* This is a draft of the first chapter of the book *Calling for Explanation* by Dan Baras that has been accepted for publication by Oxford University Press.

1 Introducing an idea: Facts that call for explanation

In this chapter, I will introduce an idea and argue that everybody should care about it. The conclusion of the book will be that everybody should forget about this same idea. You might think that this reversal makes the book a waste of your time, but please do not be tempted to toss it in the bin just yet. Getting from the starting point to the conclusion is, I believe, a journey worth making. We will examine a very common way of reasoning and become aware of its pitfalls, which could have serious implications for how we understand the world. Let's go.

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An acquaintance of mine became very religious at a certain point in his life. When asked what it was that brought about this change, he said:

> There were things that happened to me that I realized just could not be coincidences.

From this realization he drew the conclusion that God exists and intervenes in his life. Such thoughts, in one version or another, are very common. Many people believe in karma, astrology, lucky days, or lucky objects because they feel that certain events can't be coincidental. I've had such experiences myself: Once, when I presented this project at a colloquium, I arrived at the lecture hall half an hour in advance to make sure that everything was functioning properly, and I discovered that the projector wasn't working. After several failed attempts to get it to work, I went looking for the relevant administrator. She turned out to be sick that day. And at just that moment, all of the relevant secretaries happened to be out of office. As a result, we had to move to

a different room, and I started late. Then, in the middle of the lecture, security personnel came into the building and told us we had to evacuate immediately due to a suspicious object. I have been attending these colloquia for a few years, and none of this ever happened to anyone else. As irrational as I believe it to be, I found it difficult to resist the conclusion that the universe was against me or was trying to make a point. The combination of incidents seemed too much to be coincidental. I am sure that you can recall similar thoughts of your own in response to such situations. If you can, treat the discussion that follows as an attempt to analyze your own thoughts.

What precisely does this way of thinking consist in? Is it a good way to think? These are the questions that we will explore in this book.

This way of reasoning can be broken down to two steps: First, the person in question makes the claim that a particular fact has some special feature, sometimes described by saying that it is "striking" or "calls for explanation." Second, they make a certain inference about the explanation of the fact. Precisely what the inference is varies. It might be that the explanation of the fact must be of a certain type, or that the fact is unlikely to be "coincidental," or that some particular explanation must be correct. My religious acquaintance, for example, inferred from the things that seemed like they couldn't be coincidences that a providential god exists. In the example from my lecture, I inferred from the many events interfering with my talk that the universe was intentionally acting against me. My own view is that in these two examples, the inferences described, while instinctive, are irrational. Nevertheless, sometimes it is rational to believe of certain facts that they are not coincidental.

If this way of thinking only occurred in laypeople, perhaps it could be dismissed as simply another piece of human irrationality. However, it has been used by some of the

most respected and well-trained thinkers as well, including both religious people and atheists. In fact, philosophers have justified some grand conclusions using this kind of reasoning. I will explore some of them in the section that follows.

1.1 Grand conclusions

Some very influential philosophers have argued for some very grand conclusions based on the idea that certain facts call for explanation. In this section, I will describe some prominent examples of these arguments.

In his book *Universes* (1989), John Leslie explains that our universe has particular properties, without which there would be no living beings. For instance, we could not have come into existence if entropy had not been extremely low in the Big Bang, if the universe had expanded a bit more slowly after the Big Bang, if the strong force holding subatomic particles together had been a bit stronger or weaker, etc. This collection of facts is referred to as the fine-tuning of the universe for life. Based on the assumption that all of these facts represent free variables (i.e., that the strength of the strong force, the rate of expansion, etc., could have been anything and just happened to be what they are), some cosmologists have attempted to estimate the probability of life evolving in our universe. The results suggested in the literature are probabilities as low as $\frac{1}{10^{229}}$ or $\frac{1}{10^{10^{123}}}$.[1] These are very small probabilities, barely graspable. As a result, Leslie argues that the fine tuning of the universe can't be a coincidence.

[1] The first number comes from Smolin (1997, p. 64), the second from Penrose (2004, p. 729). For references to more such claims, see Friederich (2017, sec. 1).

This reasoning is used to support for the idea that the universe was intelligently designed. However, if we rule out that possibility for various reasons (chief among them being the existence of evil in our world), then we need an alternative explanation for the existence of our universe. One such explanation is that our universe is only one out of many, many other universes with different initial conditions and laws of nature, such that it is no coincidence that one such universe is fine tuned for life.[2] This theory is often called the *Multiverse Hypothesis*. Leslie contends that this hypothesis is viable and, though he remains agnostic about God, he defends the viability of a belief in a Neoplatonic god as another possible explanation for the fine-tuning of our universe. He also notes that the two possibilities are consistent, so they may both be true.

Peter van Inwagen (1993, Chapter 8)[3] and Roger White (2018) develop Leslie's style of argument into an argument for the existence of God. White summarizes his argument as follows:

> 1. If a fact *E* that we observe stands in need of explanation, hypothesis *H* provides a satisfactory explanation of *E* and one that is better than any alternative explanation available, then *E* provides significant evidential support for *H*.
>
> 2. That our universe is hospitable to life stands in need of explanation.

[2] Examples of cosmologists who develop this line of thought are Lee Smolin (1997) and Sean Carroll (2010).

[3] Van Inwagen continued to develop his argument in later editions. In those later editions it is less clear to what extent the idea of facts calling for explanation plays a role. For his most recent formulation, see van Inwagen (2015, Chapter 9).

> 3. That God adjusted the constants in order to allow for life to develop provides a satisfactory explanation for why our universe is life-permitting.
>
> 4. There is no comparably satisfying explanation of this fact available.
>
> 5. Therefore, that our universe is life-permitting provides significant evidential support for theism. (White, 2018, pp. 29–30)

The first premise of White's argument is one version of the idea that this book is about. The rest of his argument illustrates how this principle is used to derive far-reaching conclusions.

