodor's particular view and his reasons for it in the next section. The rest of this discussion concerns NRP generally.[11]

NRP is non-reductive in that it says that the special sciences involve laws, causal relations, explanations, and so on that are, "in a certain sense", irreducible to those of physics and it is physicalist in "a certain sense" since it says that everything is ultimately constituted micro-physically and that the laws of microphysics are complete in the domain of micro-physics. Fodor remarks that NRP is now (and has been since the 1970s) "conventional wisdom" having replaced the reductionist conventional wisdom of previous generations. Unfortunately, like much conventional wisdom it is not so clear exactly what it comes to. Advocates of NRP differ on how to understand "irreducible" and "physicalism." The first way- which I label "NRPM" (for "non-reductive physicalism *Metaphysical*") understands the irreducibility of the special sciences as involving the existence of kinds and laws that are metaphysically over and above the kinds and laws of physics. NRPM endorses physicalism in so far as it claims that everything that exists is physically constituted, every instantiated special science kind is physically realized and every special science nomological/causal transaction is physically implemented. So, unlike the versions of emergentism I mentioned earlier it doesn't say that the fundamental laws of physics can be overridden or are gappy. However NRPM is similar to emergentism it says that special science laws are autonomous from the laws of physics.[12] I will discuss how that can be so when addressing Fodor's version of NRPM.

[10] I will later suggest that Fodor is an emergentist in the sense that he thinks that there are special science types and laws whose typehood and lawhood are not determined by physical facts but rather emerge from them.

[11] In the 1980s NRP became widely accepted but recently there has been a growing dissent from the "non-reductive" part of NRP. In particular, Kim has been arguing for the last decade or so that the causal completeness of the physical sciences supports the reducibility of the special science reducible to physics. One problem with connecting his discussion to my discussion in this paper is that he seems to understand physics not as fundamental physics but as including macro-physics and chemistry and perhaps even neurophysiology and biology. This is understandable since his main interest is the relationship between the mental sciences and the non-mental sciences. His view (it seems) is that there are no autonomous psychological laws mental sciences are reducible to and not autonomous from the physical sciences construed broadly. For example, he claims that his arguments show that mental properties are not causally efficacious and mental predicates are not (as such) projectible. He also seems to think that mental laws are reducible to physical laws. All this needs a lot of discussion but not here since this is a paper mostly about Fodor. I discuss Kim's views in Loewer (2007a,b).

[12] There are two features of NRPM that earn it the title of "emergentist." One is that the fact that a special science property is a *natural kind* is an emerging feature that is not metaphysically entailed by the existence of physical kinds. The second is that the lawhood of special science laws is not entailed by the laws of physics. An even more emergentist view that some may still consider physicalist is that the instantiation of special science properties is not entailed by the totality of laws and facts of physics. Rather there are basic "bridge laws" that connect special science properties to physical systems. I won't consider views of this sort in the paper since it is not Fodor's view and as will be clear is open to the same objections I will discuss to Fodor's view.

According to the other way of understanding NRP—which I label NRPL (non-reductive physicalism *light*)—the irreducibility of the special sciences is not metaphysical but *merely* conceptual and epistemological. According to NRPL the special sciences contain vocabulary/concepts that are conceptually independent of the concepts/vocabulary of physics. NRPL also allows that special sciences contain their own confirmation (and other epistemic) relations that are independent of physics. A biologist may have evidence that a biological generalization is lawful (think of the Mendelian laws) without having any idea how this regularity is rendered lawful or implemented by fundamental laws of physics even though the former is grounded in the latter.[13] However, NRPL, in contrast with NRPM, holds that the nomological structure of the world *is* completely specifiable by fundamental physics. The special sciences don't add to the nomological structure (as they do according to NRPM) but rather they characterize aspects of the structure generated by the fundamental physical laws that are especially salient to us and amenable to scientific investigation in languages other than the language of physics.

