Why are there High-level Regularities?

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> 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)

Fodor is puzzled, here, about why there is anything except physics. His specific puzzlement in this passage isn't about why there exists morality or aesthetics, or all sorts of other things that aren't physics, though clearly those are interesting puzzles too. Rather, his puzzlement is about why there are special sciences. Why, in addition to physics, do we have biology, economics, sociology, geology and so on? This is particularly, puzzling if we assume, as I do, that our world is ultimately physical — that the basic constituents of the world are physical, and all of the higher-level features of the world are made up of these constituents.

This question about the existence of the special sciences can be approached in various ways. One way is to look at the special sciences and find what advantage there might be to studying the world in those terms rather than in physical terms — to find some reason why we would bother to do biology, for example, in addition physics. And, of course, there are lots of things we could say here. For example, there is a large literature on the explanations given by these special sciences, and how they might be superior to the lower-level explanations given by physics.[1] If special science explanations really are

[1] Garfinkel (1981), Jackson and Pettit (1992), Hitchcock and Woodward (2003) and Strevens (2008) are very influential examples of slightly different approaches to explaining the superiority of higher-level explanation.

superior, at least some of the time, then this provides one reason why we might want to pursue special sciences as well as physics. Another natural thought is that there is a kind of pragmatic advantage to studying the world at the higher-level. It's just too hard to do the physics of interest rates, for example — economic investigation is more tractable.

But, prior to the question of what makes the special sciences worth pursuing is the question of why there is even anything there can be reasonably pursued. Why, that is, do the basic requirements for the existence of higher-level sciences hold?

What requirements are these? Well, for there to be higher-level sciences there presumably have to be higher-level counterfactuals and causation and explanations, and so on. And, again, there is a large literature on all these issues. But the most obvious requirement is that there must be high-level regularities. Such regularities don't need to be exceptionless — most regularities in the special sciences seem to be exception-tolerant in one way or another, perhaps in virtue of being probabilistic, or including a ceteris paribus clause, or being a generic claim. But there must, at least, be *some* patterns, *some* high-level regularities. You couldn't have a discipline of economics, for example, without there being some general things to say about the allocation of resources.[2]

That's the point I will focus on — about the existence of such high-level regularities. It's the point that Fodor was focused on too — he glosses the question 'why is there anything except physics?' as the question of 'why there should be (how there could be) macrolevel regularities at all in a world where, by common consent, macrolevel stabilities have to supervene on a buzzing, blooming confusion of microlevel interactions' (Fodor, 1997, p.161).

So, that's what I'm going to investigate in this paper — why are there high-level regularities when, at

[2]Perhaps this is a little quick. Maybe there are some disciplines that proceed, not by way of generalization, but by detailed investigation into specifics. Certain types of anthropology might, at least on some conceptions, be disciplines of this kind. And there is a long tradition of theorizing about social science that, in one way or another, points to there being a distinction between disciplines, or at least methodologies, that generalize and those that specify. (Consider, for example, the distinctions between *nomothetic* and *idiographic* (Windelband, 1904) approaches to enquiry and the distinction between *erklären* and *verstehen* as different types of explanation and understanding (e.g. Dilthey, 1894).

Some will be inclined to respond that disciplines that don't generalize don't count as sciences, so all *special sciences* require regularities. But regardless of whether we agree with that, there is clearly an important set of special sciences for which the existence of high-level regularities is a prerequisite.

the basic level, things are just a blooming, buzzing confusion? Isn't it baffling, for example, that the almost unimaginable array of fundamental particles and fields that make up an economy somehow choreograph themselves into the regularity that the average returns on stocks are inversely proportional to their covariance with the market? And isn't it even more baffling that this isn't even close to being an isolated case? We have sociology, ecology, development economics, geology, ecology, biochemistry, neuroscience, microeconomics, meteorology, immunology, oceanography, thermodynamics and many many more special sciences, all with their proprietary regularities. And aren't such regularities *even more* baffling when we recognize, as (Fodor, 1997) stresses in response to Kim (1992), that these regularities connect kinds that are physically heterogeneous. Stocks, and their prices, for example, can be realized by systems that vastly physically different — the ticker-tape-driven stock market of the 1920s is very physically different from the algorithm-driven stock market of today.

Is it just a coincidence, a miraculous piece of luck, that the blooming, buzzing confusion of the lower-level gives rise to such high-level stability? Or is there something more substantial we can say?

In this chapter I'll start by discuss a few different strategies for explaining the existence of high-level regularities. I'll end up sketching a novel strategy. The key idea is that we can transform the question of high-level regularities in a way that makes accounts of *natural properties* important for answering the question. Then we can to appeal to certain accounts of natural properties in the special sciences to answer the transformed question. To be clear, the focus in this paper is about understanding the general strategy, and it's strengths and weaknesses, rather than on the detailed implementation of the strategy — space constraints prevent me from going into great detail about the accounts of special science naturalness needed for this implementation.