Derek Parfit has endorsed a version of Leslie's argument as well. In an article published in the *London Review of Books* (1998), Parfit more or less repeats that argument (acknowledging his debt to Leslie in a footnote), though he is more convinced than Leslie is that theism should be ruled out due to the problem of evil. Parfit argues that

> Of the range of possible initial conditions, fewer than one in a billion billion would have produced a Universe with the complexity that allows for life. If this claim is true, as I shall here assume, there is something that cries out to be explained. (Parfit, 1998)

He claims that this is a reason to believe the Multiverse Hypothesis.

Thomas Nagel entertained such thoughts as well. In *Mind and Cosmos* (2012), Nagel argues that the existence of conscious beings and of moral knowledge cannot be coincidences; they must have an explanation. However, he says that he just cannot accept the theistic explanation. Instead, he suggests that we revive an ancient Aristotelian idea that there are final causes, or *telos*, meaning that things happen in

our world not just because of prior conditions but also *for* certain ends. It's as if the universe has intentions for the future and does things to bring them about. The premise of his argument that interests us is expressed in the following passage:

> [S]ystematic features of the natural world are not coincidences, and I do not believe that we can regard them as brute facts not requiring explanation. Regularities, patterns, and functional organization call out for explanation—the more so the more frequent they are. (Nagel 2012)

These are all versions of fine-tuning arguments, arguments from the fine-tuning of our universe for life. They illustrate the grand conclusions that some defend based on the assumption that particular facts call for explanation. However, there are many other types of argument that reach similarly grand conclusions based on the same assumption.

One such argument was developed by Hartry Field in the context of philosophy of math. Field (1989, pp. 25–30) argues against mathematical Platonism—that is, the view that there are mind-independent mathematical facts. The version of this view that he targets includes a number of commitments. The first is that there are mathematical facts that are neither metaphysically grounded in nor caused by our beliefs or by any other mental states. Another commitment is that mathematical facts are not the types of entities that cause anything to occur; therefore, they do not play a causal role in shaping our mathematical beliefs. In addition, these Platonists reject skepticism and believe that humans—especially the mathematicians among us—have mathematical knowledge. Such non-skepticism implies that there is a massive correlation between our beliefs and mathematical facts. This latter commitment, Field argues, gives us reason to reject Platonism:

> [T]he correlation between mathematicians' belief states and the mathematical facts… is so striking as to demand explanation; it is not the sort of fact that is comfortably taken as brute. (Field 1989, 26)

Field argues that Platonists are committed to the existence of a striking correlation, one that there are two principled reasons to believe cannot be explained. First, we do not have at present such an explanation. Second, the supposed correlating components are causally and metaphysically independent of one another. Thus, Platonism implies that there is a striking correlation that demands explanation, but at the same time it seems to imply that no such explanation exists. This, Field argues, is a significant reason to reject Platonism.

The argument can be summarized as follows:

(1) Non skeptical mathematical Platonism implies that there is a massive correlation between our mathematical beliefs and the mind-independent, causally inefficacious mathematical facts.
(2) This massive correlation is striking, it calls for explanation.
(3) We have principled reasons to believe that if Mathematical Platonism is true then the correlation does not have the kind of explanation that is called for.
(4) If a theory implies that there is a fact that calls for explanation but the same theory implies that there are principled reasons to believe that the explanation called for does not exist, that is a reason to reject the theory in question.
(5) Therefore, we have a reason to reject non skeptical mathematical Platonism.

This argument is known as *the reliability challenge* to mathematical Platonism,[4] or *the Benacerraf-Field argument*, because Field presents it as a development of an earlier argument presented by Paul Benacerraf (1973). Field's argument is considered to be one of the most important in contemporary philosophy of mathematics, and yet one of its core premises—that there are facts that call for explanation—has surprisingly received little attention.[5]

More recently, philosophers have applied Field's argument to other theories with similar features. Sharon Street has developed a similar attack against robust moral realism, the view that there are mind-independent moral facts. Like Field's argument, her argument rests on the idea that realists are committed to a correlation between our beliefs and mind-independent truths. Street argues that such a correlation calls for explanation but that realists lack the ability to provide one:

> There is a striking coincidence between the normative judgments we human beings think are true, and the normative judgments that evolutionary forces pushed us in the direction of making. I claim that the realist about normativity owes us an explanation of this striking fact, but has none. (Street 2008)[6]

[4] Often, reliability and knowledge are thought to require a correlation across a set of close possible worlds in addition to the actual world. Field does not present it this way, however, and I will stay close to his presentation. As far as I can tell, nothing in my argument hinges on this issue.

[5] That's not to say that it hasn't received any attention at all. Within local debates, philosophers have made local remarks about whether some fact needs explaining and how it might be explained. But they do not amount to a general and comprehensive treatment of the idea that there are facts that call for explanation.

[6] The argument is further elaborated in Street (2016). In other writings (Street, 2006, 2015), she develops her argument against moral realism somewhat differently, relying less on Field's style of argument.

David Enoch (2009, 2011, Chapter 7) argues that this reliability challenge is the most troubling epistemological challenge to robust realism about normativity.

Joshua Schechter (2010, 2018) develops a similar challenge with regard to our knowledge of logic. Schechter argues that

> [O]ur possession of a reliable deductive mechanism is a striking fact. It "calls out" for explanation. Ceteris paribus, it is a cost of a theory if it treats striking phenomena… as merely accidental or otherwise unexplained. So it is a significant cost of a view if our possession of a reliable cognitive mechanism is left unexplained. (Schechter, 2010, p. 447)

Schechter is less decisive than Field and Street as to the proper conclusion of his argument. His conclusion is that something is likely wrong with the theories that yield this result—including the theory of our cognitive evolution, the view that we are reliable in logic, and the claim that we lack an explanation of our reliability in logic—but in this article, he doesn't argue that any one of these claims is more suspect than the others. Elsewhere he suggests that the theory of evolution does provide an explanation of our reliability in logic (Schechter, 2013).