NRPM and NRPL agree that the special sciences are conceptually, epistemologically, and methodologically autonomous/irreducible to physics but disagree about what autonomy/irreducibility consists in and how it is to be explained. NRPM says that the autonomy/irreducibility is metaphysical and seeks to explain the conceptual and epistemological autonomy in terms of the existence of special science kinds and laws of physics. If NRPL is true then the autonomy/irreducibility of the special sciences isn't explained in terms of basic special science kinds and laws but must ultimately be due to facts and laws of micro-physics and to our epistemological situation in the world (which it says is also due to the facts and laws of micro physics). The two views also disagree about physicalism. NRPL is compatible with strong versions of physicalism on which all truths, including those of the special sciences, hold in virtue of facts and laws of fundamental physics. NRPM rejects this strong claim since it says there are facts about kinds and laws of special sciences that are independent of physics but it is compatible with token physicalism (as Fodor emphasizes).

Many philosophers who align themselves with NPR straddle the fence between NRPM and NRPL coming down on one side or the other depending on whether they are emphasizing irreducibility or physicalism. But when push comes to shove Fodor falls off the fence on the side of NRPM. Or so I will argue below and then argue that NRPM is not an attractive view.

In the early 1970s Fodor led an attack on reductionist accounts of the special sciences. In his "Disunity of Science as a Working Hypothesis" he claimed that it is implausible that any of the special sciences are reducible to another one (e.g. psychology to neural sciences) and implausible that any special science is reducible to physics, even in principle, and even at some imagined state when physics and the special sciences are completed. Of course what you think of this claim depends on what you think reduction is. Various views about exactly what it is to reduce the laws of one science to those of another were discussed by advocates and critics of the unified

[13] It is not difficult to represent Bayesian confirmation functions in which L metaphysically necessitates K and there are statements E that confirm one but not the other.

sciences view.[14] Fodor set his sights on the view that the law N(F, G) (which Fodor says is intended to be read as F events *bring about* appropriately related G events) is reducible to the more basic law N(P, Q) iff there are "bridge principles" connecting the special science kinds with physical kinds. Advocates of reduction were often unclear concerning the nature of these bridge principles. The way Fodor understands them bridge principles have the form of identities; F = P. Since P is a physical kind a bridge principle says that a special science kind term denotes a physical kind. On this account the bridge principles "reduce" a special science law to a law of physics by showing that the special science law is actually a special science characterization of a law of physics.

Fodor announced that the classical account (as he understands it) is all wrong. He has a number of persuasive reasons:

1. There are very few (if any) examples of successful classical reductions of the laws of any special science to those of fundamental physics. It is even controversial whether there are classical reductions of chemistry and thermodynamics to physics. Further, we have no idea what natural kinds of fundamental physics could correspond to kinds of psychology or biology or even meteorology and no one has ever produced a reduction of a putative law of one of these sciences to physics.
2. The special sciences have developed to a great extent independently of fundamental physics (and by and large of each other) in ways that are apparently incompatible with reduction. Each science employs its own vocabulary, laws, explanations, typical causal mechanisms and so on. The best explanation of this autonomy is that each of the special sciences taxonomizes nature in terms of its own system of natural kinds and these are seldom identical to physical kinds (or each other) and that special science laws are irreducible to laws of physics.
3. Special science kinds—especially those found in psychology and biology—are typically functional properties. A functional property specifies a causal or nomological role; e.g. pumps blood—which can be satisfied by many distinct physical properties. Fodor concludes that functional properties are not identical to physical properties but rather their instances are *realized* by configurations (typically very complex configurations) of physical entities satisfying physical properties and relations. He points out that not only can a functional property be multiply realized but its realizations are typically physically heterogeneous. For example, hearts (natural and artificial) can be four chambered or three chambered or made of cellular tissue or metal or plastic or.... It may even be that it is metaphysically possible for certain functional properties to be realized in worlds that are impossible by the lights of our physics but realized and implemented by physics very different from the actual physics.[15] So functional properties are not identical to

[14] Much of the discussion concerns the reduction of one theory to another where the theories are not claimed to be true and so reductions often involved "corrections" (e.g. the "reduction" of thermodynamics to statistical mechanics).