So let's consider some possible responses to the puzzle.

1 Fodor

Fodor's reaction to this puzzle was simply to be baffled. But, the type of bafflement that he points to interestingly specific. As we saw in the quote at the start of the paper he reacts to the question of why there are special science regularities as follows: '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'.

This particular type of bafflement suggest an interesting position, one which connects to other positions Fodor holds about the special sciences. So in the rest of the section I'm going to discuss this position. I'll write as if it was Fodor's position, and I think a decent case can be made that it was. But, ultimately, I don't care about Fodor scholarship or exegesis — I'm merely interested in a position that is suggested by some things that Fodor says.

There's a natural interpretation of Fodor (1974) which takes him to deny physicalism, at least on some reasonable conceptions of what physicalism is. (Loewer (2009) makes this case in more detail) For example he says that:

> I am suggesting, roughly, that 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 natural kinds. Fodor (1974, p. 113)

The suggestion here seems to be that there are some features of the world that don't hold in virtue of the physics. There are facts about special science natural kinds, for example, that float free of the physics. As Loewer (2009) notes, he says similar things with respect to special science laws — they don't seem to hold in virtue of the physical facts on his view.

And if there are things in the world that don't hold in virtue of the physics then there is a natural sense in which the view denies physicalism. I don't want to get into the debate about the mass of different formulations of physicalism though. Perhaps there are reasonable senses in which Fodor does count as physicalist. But he does seem to suggest that special science laws and kinds don't hold in virtue of the physics.

If you have this kind of view — that special science laws and kinds are just a basic part of the way that the world is put together — then Fodor's specific kind of bafflement makes sense. Notice that Fodor thought that the question of why there is anything except physics was similarly puzzling, and related to, the question of why there is anything at all. The question, that is, of why is there something rather than nothing.

The question of why there is something rather than nothing seems so intractable because it's about the fundamental makeup of the world. When we ask why certain entities exist *now* we can explain this by appealing to entities that existed in the past, showing how they evolved into the entities that exist now. But clearly this doesn't answer the question of why there is something rather than nothing, because why did those past entities exist? Why, in fact, did the world start off with entities existing? This is a question about the world's fundamental starting points.

If we think that special science laws are part of the fundamental makeup of the world, as Fodor seems to do, then it's easy to see why the question of why there exist such special science regularities seems closely connected to, and similarly as puzzling as, the question of why there is something rather than nothing. They are both questions about why the fundamental nature of the world is as it is. And such questions seem intractable, because part of what it is to be fundamental is for there to be nothing that is explanatorily prior. So there seems to be no material we can use to give an explanation.

What's particularly interesting about this position, though, is that it might seem to defuse the worry about the existence of the special sciences, or at least make the worry seem less pressing. If you think that special science laws are basic you can answer the question of why there are special science regularities by simply replying 'that's just the way the world is put together' just as someone might answer the question of what there are basic physical regularities by saying that physical laws are just part of the way the world is put together. And why is the world put together in the way that it is?

Who knows, that just seems like an intractable puzzle.

So, I think, Fodor's denial that the world is ultimately just physical does, in a sense, defuse the force of the puzzle about special science regularities. By subsuming the puzzle of special science regularities to the puzzle about why the basic nature of the world is as it is, it makes it seem more reasonable to ignore the puzzle – it makes the existence of special science regularities seem like the type of thing that it is appropriate to leave unexplained. And further, it suggests that there is no special puzzle about special science regularities. No more, at least, than the puzzle about why there are physical regularities.

This approach is, I think, interesting and not something that should be rejected out of hand. But I'll just quickly raise three concerns. Firstly, there is obviously a sense in which this isn't a satisfying explanation of the puzzle that we started out with. It is, at best, a reason to think that we shouldn't look for an explanation, or that if we do look we won't find one. This is a reasonable position to fall back on, but it still motivates us looking for a more substantial explanation. Secondly, the view is not physicalist, in the sense that there are parts of the world that don't hold in virtue of the physics. This seems deeply unattractive to me. But, regardless of that, the puzzle that I started out with, that I want to address in this paper, is the puzzle of why there is anything except physics, when, in a sense, physics is all that there is. The puzzle is trying to square the idea that the world is ultimately just physical with the existence of the special sciences. So for the rest of the paper I'm going to consider positions which accept that the world is ultimately physical. And thirdly, the Fodorian response I've been considering is to say that certain special science laws are just part of the way that the world is put together — such laws are fundamental. But this leads to concerns of redundancy. If the fundamental physical laws already make all the physical events happen, and if the higher-level entities are made up out of physical entities, then it can be hard to see what the fundamental special science laws are there to do. (Loewer (2009) develops this kind of objection to Fodor. And, of course, this point is very closely related to huge literature on mental causation and overdetermination.)

None of these concerns rule out this Fodorian position but they motivate us to look elsewhere.