Throughout this discussion, you may have noticed a certain difference between these reliability arguments and the fine-tuning arguments described earlier. Specifically, reliability arguments are typically cast as negative arguments (*against* Platonism or moral realism), whereas the fine-tuning arguments are normally presented as positive arguments (*for* a certain view, such as the existence of a god or of multiple universes). Although this difference may seem significant, however, I don't think that it is—one is just the flipside of the other. The fine-tuning arguments are as much arguments *for* theism or multiverse as they are *against* the single-undesigned-universe hypothesis.

Likewise, the reliability arguments are as much arguments *for* fictionalism and constructivism as they are arguments *against* realism. The arguments' conclusions all result from the conviction that a certain fact is unlikely to be coincidental, so we should reject theories that imply that it is and favor theories that imply that it is not.

These are not arguments that just appear out there in the literature and have no real impact. Rather, these are among the most hotly debated arguments in the relevant fields: philosophy of religion, philosophy of cosmology, philosophy of mind, philosophy of mathematics, metaethics, and philosophy of logic. And they all assume that certain facts call for explanation, precisely the assumption we will examine and challenge in what follows.

So far, all of the examples explored here address facts that are in one way or another extraordinary or remarkable, and the conclusions were all meta-physical (in the sense that they go beyond the physical—that is, they go beyond the kinds of questions that scientists normally try to answer by empirical means—rather than in the sense of the word that refers to the foundational principles of all that is physical). But these are not the only examples in the literature. Theorists who argue for these meta-physical claims often start by pointing out that the contrast appears in ordinary reasoning. For example, a seemingly ordinary coin is tossed 97 times and lands HTHTHT… (H=heads; T=tails). That sequence intuitively calls for explanation, and we should conclude that it most likely is not the result of chance. However, if a coin is tossed 97 times and lands in a random-looking sequence HHHTHTHTT… then it would not call for explanation. Note, however, that in both cases, the prior probability of the coin landing in that particular sequence is extremely low.

In another such example, you put a bunch of stones in a container and shake them around. After a few shakes, you notice that the smaller stones are at the bottom and the larger ones on top. You repeat this experiment over and over and get the same result every time. You should believe that this result is non-coincidental—that there is some nice explanation of why the smaller stones always end up in the bottom. If you had no idea what the explanation was, you should think that this fact calls for explanation. On the other hand, suppose that you look at a sandbox and notice that the grains of sand are placed in some particular way—this grain of sand is over here, and that grain of sand over there. Every sandbox is arranged in some particular way that is different from that of every other sandbox, and the same is true of the sand box in front of you. The fact that it is arranged as it is does not call for explanation. It is plausibly coincidental.

In sum, influential philosophers have argued for substantial claims based on the kind of reasoning we will explore in this book—that is, on the basis of some fact that is thought to *call for explanation*.[7] They have argued that God exists, that there exist many universes other than the one we inhabit, that science should undergo a paradigm shift and reintroduce teleological explanations, that there are no mind-independent mathematical facts, that there are no mind-independent moral facts, and that something is wrong with our understanding of our own knowledge of logic. These are very grand conclusions relying on a single kind of assumption. But are the arguments sound? What if the assumption on which they are based is false? To figure out whether that is the case, we need to understand precisely what this assumption says.

[7] There are more examples in the literature. See Bhogal (2020) for an argument against Humeanism about laws of nature; Bhogal (n.d.) for an argument against views of modality that leave modal patterns unexplained; and Berker (2018) for an argument against the existence of practical reasons for belief.

We will explore these questions in the sections that follow. First, however, we must clarify the terms that we will be using.

1.2 Facts

What kinds of things might call for explanation? For my newly religious friend and for me on the day of my presentation, what called for explanation were particular events that occurred. In fine-tuning arguments, physical constants or the initial conditions of our universe call for explanation. In reliability arguments, human knowledge of domains such as mathematics or ethics call for explanation. And as we will see below, and in more detail in Chapter 3, mathematical theorems can also call for explanation as well. We should use language in a way that allows for all of these possibilities. Therefore, in this book I will talk about *facts* that call for explanation.

"Facts" seems to me a more inclusive term than "occurrences," "events," "states of affairs," or "phenomena," all of which appear in previous literature as the term used to describe that which calls for explanation. Such terms are not always appropriate—it does not seem appropriate, for example, to call mathematical facts "events" or "states of affairs." In contrast, for every event that actually occurred, it does seem right to say that it is a *fact* that the event occurred. Furthermore, the explanation of the event is identical to the *e*xplanation of the fact that the event occurred. It also seems right to say of any state of affairs that obtains that it is a *fact* that the state of affairs obtains. Furthermore, the explanation of why the state of affairs obtains is identical to the explanation of the fact that the state of affairs obtains. And it also seems right to say that, as a matter of *fact*, something appears one way or another (which is one way of using the term "phenomenon"). Furthermore, the explanation of why something

appears some way is identical to the explanation of the fact that it appears as it does. Therefore, I will refer to all of the things that can call for explanation as *facts*.[8]

There are, of course, different views about what precisely facts are. As I'm using the term, every true proposition corresponds to a fact. However, I am hesitant to say that the proposition *just is* the fact because a proposition is an abstract entity. Propositions are the meanings of certain sentences (the sentences that can be true or false) or the thoughts or contents expressed by such sentences. I don't think the *thoughts* are what call out for explanation; rather, it is the *facts* that correspond to those propositions—or the facts that make those propositions true—that need explaining.

To help illustrate what I mean, here's a sentence in English: "Whenever I press a certain button in my office, the light in my office turns on." Here's another sentence in English: "The light turns on in my office whenever I press a certain button." Although these are two different sentences, they express the same proposition. However, what might call out for explanation is not the proposition—rather, what might call out for explanation is *the fact that* the light turns on in my office whenever I press a certain button.

On my use, "the fact that" is a hyperintensional expression. Two facts can be distinct even if there is no possible world in which one holds and the other does not. For example, the fact that 2 + 2 = 4 is distinct from the fact that 1/89=0.01 + 0.001 + 0.0002 + 0.00003 + 0.000005 + 0.0000008… (keep adding a 0 and the next number in the Fibonacci sequence). The former doesn't call for explanation in the way that the latter does—even though both are necessary truths, true in all possible worlds.

[8] I did not do so in some of my previous work. I have since realized that this was a mistake.