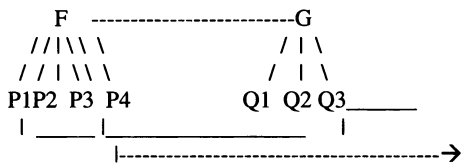
[15] Perhaps there is a possible world (not ours) whose fundamental physical ontology and laws are characterized by classical mechanics or whose fundamental ontology is gunky or something even more exotic. There seems to be no reason why in such world their may not be configurations of physical systems that satisfy the causal/nomological profile of *is a heart.*

physical properties and if special science kinds are functional properties classical reduction is ruled out.

4. Fodor says that special science laws typically imply regularities that hold ceteris paribus. For example (Fodor's example), Gresham's law grounds the regularity "introducing bad money into an economy leads to the hoarding of good money *ceteris paribus*." Let Ncp(F, G) stand for the law that Fs bring about Gs ceteris paribus. The qualifier "ceteris paribus" has the effect that certain instances of Fs that don't bring about Gs fail to count against the truth of Ncp(F, G) while others do. Fodor's idea is that if Ncp(F, G) then instances of the kind F in virtue of being F have the power of bringing about G unless interfered with. Neither Fodor (nor anyone else) tells us how to distinguish spurious from genuine counter instances—i.e. interfering factors from situations which falsify—to a putative law.[16] Perhaps an answer may not to be available until a few days before we find out why there is anything at all. However, this need not delay our discussion since Fodor's views about laws and reduction depend only on their being an answer and not on our knowing what it is and it is obvious that there cannot be a classical reduction of Ncp(F, G) to an exceptionless law of physics since no exceptionless law and identity statements can imply Ncp(F, G).

I agree that classical reductionism as Fodor construes it is dead. Let's look at what he offers in its place.

Fodor depicts his alternative to the classical account with this often-reprinted diagram:



The squiggly line connecting F to G depicts Ncp(F, G). The Ps are all the physical properties (or complexes of physical properties) whose instantiations (by micro physical entities) realize F and the Qs are physical properties whose instantiations realize G (not all of which are lawfully connected to P properties). Fodor doesn't say much about the nature of realization. I will construe it rather strongly as requiring that if P realizes F then it is impossible given the laws of physics for P to be instantiated without F also being instantiated.[17] The lines connecting Ps to Qs depict fundamental

[16] Fodor (1991) does make a proposal for the truth conditions (or a sufficient condition) for cp laws but it is problematic. See Warfield (1993) for a discussion of Fodor's proposal and Rey and Pietoski (1995) for a somewhat better account of *ceteris paribus* laws.

[17] This is the usual requirement on realization. It is satisfied in the case of functional realization where a property instantiation realizes a functional property in virtue of satisfying the causal/nomological profile associated with that property. Fodor sometimes suggests that he holds a weaker account of realization on which all that is required is that an instantiation of P nomologically implies instantiations of F where the laws may include connecting laws that are not reducible to laws of physics. My claim that Fodor's view is a version of NRPM is obviously true of the weaker account but is also true of the stronger account of realization and is obviously true of the weaker account.

laws of physics. The Ps that fail to lead to Qs that realize Gs are "spurious exceptions"; i.e. they don't falsify the Ncp(F, G). On this account every physically possible instantiation of N(F, G) is implemented by a physical law but N(F, G) is not reducible to the physical laws since F and G are multiply realized (perhaps because they are functional properties) and so not identical to any physical kind.

A naive question that occurs to most everyone when first encountering Fodor's views is why isn't Ncp(F, G) reducible to the disjunctive law of physics

(D) Ncp(P1vP2 v..., Q1v Q2v...) (Where the Ps are all the realizations of F)

or, better, eliminable in favor of the exceptionless law of physics

(D*) N(P*1vP*v..., Q1vQ2v...) (Where the P*s are the Ps that lead by physical law to realizers of G).

Assuming we can figure out what "ceteris paribus" comes to why isn't (D) a law since it follows from laws of physics and it holds iff Ncp(F, G) does? And since (D*) is also a entailed by laws of physics why isn't it a law of physics? If (D) is a law then it looks like we can come pretty close to a classical reduction of Ncp(F, G) to laws of physics.