2 Anthropic Reasoning

Here's an approach to the puzzle that we can put aside quickly. We might attempt to use anthropic reasoning to explain the existence of special science regularities. The basic thought is simple — entities like us would not exist without there being some higher-level regularities. If there were no regularities about the working of DNA, for example, then we would not exist. So, it is not surprising that we live in a world where there are such regularities.

Such anthropic reasoning is highly controversial. It's unclear whether such reasoning really can generate good explanations, and under what conditions. But, regardless of these complicated questions, it can't be a satisfying answer to our puzzle because most high-level regularities are not required for our existence. The regularities of microeconomics, for example, are not required for our existence. Similarly with the regularities of ecology, sociology, meteorology, psychology and so on. So we should look for a more general story about special science regularities.

3 Using the Physics to explain

3.1 Metaphysical Explanation

Here is perhaps the most obvious thought about how to explain the existence of special science regularities — we are assuming that all the special science facts hold in virtue of physical facts, so it must be that the special sciences regularities are explained by the physics.

There is a sense in which this is correct. The physicalist assumption that the special science facts hold in virtue of the physical facts is a claim about explanation, but not the type of explanation we are looking for when we ask why there are special science regularities. It implies that the special science regularities are *metaphysically* explained by, or *grounded in* the physical facts. So the fact that average returns on stocks are inversely proportional to their covariance with the market is grounded in the facts about the fundamental particles and fields and so on.

But this type of metaphysical explanation is clearly not what we are looking for when we are trying to explain the existence of special science regularities. In fact, such an explanation is part of the puzzle — given that the special sciences are grounded in the buzzing, blooming, confusion of fundamental physics, how do higher-level regularities arise? The metaphysical explanation doesn't dispel the sense that it is surprising or coincidental that there are such regularities (see Lando (2017) and Bhogal (2020a) for recent work on the notion of coincidence that backs this kind of judgement).

3.2 Precise Scientific Explanations

So we can put aside such metaphysical explanations. But still, it might seem, that the assumption of physicalism guarantees that there is a kind of scientific explanation of the special science regularities. For simplicity, let's assume that the the physical laws are deterministic. Then, someone might try to explain the existence of higher-level regularities by appealing to the physical laws and the precise initial conditions of the universe, showing how these lead the world to evolve into a situation where there is a mass of high-level regularities. Whether or not this genuinely counts as an explanation it's clearly unsatisfying. It, too, doesn't dispel the sense that it is surprising or coincidental that there are such regularities.

The problem with such a putative explanation is that it makes the existence of the regularity appear extremely fragile. In order to explain the existence of higher-level regularities this explanation appeals to the precise details of the initial conditions of the universe. Those conditions could very easily have been different. And so it makes it seem like the higher-level regularities could easily have not have held.[3]

[3]This kind of idea is investigated in great detail in the literature on levels of explanation. I stated that the problem with the putative explanation is to do with modal fragility, this is in the spirit of Weslake (2010), Wilson (1994), Bhogal (2020b), and others. But others think that the problem is something subtly different, for example do to with the way in which the explanation doesn't cite the proper *difference-makers* (e.g. Strevens, 2008); or the way in which the explanans fails to be *proportional* to the explanandum (e.g. Yablo, 1992; Woodward, 2001). These are all fairly closely related, and the difference between them doesn't matter for the purposes of this paper.

3.3 Generic Scientific Explanation

This explanation which appeals to the precise physical details isn't what we want. But perhaps we can explain the existence of regularities by appealing not to the precise physical details, but to more generic features of the physics. Such an explanation would be more satisfying. Imagine that we toss a coin and it lands heads 100 times in a row. If we then explain this regularity by citing the exact physical details of each coin toss and the deterministic laws this would be deeply unsatisfying. Much better would be to point to genetic features of the physical situation — for example, the fact that the coin is weighted in such a way to make it overwhelmingly likely to land heads.

How can we give such an explanation of high-level regularities though? Perhaps the most influential idea, in the recent literature, stems from Batterman (2000) and his discussion of *renormalization group* (RG) explanations.

The literature on RG explanations is technical and complicated, and here is not the place to get into the physical details. But the basic idea is to start with a particular physical system and a function, specifically a Hamiltonian, that describes that physical system. Then we apply a particular transformation to the Hamiltonian to output another Hamiltonian that intuitively represents the system at a larger scale. Then we can, if we choose, apply the same transformation again to the resulting Hamiltonian. Sometimes, when we repeatedly apply this transformation to the Hamiltonians that represent different physical systems we find that the transformed Hamiltonian ends up being the same for both systems. This tells us that at a certain scale, or level of grain, the different systems exhibit the same behavior.