What precisely it means for something to be a fact, though, is not the topic of this book, nor is anything here dependent on my way of using this term—my intention is simply to explain what I mean when I use it. Throughout this book the explananda will be facts. If you have a different theory of facts, such that this use of the term would not satisfy you, you are welcome to mentally replace it with whatever you see as more fit for the task.

1.3 Disambiguation

The term "calling for explanation" and correlates such as "needs explanation" or "cries for explanation" are used in more than one way. When people say that a certain fact calls for explanation or that a certain hypothesis would call for explanation if it were true, sometimes they are referring to a psychological phenomenon. These people mean that a certain fact gives rise to a feeling of curiosity or an interest in discovering an explanation for it.[9] Who is it that becomes curious about the explanation of some fact? Perhaps the curious party is simply the speaker, though I suspect that it is typically meant to be a claim about a broader group of people, like scientists in a certain field. Suppose *E* (as in *explanandum*) is one such fact. The first psychological meaning of "*E* calls for explanation" is:

(1) *Psychological sense (descriptive)*: *E* gives rise to a sense of curiosity and interest in discovering what the explanation of *E* is.

As this psychological sense of calling for explanation has been stated, it is a descriptive claim about whether *E* actually gives rise to curiosity. But this is not the

[9] Example: Grimm's (2008) discussion of facts that need explanation focuses on this sense of curiosity. Liquin and Lombrozo (2020) present empirical work on this kind of curiosity, which they call explanation-seeking-curiosity.

only psychological sense of calling for explanation. Another, which is not about when *E actually* gives rise to curiosity, is about when *E ought* (broadly speaking) to make one curious. There are different kinds of normativity associated with such affects, and one that has been widely discussed recently focuses on when and why such attitudes are *fitting* (D'Arms & Jacobson, 2000). This yields the following sense of calling for explanation:

(2) *Psychological sense (normative)*: It is fitting to be curious and interested in discovering an explanation for *E* (perhaps a certain kind of explanation).

Both senses of calling for explanation might vary significantly from one person to another, though in different ways. People's actual dispositions vary, so it's clear how actual psychological attitudes might vary from one person to another. The fittingness version, however, is normative, and to the extent that norms can be objective, the fittingness of curiosity might be as well. Still, all should agree that the fittingness of attitudes tends to be context sensitive, so at the very least they are sensitive to one's evidential state; they are often also sensitive to one's goals.

Normally, there is an epistemic precondition to having fitting curiosity. The precondition is that at present one does not possess (i.e., justifiably believe) an explanation for the given fact consistent with one's background assumptions about the world. Let us call this set of background assumptions *A*. Sometimes when people say that fact *E* calls for explanation, they mean to imply that

(3) *Privative explanatory sense*: Given a set of background assumptions about the world *A*, we currently lack an explanation for *E*.

Other times, people imply more than just that we lack an explanation. "*E* calls for explanation" can also be used to imply the following:

(4) *Practical sense*: Given a set of background assumptions about the world *A*, we have reason to seek an explanation for *E*.[10]

Of course, in order for you to have some reason to invest in discovering the explanation for some fact, you need to have reason to believe that you have some chance of succeeding. But that is a relatively low bar to clear.[11]

None of these senses or implications of calling for explanation would fit as a premise in the fine-tuning and reliability arguments presented above (§1.1). In these arguments, claiming that a fact calls for explanation amounts to a claim with a more salient epistemic significance. That a fact calls for explanation is used to confirm or disconfirm theories. When these philosophers say that *E* calls for explanation, they are implying the following kind of claim:

(5) *Epistemic sense*: We have an epistemic reason to believe that *E* has a special kind of explanation.

Why special, and what does that mean? We will get to those questions shortly. For the moment, simply note that when calling for explanation is used in this last way, it is

[10] Example: Wong and Yudell (2015) seem to use "need for explanation" in this sense, since they conceive of it as a reason for *action*.

[11] Later in this book, I discuss William D'Alessandro's (2020) recent in-depth case study of a theorem in mathematics that is thought by mathematicians to call for explanation. He takes as a sign for calling for explanation the fact that ever since the theorem was discovered in the 18th century, mathematicians have searched for new proofs with the hope of finding more illuminating proofs. What is not clear from the discussion is precisely what those mathematicians thought. Did they think they had reason to expect an explanation of a certain type? Or, without having expectations one way or another, did they try to find such an explanation because if they would discover such an explanation, it would be illuminating?

used as a reason to reject theories that imply that *E* does not have the *relevant* kind of explanation.

It is only this last sense of calls for explanation that can justify the inferences that interest us in this book. When Leslie, White, and Parfit argue that the fine-tuning of our universe calls for explanation, they use that argument to reject the theory that says that there exists only a single universe and that it came about by chance. When Field, Street, and Schechter argue that our knowledge of mathematics, morality, and logic calls for explanation, they are using that assumption to argue against realist theories that seem to imply that our knowledge is coincidental.

To clarify, I do not mean to say that these authors use the term "calls for explanation" such that it just means what *epistemic sense* says. Suppose we knew for certain that a particular fact had a special explanation, and we knew what that explanation was—it would seem weird to say that that fact calls for explanation. At least typically, people don't use the term "calls for explanation" to describe facts for which they have the explanation, even when they have reason to believe that those facts have a *special* explanation.[12] Whether this is a matter of pragmatics or semantics and what exactly governs the use of "calling for explanation" are questions I will return to later in the book (Chapter 6). All I want to claim here is that whatever else calling for explanation might imply, what is important for the arguments I am interested in is a claim of the kind described by *reason for belief*.

[12] However, I have come across people with different linguistic intuitions about this. Taking a firm stand on whether a fact for which we know an explanation "calls for explanation" will not be essential to any of my arguments.