Fodor's sophisticated reply to the naive question is that it is a mistake to think that (D) and (D*) are laws. They are not laws because laws only link natural kinds and (D) and (D*) don't link natural kinds. The obvious question now is "why aren't the disjunctive properties in (D) and (D*) natural kinds?" Fodor's initial, not very helpful, answer to this one is that they are not natural kinds because they don't occur in laws. He adds that the property P*1vP*2v... is not a natural kind (nor is the disjunction that includes all the realizers of F) because disjunctive properties need not be kinds and disjunctions of physically heterogeneous properties are not kinds of physics. He seems to mean by this that the various Ps can be realized by various configurations of physical entities that are made from different materials. On the other hand, although the disjunction of the realizers of F may be physically heterogeneous (and so not a kind of physics) they may be psychologically homogenous so that F *is* a kind of psychology. If F is a functional natural kind of psychology its instances are psychologically homogeneous since they share the same psychological role.

Fodor thinks that a special science regularity's powers—if it has them—to support counterfactuals, explain the behavior of special science systems, be confirmed by its instances and so on don't follow merely from the fact that it is implemented by laws of physics. It is further required that its instances are instances of special science kinds and that it follows from a special science law. Further, special science kinds may be realized and special science laws obtain even in worlds whose fundamental properties and laws are very different from those of the actual world. In these worlds the special science kinds are realized by alien fundamental properties and special science laws by alien fundamental laws.

Fodor thinks that his account of special science kinds and laws underwrites special science confirmation, explanation, causation, and counterfactuals, and explains why they are autonomous from the laws and kinds of physics. Here is how it is supposed to work:

Confirmation: Fodor thinks of confirmation in a more or less Goodmanian fashion. On Goodman's account a generalization is confirmable iff it is law-like and it is

law-like iff it links projectable *predicates*. Fodor agrees. But whereas Goodman thinks that whether or not a predicate is projectable is relative to a community of scientists and depends on its history of past projections, Fodor thinks projectability depends on whether the predicates refer to natural kinds and belong to the vocabulary of the science dealing with those kinds. If F and G are kind predicates of psychology then N(F, G) is law-like and confirmable. Since the disjunction of the predicates of physics that refer to the Ps that realize F is not a natural kind predicate of physics (or any other science) it is not projectible and generalizations involving it are not confirmable. This is completely compatible with the fact that the disjunction is coextensive in physically possible to F since confirmation relations need not be transmitted across coextensive predicates. It follows that confirmation relations of a special science can be independent of those of physics.[18]

Explanation: Fodor accepts a causal/nomological account of explanation. So he thinks that laws play a central role in explanation either by subsuming explananda or by backing a causal relations and processes. For example, we can explain why the introduction of massive amounts of paper money into the German economy in the 1920s drove gold coins out of circulation in terms of Gresham's law. An aspect of his non-reductive view is that special science laws provide nomological structure that grounds explanations which are unavailable to physics.

Given (1) and (2) there is also a story in fundamental physics in which the micro-physical state (or processes) S1 of the world that realizes the process of the introduction of Bad Money into the German economy in the 1920s and fundamental dynamical laws lead to subsequent micro physical states (or processes) S2 that realize the removal of Good Money from the German economy. Needless to say this is not a story that we will ever have in hand or if we did we would recognize as an explanation. A Laplacian Demon who knows that S1 is the physical state in the 1920s could use the fundamental laws to explain S2 but still would not have an explanation of the disappearance gold coins from the economy since she needn't know that S2 realizes the disappearance of gold coins.

Let's say that a "super Laplacian demon" also knows which micro physical states realize which special science properties. So the super demon knows that S2 realizes the hoarding of gold coins and S1 realizes the introduction of paper money. The interesting point is that Fodor and other non-reductionists (e.g. Kitcher) think that even so the super Laplacian demon would be missing the explanation since she wouldn't see how this explanation generalizes. She wouldn't know that other instances of the introduction of bad money lawfully lead (ceteris paribus) to the disappearance of good money.[19] Kitcher's says that from the demon's perspective—the perspective of fundamental physics—special science generalizations appear to be coincidences. Here is an example that Kitcher (2001) gives to support his point

[18] Kim (1997) argues contra Fodor that since "P1vP2v. . ." and "F" are co-extensive in all physically possible worlds either both are projectible or neither is. Kim prefers the second. But as Fodor says in reply this neglects the fact that confirmation is *intensional* and concerns the predicates not their extensions.