This procedure seems to open up the possibility of a certain type of explanation of high-level regularity. If we can show that there is a large class of physical systems, F, such that when we repeatedly apply the transformation their Hamiltonians all flow into the same transformed Hamiltonian then we know that all of those physical systems realize the same high-level regularity. In doing this, then, it seems like we can explain the high-level regularity by identifying the generic features of physical systems that really make a difference to the holding of the high-level regularity — the features that make a physical system part of the the class, F. And this explanation is much more satisfying than simply appealing to the precise details of the physics.

Notably, though, this approach is extremely piecemeal. It has to be applied to every high-level regularity, one at a time — trying to find the features of physical systems that make a difference to the holding of that regularity. And although that's an extremely interesting scientific project, it has a lot of limitations for answering the question we are targeting — the question of why there are high-level regularities.

Firstly, the project of trying to explain all special science regularities in this way is rather optimistic. When we consider the huge number and diversity of special science regularities — again, we have sociology, ecology, development economics, geology, ecology, biochemistry, neuroscience, microeconomics, meteorology, immunology, oceanography, thermodynamics and so on all with distinct regularities — then executing this piecemeal approach, taking one regularity at a time, start to seem extremely intimidating.

Moreover, it's just very hard to see how RG explanations are supposed to work for the vast majority of special science regularities. RG explanations have only been worked out for very few cases, notably the similar behavior of strikingly different systems during phase transitions. And the prospect for giving renormalization group explanations of, for example, the regularities expressed by the Lotke-Volterra equations in population ecology, seem slim at best.

In fact, Batterman (2000) accepts that there are limits to the applicability of renormalization group explanations. For example, citing Block (1997, p. 120), he asks 'how can considerations of structural stability play a role in explaining how an "and"-gate can be instanced in silicon, in hydraulics, and in cats, mice and cheese?' Batterman notes that RG explanations may not be appropriate for such cases — it doesn't seem like we can use RG explanations to explain regularities about 'and'-gates. In fact, Batterman accepts that's it's unlikely that we could use the mechanics of RG explanations to explain all high-level regularities (p.116-117). So it looks like the RG strategy can't apply to a wide enough range of cases to resolve our puzzle about high-level regularities. Rather he hopes, will use other explanatory strategies to the same end, the end of identifying the generic physical facts that make a difference to the holding of particular high-level regularities. And perhaps such other strategies will help to resolve our puzzle. But again, this hope seems rather optimistic — we have very little idea what such explanatory strategies would look like.

More importantly than this concern about optimism, though, even if we could execute this explanatory strategy for a wide range of special science regularities, there is still a sense in which it doesn't satisfyingly answer the question of why there are special science regularities at all. Again, the strategy we are considering is a piecemeal one. To execute this properly would consist in going through the special science regularities we have, one-by-one, and finding, for each one, the physical features that give rise to the regularity.

But this isn't really a satisfying explanation of why there are special science regularities at all. Consider, again, trying to explain why the coin we tossed 100 times lands heads every time. We could take a piecemeal approach and attempt to explain the regularity by separately explaining why each coin toss landed heads. That is, we could try to explain why the first coin landed heads by appealing to the way it was tossed and the physical laws, and we could do the same for the other 99 tosses. Even if we were successful in doing this, simply separately explaining each toss doesn't satisfyingly explain why all the coin tosses landed heads. In a similar way, conjoining lots of separate explanations of specific special science regularities doesn't satisfyingly explain why we are in a world which contains a mass of high-level regularities. It doesn't bring us closer to seeing how the buzzing, blooming confusion of the physical-level leads to regularity and not chaos.[4]

This kind of piecemeal, bottom-up approach, exemplified by RG explanations, is valuable and fascinating in many ways, but it doesn't seem to illuminate the core question of why there is anything except physics.

[4]Perhaps there are some cases where this strategy could result in a good explanation of why there are higher-level regularities. Perhaps if it turned out that when we separately explain all the higher-level regularities we find that the it's the same features of the physical-level that are the difference-makers for the holding of all the regularities then that might bring us close to an explanation of why we live in a world with such a mass of high-level regularities — it's because those physical-level features hold. But we have no reason to expect that such a situation would result.

4 A Top-Down Approach

4.1 Transforming the Question

I'm going to suggest a different strategy for answering the question of why there are high-level regularities. It's one that is top down and general rather than bottom-up and piecemeal.

The first part of the approach involves transforming the question of why there are high-level regularities into something that we can get more of a grip on. And the first step in this transformation is to emphasize something that is extremely familiar, but sometimes gets ignored by philosophers of science. Properties, at least on one conception of properties, are *abundant*. As well as properties like mass, and charge, and greenness, there are properties like *grue*. Grue is fairly simple to define — we do it with few problems in our undergraduate classes. But there are many, many, other properties that we can characterize via ridiculously complicated definitions with millions of conjunctions and billions of disjunctions. The question of just how many properties there are get to issues that are far away from the direction that this article is going but there is clearly *a lot*. Certainly there is an uncountable infinity of properties (there is an uncountable infinity of just length properties after all — like being 1 meter long, being π meters long, etc.).