In some examples, several of the meanings (1–5) apply. For example, imagine a coin that is tossed many times and lands consistently in the alternating sequence HTHTHT… The result would likely give rise to emotions of curiosity and surprise, and fittingly so. We would also not know what the explanation is for this occurrence, and we would have reason to seek such an explanation. Finally, we should infer that the fact that the coin landed in this sequence is not coincidental. There is a special explanation for why it landed thus, perhaps some mechanism that, on each toss, makes it land on the opposite side of the previous toss. This is an example of a fact that would call for explanation in all of the aforementioned senses of the phrase—and examples like this might be partly responsible for blurring the distinctions between them. However, the different meanings of calling for explanation are logically independent, and, as I will shortly illustrate, there are cases in which only some of them apply. It is therefore important to distinguish between them.

The lack of clarity in what sense of the term is being used has led to confusion. A noteworthy example appears in the philosophy of physics, where there is a longstanding debate about whether a hypothesized past state of the universe calls for explanation. Huw Price has long argued that it does; Craig Callender argues that it doesn't. Upon examination, however, it turns out that they are actually talking past each other rather than disagreeing. Their views turn out to be compatible—they are just using "calling for explanation" in different ways.[13]

To explain this debate more fully, here is some background: The second law of thermodynamics says that the entropy (roughly, the degree of orderliness) of a closed

[13] My analysis of the Price-Callender debate is based on joint work with Orly Shenker (Baras & Shenker, 2020). There, we provide more background and also use our insights to examine some of the arguments provided by different sides of the debate.

system will always increase until it reaches equilibrium. This law turns out not to be a fundamental law of nature but is explained by statistical mechanics as a statistical regularity. To explain the current non-equilibrium state of our universe, physicists have thought it necessary to hypothesize that in the distant past—perhaps at the universe's beginning—our universe was at a much lower level of entropy than it currently is in (and its current state is already low). The same probability measures from statistical mechanics that are used to explain why entropy tends to increase imply that that past state of low entropy is exceedingly improbable. This hypothesis is often called the *Past Hypothesis*, and the state that it posits is referred to as the *Past State*. The question is whether the fact that our universe was in such an exceedingly low level of entropy—especially considering how improbable it is—is a fact that *calls for explanation*.

In his book entitled *Time's Arrow and Archimedes' Point* (1997, pp. 22–48), Price started advocating the view that the Past State needs explanation. His main claim there is that we *lack an explanation* for the Past State. At the end of the book, he summarizes his view contrastively: "What needs to be explained is the low-entropy past, not the high-entropy future" (p. 262). Why, in his view, does the low-entropy past need explanation but not the high-entropy future? As his argument makes clear, the fact that entropy was low in the past is the fact that we lack an explanation for, whereas the fact that entropy has been increasing ever since is (assumed to be) well-explained by statistical mechanics.

Consider now a quote from Price's later article. Price explains that the past state of low entropy should be equated with the smoothness of the universe shortly after the Big Bang (Price, 2002, p. 114). Then he argues:

> Initial smoothness calls for explanation…Would it really be plausible to suggest that physicists should sit on their hands and not even *try* to explain it?... [T]he issue is whether it is appropriate to try. (Price 2002, 115)[14]

The claim presented here is a practical one: It is worthwhile for physicists to try to come up with an explanation of the Past State, and they should devote their time and other resources to this project.[15]

Callender never disputes that we lack an explanation for the past state, nor does he dispute that it may be worth trying to devise one. Consider the following quote from Callender, in which he compares the case of the Past Hypothesis with a case concerning the standard model in particle physics. As Callender describes it, some physicists feel that certain elements of the "standard model" are ad-hoc, and there is an ongoing debate on whether these elements should be endorsed as "brute facts" or whether they call for explanation:

> [As with the Past Hypothesis] it seems to me that it's perfectly within the rights of the physicist to find something ugly about the standard model and want to devise an alternative without so many knobs. When that alternative exists and is shown to be empirically adequate, we can then compare the two. It may well be that it is superior in various empirical (one would hope) and theoretical ways. (Callender 2004b, 248)

[14] Price (2004, 230) repeats this claim using similar wording.

[15] Note that this was probably what Price intended to imply in the 1997 book as well, although he is not explicit there. Otherwise, what is the point of his argument that the Past State is currently unexplained?

Although Callender clearly claims that we don't know in advance whether the Past State has an explanation, he concedes that it is possible that physicists will be able to either come up with such an explanation or devise a better theory without the Past Hypothesis. That means that he believes that it is possible that the Past State has an explanation and that it is possible that we will discover the explanation. He doesn't go so far as to say that it is a worthwhile project to try to discover this explanation, but once he made the other two concessions, it is difficult to reject the claim that it is worth the effort.

Then in what sense does Callender argue that the Past State *does not* call for explanation? Callender summarizes his view thus, in his abstract:

> For the generalizations of thermodynamics to obtain, it appears that a very 'special' initial condition of the universe is required. Is this initial condition itself in need of explanation? I argue that it is not… I urge the view that it is not always a serious mark against a theory that it must posit an 'improbable' initial condition. (Callender 2004a, 195)

The quote suggests that Callender's imagined interlocutor believes that it counts against a theory if it includes the Past Hypothesis and implies that the Past State is a brute fact. Interestingly, however, even though Callender's articles are presented as responding to Price, Price, to the best of my knowledge, nowhere endorses the view against which Callender is arguing. Callender's claim is that the Past State *does not* give us reason to reject theories that leave it unexplained, a claim that Price might agree with.

The lesson to be learned from this section is that people use the term "calls for explanation" and its cognates to express a variety of claims, but not all of those claims

are the subject of this book. Here we are interested in a very particular kind of claim: the claim that a certain fact is unlikely to be the result of coincidence,[16] and that this is a reason to reject background theories that imply the contrary.