[19] But this isn't quite correct, at least for strict higher special science laws, since issues about vagueness aside the super demon could find all the micro states that realize F and all that realize G and discover that each of the former leads to one of the latter. If the law is ceteris paribus then the demon would also have to figure out which exceptions don't falsify the law and not even Fodor has told us how to do that.

> ...the regularity discovered by John Arbuthnot in the early eighteenth century. Scrutinizing the record of births in London during the previous 82 years, Arbuthnot found that in each year a preponderance of the children born had been boys; in his terms, each year had been a "male year". Why does this regularity hold? Proponents of the Unity-of-Science view can offer a recipe for explanation, although they can't give the details. Start with the first year (1623); elaborate the physiochemical details of the first copulation-followed-by-pregnancy showing how it resulted in a child of a particular sex; and continue in the same fashion for each pertinent pregnancy; add up the totals for male births and female births and compute the difference. It has now been shown why the first year was male; continue for all subsequent years. Even if we had this "explanation" in hand, and could assimilate all the details, it would still not advance our understanding. For it would not show that Arbuthnot's regularity was anything more than a gigantic coincidence. By contrast we can already give a satisfying explanation by appealing to an insight of R.A. Fisher....

Fisher's insight concerned the selective advantages under certain circumstances of sexual asymmetries in birth rates.

I am sure Fodor would agree. Without Gresham's law it would appear to be a *coincidence* that all those micro to-ings and fro-ings that realize the introduction of bad money lead to microstates that realize the disappearance of good money. Gresham's law explains why the regularity is not merely coincidental.

Causation: The explanation of the disappearance of good money in terms of the Introduction of bad money is a causal explanation. The property of being bad money introduced into the economy is in some way causally relevant to the disappearance of good money. There is considerable controversy concerning exactly what "causal relevance" means and what it takes for a property of a cause c to be causally relevant to its causing e. Fodor's view is that if c causes e and there is a law N(F, G) (or a law Ncp(F, G) and the cp conditions are satisfied) which subsumes c and e then c's being F is causally relevant to c's causing e (and to its causing e to be G) and F is a causally relevant property. Of course, on his view if c's causing e is covered by N(F, G) it is also covered by an implementing law of physics N(P, Q) (and perhaps other special science laws as well) so both F and P are both casually relevant to the causal transaction. There is thus a great deal of causal over determination on Fodor's view.[20]

Counterfactuals: Counterfactuals are closely connected to laws, explanation and causation. For Fodor counterfactuals limn the nomological and explanatory structure of the world. Explanations (in particular causal explanations) like that of the hoarding of gold in Germany are closely connected to counterfactuals e.g. *if the government had not introduced bad money into the economy gold would not have been hoarded.* He thinks of counterfactuals along the lines of Goodman's account.[21] On the way he construes that account "If an x had been F at time t then y would have been G at t*" is

[20] Fodor applies this account to mental/intentional causation. For example, X's thinking that there is water over there is causally relevant to X's intending to go over there if (and only if?) there is a cp law connecting thinking that water is located in a particular place and intending to go to that place. See Fodor (1989).

[21] Goodman's account is in Goodman (1983).

true only if there is a law linking F and G *as such*; i.e. the law connects the kinds F and G. So on Fodor's view special science counterfactuals require special science laws. Recently, he has employed this view about the relation between counterfactuals and laws in an interesting criticism of selectionist explanations in evolutionary biology.[22] The gist of his argument is that that there are no selectionist laws of evolutionary biology of the appropriate kind to the conclusion that there are no (generally) counterfactuals of the kind needed to underwrite claims about what traits are selected for. It is clear that he thinks that laws of physics are not suitable for supporting these counterfactuals since they don't connect biological properties. So without special science laws there are no special science counterfactuals and without them no special science explanation or causation.