The reason the abundance of properties is relevant to the topic of this paper is that because such abundance makes it, in one sense, extremely unsurprising that there are so many high-level regularities. There are just *so many* properties that there will be simple universal generalizations that we can state, regardless of what the world is actually like. For example, Lewis, when discussing his view of laws of nature, considers a predicate F, that holds of all and only the objects in the actual world. *Everything is F* will, then, be a very simple regularity that holds in our world. Clearly we can generate an analogous regularity for any possible world. What's more, it's extremely easy to see how to generate other true regularities in similar ways. There will be a property G such that everything in the USA is G. There will be a properties H and J such that every time a stock has property H then it had property J yesterday. If we really make use of the idea that we can define up predicates in a vast variety of different ways, with unlimited complexity, then it's easy to see that there will be get many, many regularities, no matter what the world is like.

But, of course, this isn't a satisfying answer to the question of why there are high-level regularities. Regularities like *everything is F* aren't the type that we are thinking of when we ask why the world contains higher-level regularities. The reason that we were trying to make sense of why there are higher-level regularities is as part of understanding why the special sciences exist, and regularities like *everything is F* are not the type that science investigates.

Why are such regularities not the type that gets investigated in our special sciences? Clearly the problem is with the property F. Property F seems weirdly *gerrymandered* and not *projectable*. To use the terminology most common in the metaphysics literature, property F seems *unnatural*. Let take a moment to consider the concept of naturalness in a little more detail.

4.1.1 Naturalness

It's common for metaphysicians to recognize the need for a distinction between *natural* and *unnatural* properties. The literature here largely stems from Lewis (1983). His key idea was that natural properties play a variety of important theoretical roles, to do with laws, similarity, induction, reference, causation, and so on. Scientific laws are about natural properties; sharing of natural properties is what makes for similarity between objects, and so on.

The literature that followed Lewis largely focused on fundamental physical properties and on a primitivist conception of naturalness. The natural properties (or at least, the perfectly natural properties) were taken to be things like *spin* and *charge*, and their naturalness was taken to be a basic, irreducible, fact. Call such fundamental physical natural properties *F-natural* properties.

But just as there is reason to accept such F-natural properties there is similar reason to accept a distinction between natural and unnatural *special science* properties. Just as there are certain, natural, properties that play central roles in the practice of physics so there are certain natural special science properties which play analogous roles with respect to the practice of the special sciences.

For example, it seems like there cannot be special science laws about unnatural properties. ?, p. 102 makes this point when he says: 'I take it that there is no natural law which applies to events in virtue of their being instantiations of the property *is transported to a distance of less than three miles from the Eiffel Tower*'. Similarly, such unnatural properties are not good candidates for performing inductions on. Neither do they seem to be good candidates for giving explanations of other facts we care about.

That is all to say, that it seems like some special science properties are unnatural, and because of this, our special science theorizing should not be framed in terms of those properties — such properties don't play the right roles with respect to laws, induction and explanation. [More detail here. Also maybe some note about how unnatural properties can play certain roles in out theories.]

Regularities like *everything is F* aren't the type of regularity that are investigated by the special sciences, because are F is unnatural — it doesn't play the relevant roles in our special science theorizing. So even though the abundance of properties guarantees the existence of regularities like *everything is F* that doesn't solve our problem. When we are asking why there are high-level regularities we are not asking about the totality of properties — that would make the answer too easy. We are only asking about the natural properties — the ones that can play the relevant roles in science. So the question we are interested in is why are there high-level regularities about relatively natural properties?

But now we have transformed the question in this way we can see a new way of attacking it. The concept of naturalness gives us a hook we can use to get a grip on the question. Perhaps if we give an appropriate account of special science naturalness then that will go some way to answering the question of why there are high-level regularities about natural properties, thus resolving our puzzle.

5 Regularities and Accounts of Special Science Naturalness

The first step was to transform the question we are interested in — in order to see the relevance of accounts of special science naturalness. The second step is to give an account of special science naturalness that will help us answer the question.

As I noted in the introduction, I don't have space to develop relevant accounts of special science naturalness in detail, but in this section I will gesture towards some accounts that could do the job.

There are, in fact, not many accounts of special science naturalness in the literature. I'll quickly mention a couple of accounts that don't seem to help us with the question at issue, before noting the type of account that does.

As we noted in section 4.1 the most typical approach to the naturalness of the fundamental properties is to take their naturalness as a primitive. Similarly, you might take a primitivist view of special science naturalness. Clearly such a view doesn't help to explain why there are high-level regularities about such natural properties though. The fact that some high-level properties have this primitive feature of naturalness doesn't explain why there are regularities about such properties. In fact, you might think, it just piles another mystery on top. Not only do high-level regularities arise from the buzzing, blooming confusion, but, miraculously, the properties involved in those regularities have this primitive feature of naturalness.