1.4 An intermediate view that everybody should accept

The view we are exploring contains a background assumption: that there are certain facts that call for explanation and other facts that do not call for explanation. And for this view to do any epistemic work, a further assumption is needed: that at least sometimes we can identify which is which. This view can be understood as an intermediate view between two extremes, one of which is the view that *all* facts call for explanation and the other of which is that *no* facts call for explanation. In a related discussion, Robert Nozick (1981, p. 121) helpfully distinguishes between egalitarian and inegalitarian theories of what requires explanation. The two extreme views just presented are egalitarian in the sense that they treat all facts alike, whereas the intermediate view—that some facts call for explanation and some do not—is inegalitarian. The egalitarianism of the extreme views is an attractive feature of those views, and a pertinent challenge to the inegalitarian view asks why it does not treat all facts alike. That is, why, in that view, do some facts call for explanation and others do not?[17]

A nice illustration of each of these three views is presented by considering the existence of our universe. Does the existence of our universe call for explanation? One view is that no matter what the universe is or could be like, its existence would

[16] To be clear, "result of coincidence" is a somewhat figurative way of talking. It is not meant to imply that *coincidence* can be a *cause* of events.

[17] See Della Rocca (2010) for a related argument for the principle of sufficient reason (PSR). I will discuss the PSR shortly.

call for explanation. Cosmological arguments for the existence of God seem to assume as much (though I will soon qualify this claim). These arguments say that the mere fact that a universe exists is unlikely to be unexplainable, and that this is a reason to believe that God exists. On the other extreme lies the view that the existence of our universe, no matter what its features are, does not call for explanation. According to this view, no matter how special our universe may be, the fact that it exists is no reason to posit God or anything else to explain it. These are the two extreme—and egalitarian—views.

The intermediate view is the one that motivates fine-tuning arguments. Fine-tuning arguments are premised on the idea that there is something very special about our universe, such as that it is fine-tuned for the emergence of life. Different versions focus on slightly different special features of our universe, such as the existence of planets or the existence of conscious beings. The basic idea, however, is the same: They say that because our universe is fine-tuned, we should believe that its existence is non-coincidental, and as a result they posit the existence of God or of multiple universes. If it were not fine-tuned, we would not be theoretically forced to make such an inference.

Having outlined the extreme and the intermediate views, I have to address whether anybody actually accepts the egalitarian views. I used to think that I could list adherents of each one of the extreme views,[18] but now I believe that doing so is a

[18] I considered adherents of the Principle of Sufficient reason as adherents of the view that all facts call for explanation. I will explain shortly why doing so is a mistake. I also interpreted the skeptical claims of Callender (2004), Gould (1985, 395), Scriven (1966, 129), and Shanks (2004, 216) (I thank Neil Manson for most of these references) about fine-tuning arguments as implying the view that no facts call for explanation. The reasons I will cite shortly to think that nobody should accept such an extreme view have made me reread these texts and realize that the claims of these authors are either too vague

mistake. Working through my mistakes will be instructive and help us understand the theoretical terrain more clearly.

Let's start with the extreme view that all facts call for explanation: This view seems, at first, similar to the view known as the principle of sufficient reason (PSR), which says that everything that exists has an explanation (i.e., a sufficient reason) for its existence. The principle of sufficient reason is most famously associated with Leibniz, although it has had earlier adherents (Melamed & Lin, 2016). One known problem with the PSR is that it entails an infinite explanatory regress. You can't just posit, for instance, that God created our universe and then you're done. The existence of God itself must have an explanation, and that explanation will itself require an explanation, and so on, ad infinitum. Leibniz and others have their responses, such as that God is somehow self-explanatory (what explains the existence of God? The existence of God. What then explains the existence of God? Again, the existence of God. And so on), and that seems to appease some people. Nowadays, the PSR has for the most part fallen out of fashion, but it nevertheless has had a bit of a revival. Recent proponents of the principle of sufficient reason include Michael Della Rocca (2010) and Alexander Pruss (2006).

(As a side note, personally, I do not find the PSR compelling. Leibniz seemed to have thought that the PSR was just obvious, whereas to me it seems obvious that there must be some brute facts. However, it is difficult to argue about what seems obvious because the answer is subjective. All I can do is report what seems obvious to me and let you judge for yourself what seems obvious to you.)

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or too specifically about fine-tuning to infer from them any general view about whether any facts call for explanation.

Be that as it may, contrary to its initial appearance as similar to the extreme view that all facts call for explanation, the PSR might actually be compatible with the "intermediate" view examined here. Why? Because the PSR says that everything has *an* explanation, but it doesn't say that everything must have some *particular kind* of explanation. True, proponents of the intermediate view typically do not explain what kind of explanation is called for when a fact calls for explanation. However, they motivate their view using examples, and those examples suggest that they have in mind something different from what PSR proponents have in mind, as I will now illustrate.

Let us consider a paradigmatic example, which adherents of the intermediate view would consider as not calling for explanation; we will then consider whether the PSR conflicts with their judgment. Suppose that a coin is tossed many times and lands in a random-looking sequence, such as HTTTTHTTHHHHHTTHTT… Proponents of the intermediate view say that this kind of fact does not call for explanation, whereas the PSR implies that it has an explanation. So far so good. Suppose the following kind of explanation was considered: The coin was tossed the first time at a particular velocity v_1 from a particular position p_1, and, given the laws of mechanics and the structure of the surrounding space, it landed heads. On the second toss, it was tossed at velocity v_2 from position p_2, so, given the laws of mechanics and the structure of the space, it landed tails. And so on for each of the remaining tosses. Let us call this kind of explanation a highly conjunctive explanation, because it is a conjunction of many seemingly independent facts. Now we should ask: When PSR theorists say that everything has an explanation, would this sort of conjunctive explanation count? And when people who endorse the intermediate view say that the sequence does not call for explanation, did they not expect that this sort of conjunctive explanation would be

available? One natural answer to the latter question is that when people say that the sequence calls for explanation, they are not referring to this kind of explanation. This highly conjunctive explanation would still imply that the sequence is coincidental in the relevant sense.