It is not surprising that Fodor's account of the relation between the special sciences and physics replaced the classical reductionist account as the "conventional wisdom." It seems to be a view that gives us everything we want. On the one hand, it apparently explains why the special sciences can be pursued to a great degree independently of physics (and each other) since they are irreducible to laws of physics. On the other hand, it maintains the fundamentality of physics since it says that all natural kinds are realized physically and that all lawful transactions are implemented by laws of physics.

I think it is clear that Fodor's view is a species of NRPM. But if you are not yet convinced consider these remarks:

> ... there are special sciences not because of the nature of our epistemic relation to the world, but because of the way the world is put together; not all natural kinds ... are or correspond to physical kinds. (p. 1974)

and

> Only God gets to decide whether there is anything, and likewise only God gets to decide whether there are laws about pains; or whether, if there are, the pains that the laws are about are MR ... Here, for once, metaphysics actually matters. (p. 161)

Sometimes Fodor explains his view theologically.[23] It goes like this: God decided to make our world one in which there are kinds of intentional psychology and certain laws involving those kinds and so lots of mental causation. He handed a list of intentional laws he wanted to his angels commanded them to make them hold in the world. But the angels said that since psychologies, at least of created beings, are instantiated in physical creatures they would have to create a physical ontology and laws of physics to implement the psychological laws and asked what physics He preferred. God replied "I don't give a hang about the physics. Just make the fundamental laws and

[22] Fodor (2007). Fodor's argues that there are no laws of the form "In environment E phenotype P1 will be (are likely to be) selected over phenotypes P2, P3...." His argument is considerably more complicated than my brief gloss suggests.

[23] I don't know any place where Fodor has told this story in print but I have heard it many times over the last 15 years.

initial conditions so that the psychological laws on my list are implemented." And so it was done.

Before evaluating whether Fodor's account is plausible I want to clarify the variety of physicalism which it endorses. Fodor points out that his view is compatible with token physicalism but violates type (natural kind) physicalism. Token and type physicalism are not the only kinds of physicalism. In fact I think neither gets right the central physicalist idea that every positive contingent fact (including nomological facts) obtains *in virtue* of the distribution of fundamental physical entities and fundamental laws of physics.[24] In particular, facts about what special science laws and kinds there are (i.e. the fact that a particular special science generalization is lawful and that a particular special science property is a natural kind) obtain in virtue of physical facts and laws. I will call this Physicalism (with a capital "P"). Physicalism doesn't imply type (or kind) physicalism since it allows for there to be natural science kinds that are distinct from physical kinds. However, it does require that whether or not a special science property is a natural kind is determined by the facts and laws of fundamental physics.[25] For now we just note that NRPM is not compatible with Physicalism since the former says that there are facts about the special science kinds and facts about special science laws that are metaphysically basic and don't obtain in virtue of physical laws and facts.

I imagine that Fodor won't be at all bothered to hear that his view is incompatible with Physicalism. NRPM violates Physicalism just to the extent that it posits special science kinds and laws and these are required, Fodor thinks, to account for the autonomy of the special sciences.

However, I think NRPM and specifically Fodor's version is immensely implausible. The problem is not its incompatibility with Physicalism but rather that its commitment to (1) and (2) threaten to make the existence of metaphysically irreducible special science laws (its commitment to (3)) entirely redundant. It thus makes it truly puzzling why there should be any special science laws. Here is why. Recall that on Fodor's view special science regularities are not laws in virtue of physical facts and laws. Their lawhood is basic. Because of this account implies that there are possible worlds W1 and W2 exactly alike in their physical facts and laws but differ wrt their special science laws; that is in W1 N(F, G) holds while in W2 it doesn't. Since special science properties supervene on physical facts and laws (this is required by physical implementation) W1 and W2 are exactly alike in their distribution of special science properties. It follows that N(F, G) is not needed to make the generalization F → G hold. W1 and W2 are also exactly alike with respect to which general truths are physically necessary. So

[24] This version of physicalism is similar to supervenience characterizations like Jackson's formulation: every minimal physical duplicate of the actual world is a duplicate *simpliciter.* But it is not clear that Jackson's formulation captures the idea that non physical truths obtain *in virtue of* physical facts since it allows for fundamental non-physical facts that are necessarily connected with physical facts but don't hold in virtue of them. It would be nice if I could provide an illuminating account of "in virtue of" but I admit to joining the ranks of philosophers who appeal to the notion without being able to provide an account of it.