Perhaps the most common approach to special science naturalness is to derive from the primitive sense of naturalness had by the fundamental properties — what I've been calling F-naturalness. The basic idea is to define a notion of degree of F-naturalness that a property has. A property's degree of F-naturalness is determined by the length of its definition in terms of the perfectly natural, fundamental, properties. Shorter definitions make for more F-natural properties.[5] The special science natural properties, on this approach, are supposed to have a high degree of F-naturalness, or at least a higher degree than intuitively unnatural properties.

This account might give us hope for explaining the existence of high-level regularities about special science natural properties. If we assume that there are regularities about the F-natural properties then we might be able to argue that there will also be regularities about properties that are fairly simply defined in terms of those properties. And since the special science natural properties are ones that

[5]Perhaps additional factors are relevant for degree of F-naturalness. For example, many think that definitions that involve lots of disjunctions make for more unnatural properties than those involving lots of conjunctions, even when the definitions are the same length.

have shorter definitions in terms of the fundamental properties, *maybe* this helps us see why there are regularities about those properties.

But this hope dissipates when we focus on just how ridiculously long and complicated the definitions of the special science properties, say, for example, *inflation*, would be in terms of the fundamental properties. There is no hope, I think, of leveraging the existence of regularities about the fundamental properties into an explanation of the existence of regularities about high-level natural properties.

So what would an account of special science naturalness have to look like in order to help us answer the question? Well, if we have a reductive account of special science naturalness where part of what it is for a property to be natural is for it to be integrated with special science theorizing in the right way, then we might be able to explain why there are regularities about the high-level sciences. To put it in the bluntest way possible, if part of what it is for properties to be natural is for there to be regularities about those properties then it's not surprising that there are regularities about the natural properties.

This kind of idea, that the naturalness of a property is closely related to there being regularities about those properties, is suggested by Lewis.

> Thus my account explains…why the scientific investigation of laws and of natural properties is a package deal; why physicists posit natural properties such as the quark colours in order to posit the laws in which those properties figure, so that laws and natural properties get discovered together. (?, p.368)

One of the points that Lewis was making here is that a large part of the reason that we think certain properties are natural is because we are able to state regularities in terms of those properties and theorize effectively using those properties and regularities. Lewis was only making this point about the *epistemology* of naturalness — it's tied up with the epistemology of laws — not about what is is for something to be a law. As we noted, he was a primitivist about naturalness.

But if we are disinclined towards primitivism about special science naturalness and we are searching for a reductive account, then it looks promising to put the idea that a property being natural is closely tied to it's scientific role in formulating interesting regularities at the center of our search.

So, I'm going to sketch a couple of accounts of special science naturalness that are of this form. Again, space constraints mean that the details of these accounts will have to be left for elsewhere.

5.1 The Package Deal Account

The first such account is directly inspired by the Lewis quote above — it's the *package deal account* (PDA) of laws and natural properties that has been developed by Barry Loewer in a series of papers (??Loewer, 2020).

This account is based on the *Best System Account* (BSA) of laws of nature. The basic idea of the BSA is that the laws are propositions that are relatively simple, but also informative about the mosaic of occurrent facts. More precisely, consider sets of axioms. Some sets of axioms are informative about the mosaic – their deductive closure tells us a lot about the mosaics. Some sets of axioms are simple, in the sense of being syntactically simple when written down. The laws are the set of axioms that best balance simplicity and informativeness.

The PDA aims to adapt the BSA so that it outputs the natural properties, as well as the laws. Roughly speaking, the BSA says that the laws are the propositions that are simple and informative about the mosaic of occurrent facts. On the PDA view, roughly speaking, the natural properties are the properties that are referred to in those simple and informative propositions.

(The BSA has traditionally been developed with a focus on the laws of fundamental physics — the output of the BSA are laws like Schrödinger's equation, not biological or economic, or sociological laws. Consequently, a PDA that is based on such an account of laws will not output special science natural properties. But, there are many suggestions for how to adapt the BSA in order to capture special science laws (e.g. Schrenk (2006); Albert (2000); Loewer (2001)). So a version of the PDA that aims to output special science natural properties should be built upon such an adapted account.)

Given the PDA account of special science naturalness it's very easy to see why there are high-level about such properties — what it is for properties to be natural is for there to be sufficiently simple and informative regularities about them.[6] There is a huge amount more to say about the PDA. Properly developing the account is extremely complicated, and it's not clear whether it can succeed. (I discuss some of these issues in other work. [cite]) But it's clear how the PDA can help us implement the strategy for explaining the existence of high-level regularities.

5.2 Explanatory Clusters

Here's another account of special science naturalness that might help us, one that I've developed in other work (Bhogal, Bhogal). The basic idea is that the special science natural properties are those that form *explanatory clusters*. Roughly speaking, a set of properties forms an explanatory cluster when most of the facts about those properties are explained well by other facts about those properties.