In other words, when people say that some facts call for explanation, they don't mean just any kind of explanation—they mean some *special* kind of explanation. In Chapter 4, we will explore this thought in depth and seek out an account for the relevant special kind of explanation. Additionally, it may be that when PSR says that everything has an explanation, it should be understood as saying that everything has some explanation or other, not necessarily a *special* explanation. According to these interpretations, then, the PSR is compatible with the view that there are some facts that don't call for explanation. A PSR theorist can consistently believe that everything has an explanation and that some things have *special* explanations. According to this view, we should believe that every fact has some explanation or other and that only some facts have a special explanation.[19]

How about the view that *nothing* calls for explanation? On a plausible interpretation, this would amount to the claim that we never have reason to believe that some fact or

[19] Michael Friedman might seem to endorse the view that all facts call for explanation, when he says that "all phenomena, from the commonest everyday event to the most abstract processes of modern physics, are equally in need of explanation" (Friedman, 1974, p. 13). However, the context is not calling for explanation in the epistemic sense we focus on in this book. Friedman is concerned with the question of what makes something a scientific explanation. In this passage, he's arguing against the view that "the phenomenon doing the explaining must [be]… self-explanatory or natural. Such phenomena need no explanation; they represent ideals of intelligibility. Explanation…consists in relating other phenomena to such ideals of intelligibility" (Friedman, 1974, pp. 11–12). It is an interesting question precisely what the relationship might be between this debate about what constitutes an explanation and our question here about certain inferences.

other has a special explanation. This is a view that nobody should endorse. Everybody should accept that we can have some evidence that some fact or other has a special explanation. Here's an example: You're walking around campus and see students gathering at a certain location. You wonder, is it a coincidence that students are gathering there, or is there some special explanation for that fact? You ask a friend, who tells you that there's a special explanation, and presumably she knows what's going on. In such a situation, who could deny that you have a reason—namely, your friend's testimony—to believe that the fact that the students are gathering has a special explanation?[20]

Here's another example: Suppose I'm showing you some magic tricks. I pull out a deck of cards and let you pick any card you like. You pick the ace of hearts. Then I ask you to return the card to the deck, and I shuffle the deck a few times, throw the deck on the ground, and keep one card in my hand—the ace of hearts. Should you believe that the fact that the card in my hand is the one you chose at the beginning is non-coincidental? Of course you should. You should believe that the magician somehow manipulated the cards. Furthermore, it seems more like the kind of explanation we would expect of facts that call for explanation than like a highly conjunctive physical explanation. And in the context of a magic show, who could deny such a claim? Nobody should accept the view that there can't be *any reasons* to believe that some fact has a special explanation. Thus, everybody should accept the

[20] You might object that in the example it seems unnatural to think of the fact as calling for explanation. If so, one might claim that what this example really illustrates is that calling for explanation doesn't just mean having reason to believe that a fact has a special explanation, and one can have reason to expect a special explanation for a fact that doesn't call for explanation. I actually believe there is something to this objection. However, for now, I'll have to keep you in suspense until Section 6.1.3, where I argue that the intuition grounding this objection fits well with the view I develop there.

intermediate view. And in that case, then in this book we are exploring a view that nobody should reject.

That isn't to say that nothing here is or can reasonably be in dispute. What might be disputed is what kinds of good reasons there are to believe that certain facts have special explanations, and what sorts of special explanations we have reason to expect in such cases. Perhaps there are some kinds of reasons that some people believe to be good ones, and others disagree. In fact, authors who at first glance seem to hold the view that nothing calls for explanation are often actually making claims about *particular kinds of reasons* that, in their view, aren't *good* reasons to believe that a given fact is non-coincidental. For the remainder of this section, we will examine two such kinds of reasons.

1.4.1 A priori calling for explanation

The first of these is a priori reasons—that is, reasons based solely on thinking, without supporting observations. There might be dispute about whether you can ever have a priori justification to believe that a purported fact calls for explanation.[21] There are some general disputes about a priori justification, and of course anyone who doubts our ability to have *any* a priori justification should also doubt that we can be justified a priori in believing that some purported fact calls for explanation. However, suppose we assume that we *can* have some a priori justification, and then we ask whether there can be a priori reason to believe that a purported fact calls for explanation. To answer this question, consider mathematical beliefs, which are commonly thought to be paradigms of a priori justified beliefs. If this description of such beliefs is accurate,

[21] For a related point with references, see Nozick (1981, p. 121) about whether we can know a priori which is the "natural fact" that doesn't require explanation.

then given that mathematical facts can call for explanation (see Section 3.3 for examples), there should be no further dispute about whether it is possible to be justified a priori in believing of a fact that it calls for explanation.

Further, I argue that this reasoning applies not only to mathematical facts but to other kinds as well. For example, it seems in principle possible to justify a priori a hypothetical claim about a fact calling for explanation. It's true that for any empirical fact—say, the fact that when you put ice in warm water, the ice will melt—you obviously can't a priori justify the belief that there is a fact f that calls for explanation because you can't a priori justify the belief that f is the case. You must first *observe* ice melting in warm water (possibly even more than once) in order to be justified in believing that the fact that ice melts in warm water must have a certain kind of explanation. Even if you never observed ice melting in warm water, however, you can be justified in believing that <were ice to melt in warm water, that would be a fact that would call for explanation>. Now it might be true that whether ice melting in warm water calls for explanation depends partly on certain background information. That, too, can be built into an a priori hypothetical: You would still be justified in believing a priori that were you to have the relevant background information and were you to know that ice melted in warm water, you should believe that it calls for explanation. More generally, we can be justified a priori in believing of *hypothetical* empirical facts that they would hypothetically call for explanation. For any fact that would call for explanation, if we were justified in believing that it was a fact, then we should be justified in believing a priori that it would call for explanation if it were a fact and if we had all the evidence that we actually have. That hypothetical empirical facts can hypothetically call for explanation is a second reason to think that facts can call for explanation a priori.

1.4.2 Isolated calling for explanation

The second possible disagreement about reasons for calling for explanation is whether facts can ever call for explanation in isolation, that is, independently of background information. Roger White thinks that a question like this was a matter of dispute between David Hume and William Paley, both of whom famously develop teleological arguments for the existence of God. Having developed his argument, Hume then criticizes it, and some think that Paley, in developing his own version, was trying to avoid Hume's critique.