[25] Physicalism is compatible with Fodor's construal of "classical reductionism" but not with NRP*M*. Physicalism doesn't imply token physicalism either since it allows for events that are individuated so that there are events that are not identical to fundamental physical events although, again, if there are such events they exist in virtue of fundamental physical facts and laws.

N(F, G) is not needed to make the generalization true in all possible physically possible worlds. So how do W1 and W2 differ other than with respect to N(F, G)? Fodor thinks that they differ with respect to counterfactual, explanations, and confirmation.

Can there be counterfactuals that hold at W1 but not at W2 in virtue of N(F, G) holding at W1 but not at W2? The answer is a qualified "No." First, consider purely physical counterfactuals (counterfactuals whose antecedents and consequents are formulated in the vocabulary of fundamental physics) whose antecedents are compatible with the fundamental physical laws. On any plausible account of counterfactuals these counterfactuals have exactly the same truth values in W1 and W2. For example, on David Lewis' account A > B is true if there is a world at which A and B obtain that is more *similar* to the actual world than any world at which A and not B obtain. Lewis provides an account of the similarity relation that he thinks captures the truth condition of the kinds of counterfactuals (those related to explanation and causation) that underlie explanation and causation. The details of his account are not important but what is important is that the similarity relation among physically possible worlds depends only on the fundamental physical facts and laws. Worlds exactly alike with respect to physical facts and laws will be ranked by the similarity relation exactly for the purpose of evaluating purely physical counterfactuals. This has the consequence that physical facts and laws settle the truth value of these counterfactuals. But it follows from this and from Fodor's view that instantiated special science properties are realized physically that counterfactuals whose antecedents and consequents are formulated in special science vocabularies will also have the exactly the same truth values in the two worlds. The reason is this. To evaluate Fk > Gj (where F and G are special science terms) we consider the worlds most similar to the actual world at which F obtains. But F is coextensive a purely physical (possibly infinite) disjunction P1vP2v.... throughout all physically possible worlds. Counterfactuals satisfy the condition

Equiv][26] If Fk > Gk and N(Fk↔P1vPv...) then (P1vP2v...) > Gk

So the truth value of the special science counterfactual is already settled by the physical facts and laws. And they are settled the same whether or not N(F, G) obtains. That is N(F, G) is just as unneeded (or over determining) to support these counterfactuals as it is to make special science regularities hold in the actual world in the first place.[27]

[26] The necessity here is physical necessity. A mentioned earlier Fodor seems to prefer a Goodmanian account of counterfactuals. His view that special science counterfactuals require backing by special science laws and cannot be backed by laws of physics together with (1) and (2) suggests that he would construe Goodman's account so that it violates Equiv. But this is quite implausible. Perhaps he really doesn't believe in metaphysical necessity.

[27] As I mentioned this conclusion doesn't depend on the particulars of Lewis' account but only on (i) physical laws and facts settling the truth values of all purely physical counterfactuals (to the extent they possess determinate truth values), (ii) the equivalence of special science sentences and disjunctions o physical sentences in all physically possible worlds, and EQUIV. Fodor's argument against Darwinian selectionist explanations is undermined by Equiv since it shows that counterfactuals stated in the vocabulary of, sat biology, can be supported by laws of physics.