Consider, for example, microeconomic properties. Facts about demand for goods are explained by agents' preferences; facts about certain preferences are explained by other preferences; facts about certain choices are explained by preferences and prices; facts about prices are explained by facts about demand and supply; facts about the existence of certain goods are explained by the demand for other goods; facts about the supply of goods are explained by the demand for certain factors of production; facts about the demand for factors of production are explained by the price of the goods that they are used in producing; and so on.

What we have here is a cluster of properties connected by robust explanatory patterns. The basic microeconomic properties are deeply connected and integrated. For another example consider classical genetics. *Gene*, *allele*, *trait*, *dominance* and *inheritance* are all closely connected by good explanations and will form a cluster. Further, consider population ecology and properties like *population*, *generation*, *predator*, *prey*, *carrying capacity*; and thermodynamics and properties like *temperature*, *pressure*, *entropy*.

[6] Loewer, in personal correspondence, has also suggested that the PDA could explain the existence of regularities.

In general, successful special sciences seem to come with such clusters of explanatory properties — the basic properties in terms of which explanatory theories in those domains are formulated.

Again, there is a huge amount more to say about this strategy. Saying precisely about when properties form an explanatory cluster and when they do not takes a lot of work. And arguing that this account will be extensionally adequate takes even more. Those are tasks for elsewhere [cite].

But, we can see how this account of naturalness helps answer our question. What it is for a property to be natural, on this approach, is for it to be part of robust explanatory patterns that connect it to other properties. And those explanatory patterns will be high-level regularities. To go back to the example of microeconomics, on such robust explanatory pattern is that facts about demand for goods are explained by agents' preferences. And this explanatory pattern generates high-level regularities connecting demand and preference. When properties form explanatory clusters, high-level regularities will result.

And, furthermore, it should be very unsurprising that there are such explanatory clusters. As we stressed in section 4.1, there is such an abundance of properties that it's deeply unsurprising that some will be clustered in the relevant way.

Notice that this account of naturalness helps answer the question of why there are regularities about special science natural properties for roughly the same reason as the PDA account. On both the PDA and the explanatory clustering approach properties count as natural if they play certain important roles in our scientific theorizing. On the PDA approach that's to do with those properties being part of simple ways of summarizing the world. And on the explanatory clustering approach that's to do with those properties being part of rich explanatory networks. But both these important roles in scientific theorizing imply that there are regularities about the relevant properties.

6 Objections

So that's the strategy. It's extremely simple. First, you transform the question of why there are high-level regularities to the question of why there are high-level regularities about natural properties. And second, you give an account of natural properties which builds in there being regularities about those properties.

There are, of course, reasons why someone would be doubtful of this strategy. Obviously, someone might doubt the accounts of special science naturalness that we discussed — especially since the discussion of them in this paper was so sparse. But, putting aside the specific accounts of naturalness, there are reasons why people might be doubtful of the general strategy for answering the question. In this section I'll consider a few such objections.

(1) Objection: Is this approach to answering the question *ad hoc*? Perhaps we can point to accounts of naturalness which guarantee the existence of regularities, but are these accounts well-motivated? Or are they just cooked up in order to resolve this puzzle about high-level regularities?

Response: As I just noted, there were two parts to the strategy in the paper. The first part, perhaps the more important one, is transforming the question about the existence of the special sciences into a question about naturalness. Clearly, there is no sense in which this transformation is ad hoc. But about the second part of the strategy — are the relevant accounts of special science naturalness unmotivated? When we describe the move in the bluntest way possible — saying that you should give an account of natural properties which builds in there being regularities about those properties — then it can reasonably seem ad hoc. But, such accounts of special science naturalness are independently very attractive. As we noted, on both the PDA and the explanatory clustering approach properties count as natural if they play certain important roles in our scientific theorizing about the world. Once we deny primitivism about special science naturalness then an account which looks to features of our scientific theorizing to distinguish between natural and unnatural properties becomes very attractive.

What's more, there is something slightly odd about the accusation of the that such accounts of naturalness might be just cooked up in order to resolve this puzzle about high-level regularities, because it's not clear that this is a bad thing. This existence of high-level regularities in a physical world is a deep, substantial, puzzle, and if an account of special science naturalness can help resolve this puzzle, then that's some motivation to accept the account.

(2) Objection: But aren't such accounts of special science naturalness very strange? In particular, they imply that intuitively unnatural properties count as natural in some possible worlds, because in those possible worlds such properties happen to be part of an explanatory cluster/be part of simple and informative ways of describing the world.

Response: The objector here is correct — on these approaches it is contingent which properties are natural. On the PDA which properties are natural depends upon what the best way of summarizing the facts about the world is. And this is clearly contingent. Similarly, on the explanatory clustering account which properties are natural depends upon how facts about those properties are explanatorily connected. Again, this is clearly contingent. And it likely will be the case that properties which are very unnatural in our world will count as natural on other worlds. In this way these accounts of special science naturalness differ substantially from the traditional primitivist approaches to naturalness which make facts about naturalness necessary.