The restriction to antecedents that are compatible with the laws of physics is required. It may be that there are worlds where the fundamental laws of physics fail (say worlds at which the laws are Newtonian rather than quantum mechanical) but at which N(F, G) still obtains. It is plausible that such worlds are more similar to the actual world than worlds at which N(F, G) fails. If so a counterfactual like "If the fundamental physical laws were Newtonian rather than quantum mechanical than Gresham's law would still obtain" may be true. I think that Fodor believes this counterfactual is true. And this is a difference that N(F, G) can make. But it is a very slight difference. And how could we tell whether this counterfactual is true. There is no experiment we can perform since we can't alter the physics of our world to find out whether Gresham's law would still hold.

Because W1 and W2 agree on their counterfactuals (at least for those whose antecedents are physically possible) there is no phenomenon that occurs in W1 and W2 that can be explained in W1 but not W2. Suppose that Gi is an instance of gold hoarding that occurs in both W1 and W2 (recall the worlds are exactly alike except for N(F, G)). Scientists in W2 can explain it in terms of the regularity F → G i.e. "the introduction of bad money drives good money out of circulation." This regularity supports counterfactuals connecting F and G although the support goes via more fundamental physical facts and laws. But it is hard to see why this should deprive the generalization of explanatory powers. It appears that in W1 there is an additional explanation of Gi in terms of N(F, G). That is right. But how does this add to the explanation when the regularity F → G already has to hold given the physical facts and laws?

What about confirmation? Suppose that there are two special scientists A1 and A2 who are occupants of W3 and who are exactly alike in their dispositions to project various predicates and more generally in their confirmation functions with the sole exception that A1 is an adherent of NRPM while her counterpart A2 is an adherent of NRPL. So when A1 obtains evidence that in her view supports F → G so will A2. A1 will also think she has evidence that N(F, G) (understood as in irreducible special science law) while A2 wont since she thinks there no such laws. But do we want to say that A2 is unjustified in her projections and confirmations? Suppose in fact that NRPL is true of W3. There are no irreducible special science laws in W3. Do we want to say that neither scientist is justified in her projections? The two scientists will make exactly the same confirmation and will construct the same special sciences and will be as successful as each other (and as their counterparts in W1 and W2) in their predictions and explanations.

What about Kitcher's argument that certain regularities (e.g. Arbuthnot's regularity) appear to be coincidental relative to the dynamical laws of physics but can be accounted for in terms of special science laws and mechanisms (e.g. Fischer's explanation in terms of natural selection). Adding dynamical special science laws clearly cannot be of any use in removing the coincidentalness of a regularity if that regularity already follows from the laws of physics. And if it doesn't follow from the laws of physics then either it conflicts with the laws of physics or the dynamical laws of physics are not, contrary to assumption, dynamically complete. Kitcher

is onto something but not something that can be accounted for in terms of Fodor's view.[28]

I conclude that if the laws of physics are nomologically complete and if all special science lawful generalizations are physically implemented then there is no need of irreducible special science laws to support special science counterfactuals, causal relations, and confirmation relations. In fact irreducible special science laws as Fodor proposed them would be otiose and their existence—if they exist—would be truly puzzling. Why would God make them the day after he made physics when the world would go on exactly as if they were there without them? So if you are convinced by the above arguments and you endorse (1) and (2) your version of physicalism should be NRPL.

NRPL still faces the problem of explaining how it can be that there are regularities in special science vocabularies that are lawful and which involve macro-systems that are from the perspective of micro physic is enormously complex and enormously multiply realized. How does it come to be that the particles and fields that constitute a special science system to-ing and fro-ing in conformity with the fundamental laws of mechanics converge on lawful special science regularities? If there is an answer to this question compatible with NRPL then it must be that the answer lies within physics. That is, it must turn out that the laws of fundamental physics and the arrangement of physical facts entail the existence of the special science regularities that play the role of laws. There is the beginning of an account of how fundamental physics yields macroscopic lawful regularities in the history of thermodynamics and statistical physics. This account and how it can be extended to other special sciences is spelled out in a sequel to this paper.[29]

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[28] Kitcher's example and many others point to the fact that the fundamental dynamical laws of physics while dynamically complete are not complete in another way. I discuss why and how to complete them so as to provide the beginning of an answer to the question asked in the title of this paper in a companion paper "Why There is Anything Except Physics" (Loewer 2008).

[29] See Loewer (2007a,b).

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