But this isn't, I think, a bad result. Notice that many special science properties can seem unnatural when first introduced, and only come to seem natural once we are familiar with the theories in which they are embedded. For example, considered in itself, *gene* might seem fairly unnatural — it is only by understanding the role that *gene* plays in our theorizing, for example, by seeing how genes are related to traits organisms possess and to inheritance of those traits that we come to find the concept natural. That an intuitively unnatural property can come to seem natural at a world when we see how it is useful for theorizing at that world is, I think, not surprising.

(3) Objection: This objection is somewhat related to the last one. Let's assume that the argument does successfully establish that there we shouldn't be surprised that there are high-level regularities about relatively natural properties — even if the world was very different, there would still be high-

level regularities about natural properties. However, the argument implies that if the world were very different the natural properties would be very different.

This argument, therefore, leaves something important unexplained: Why are there regularities about the properties that are interesting or salient to us? In our world there are lots of high-level regularities and this needs explaining. But also, lots of those high-level regularities are about properties that seems relatively interesting or salient to us. And that doesn't seem to be explained by anything we have said so far — since in most worlds there will still be regularities about properties that are natural in that world, but those properties will be very strange and uninteresting to us.

Response: I'm going to give a three-fold response to this.

Firstly, the properties that we find interesting or salient are not independent of my account. Part of why we find certain properties interesting is precisely because of the features that make them count as natural on the PDA or the explanatory clustering accounts — because of the way that they play an important and useful role in our scientific theorizing. Again, *gene* is not something that we are antecedently interested in — it only becomes interesting and salient because of it's role in explaining and summarizing what we see. So it isn't surprising that the special sciences reveal regularities about interesting properties, because part of why those properties are interesting is because the special sciences have revealed regularities about them.

But surely this isn't all there is for a property to be interesting or salient to us — surely some properties are interesting prior to our theorizing. Why are there regularities about such pre-theoretically interesting properties? Well, it's not at all clear that there are many regularities about such properties. For example, *love* is particularly interesting to us, and not in a way that depends upon our scientific theorizing, but we don't seem to have stable regularities about it. (Of course, if we are sufficiently loose with what counts as a regularity, allowing enough exceptions, then we could perhaps identity some regularities about love. But the existence of such regularities would clearly not be surprising.) Similarly, I think, for other pre-theoretically interesting high-level properties.

(4) Objection: Doesn't this make the existence of higher-level regularities too easy? This approach

implies that pretty much whatever the world is like there will be higher-level regularities about relatively natural properties.

Response: This objection does worry me somewhat. Earlier I noted that it was a problem if we give an explanation that makes the existence of special science regularities too fragile and too surprising. Is it also a problem if we give an explanation that makes the existence of special science regularities too robust and unsurprising? Perhaps it is. I certainly feel the force of this thought when we are considering the question of why the world is, at the fundamental level, regular. If someone attempted to explain why the fundamental level of the world is regular in a way that implies that there would be such regularity pretty much whatever the world is like, then I would be inclined to reject this explanation. I would be inclined to think that such an explanation can't really be explaining the right thing — whatever it's explaining, it's not the intuitive notion of the world being regular at the fundamental level.

So I understand if someone feels the same with respect to the question of why there are high-level regularities. But there is a key difference, I think, one that is related to the last objection. It's common to make the realist assumption that at the fundamental level there are some basic, metaphysically privileged properties. Properties out of which the everything else is built. And when there are such metaphysically privileged properties the key question is why there are regularities about those properties. The type of strategy developed in this paper clearly cannot explain why there are regularities about some pre-identified set of metaphysically privileged properties.

However, it's also common to think that things are different at higher-levels — there are not metaphysically privileged high-level properties. And so with respect to the higher-level the key question is not whether there are regularities about some pre-selected metaphysically privileged properties, but about why there are any such regularity of the type that we see in the special sciences. And this question is, I think, more amenable to the type of explanation given here.

The question we are asking when we ask about why there are fundamental regularities is importantly different, I think, from the question we ask when we ask about why there are high-level regularities.

And this is because of the difference in the metaphysical status of the properties involved in the regularities.

Of course, people might disagree with the assumption that there are metaphysically privileged fundamental properties and that there aren't metaphysically privileged high-level properties. Clearly this is not the place to litigate those issues. But if you think that there are no metaphysically privileged fundamental properties then we may be able to explain why there are fundamental-level regularities in a way very similar to the strategy developed here.

7 Conclusion

The question of why there are special science regularities is, I've argued, intimately related to the question of what special science naturalness is. We can, therefore, attack the question of why there are such regularities via considering what naturalness is. In this paper I've outlined such a strategy.

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