Paley (1802, p. 1) has us consider what we should believe were we to find a watch in a heath and Hume (1779, Chapter 2) considers similar examples. The two authors agree that in such a case, you should conclude that the watch did not just appear there fully formed without a designer. But why should we make this inference? White thinks there is a disagreement here between Hume and Paley. According to Hume, what justifies the inference is the fact that the watch in the heath is similar to many other watches we have observed or heard about, and we know that those other watches were intentionally crafted—thus, we infer that this watch, too, was intentionally crafted. Paley is less clear about the justification for this inference, which opens the door to speculation about his way of justifying it. White speculates that "[a]ccording to Paley, even someone who had never seen a piece of machinery even remotely like a watch could rationally judge that the watch had a designer" (White, 2014, p. 306). Setting aside Paley's theistic conclusion, we can wonder whether a watch in a heath would call for explanation even if we had no prior information about any piece of machinery like a watch. White thinks that it would—and attributes this view to Paley. Hume, however, does not.

Let us think a bit more about the Paley–White view that, sometimes, whether a fact calls for explanation can be determined by the fact itself in isolation. The view, to be even initially attractive, needs some qualification: If we know the explanation for a fact, then it seems wrong to say that it calls for explanation. But whether *we* know the explanation is about *us*, not about the fact. Therefore, there is an obvious sense in which whether a fact calls for explanation *always* depends on background information. However, this really is an unimportant quibble. One way to get around it is to say that what we're interested in is whether there are ever facts for which we have an initial pro tanto reason to believe that they have a special explanation. Such a pro tanto reason can be outweighed or screened off, such as when we have overwhelming reasons to believe of a certain explanation that it is true. If that certain explanation is not a special explanation, but being outweighed or screened off doesn't mean that the pro tanto reason doesn't exist.[22] It's true that in such a case, we wouldn't say that the fact calls for explanation, but we're not interested here in what we would say. What we are exploring in this book is a certain kind of reason for belief, and such a reason can exist even when it is outweighed or screened off.

Are there other problems with the Paley–White view? I once thought I had a good argument against it. I now believe it can be resisted. Let's work through that argument. Consider a paradigmatic example of a fact that would not call for explanation: A die is tossed a number of times and lands 42321261124654416224. For any such case, it seems that we can imagine circumstances in which the same fact

[22] If the explanation that we have overwhelming reason to believe is not a special explanation, then whatever pro tanto reason we had to believe that there is a special explanation is outweighed. If however the explanation we should believe is of the special kind, the pro tanto reason isn't outweighed. Instead, it just becomes insignificant or screened off in the sense that even without it we would have come to the same conclusion, so it might no longer seem worth mentioning.

would call for explanation. For example, suppose that a few minutes before tossing the dice, I wrote in my notebook "42321261124654416224". Then I toss the die, and lo and behold, it lands 42321261124654416224. Now it seems that the same fact—that a die landed 42321261124654416224—would call for explanation, and this is partly in virtue of a *different* fact—that I wrote this same number in my notebook a few moments earlier. The example seems generalizable. That is, it seems that for any purported fact that would not call for explanation in some circumstance, I can think of a different circumstance in which the same fact would call for explanation. And this seemed to me to support the view that whether a fact calls for explanation is always partly determined by background facts.

However, this argument fails for two reasons. First, what such examples demonstrate at most is that facts that in themselves would not call for explanation can call for explanation in conjunction with other facts. The examples do not show that there are no cases in which a fact *does* call for explanation in isolation. What we would need in order to demonstrate the latter claim is a generalizable example in the other direction—that is, a fact that seems to call for explanation, but when we subtract certain background facts, it no longer does so. The second reason that this argument fails is that there is an alternative and appealing way to describe what it is that calls for explanation in the second scenario: What calls for explanation is *not* the fact that a die landed 42321261124654416224 but rather the fact that a die landed in the exact same long and random-looking sequence as was written earlier in a notebook. This is

a different fact. And it is a fact that requires a separate argument to show that it doesn't call for explanation in isolation.[23]

Take, then, a paradigmatic fact that *does* call for explanation—say, a die landing 123456123456. Would it call for explanation if this were the only fact we knew? The more I think about what it would involve to have this be the only fact we knew, the more it seems to me that the fact itself would not call for explanation. It would have to be a scenario in which you had no basic experience of the laws of physics, no idea about how dice normally fall, and no idea even that anything falls or what falling is.[24] This is a difficult and perhaps even impossible scenario to imagine. We have never in our lives found ourselves knowing so little that we have too little experience to draw upon when trying to imagine this scenario. And this leads me to two conclusions regarding the Paley-White view. First, we do not have any good reason, as far as intuitions about examples go, to believe that facts can call for explanation in isolation. Second, in practice, our reasoning is never conducted in isolation. It therefore does not seem to matter to our actual reasoning whether facts can call for explanation in isolation.

The conclusion of this subsection is that the intermediate view, that some facts call for explanation and some do not, is a view that everybody should accept. We examined two possibilities for disagreement about what kinds of reasons there are for facts to call for explanation, a priori reasons and isolated reasons. I argued that there should

[23] I thank Oded Na'aman and others for pressing me with this challenge a few times until I finally decided that they might be right.

[24] Would you know that these are consecutive numbers? If not, surely it wouldn't call for explanation. I believe, though, that the fact that these are consecutive numbers should be thought of as part of the fact—that is, part of what calls for explanation.

not be much disagreement about them either. If there are any a priori reasons for belief, then there are also a priori reason to believe that facts call for explanation. And we lack any reason to think that facts call for explanation in isolation.

1.5 A naïve picture and a project

Let us recap what we have learned in this chapter. The thought that some facts call for explanation is a common one, and it plays a role in important philosophical arguments. For example, it is used to reject mathematical Platonism and moral realism, as well as to support theism and multiverse theories. In these contexts, the term "calls for explanation" is used to make the claim that we have reason to believe that a certain fact has a special kind of explanation. I then argued that everyone should accept the view that some facts call for explanation.

This idea can be formulated as a principle, which serves as a premise in arguments of the style described in this chapter. For ease of reference, it will be helpful to give the principle a name. I will therefore call it *the striking principle*. The reason is that the idea that when facts call for explanation is sometimes expressed by saying that those facts are "striking."[25] The striking principle consists of two claims:

(1) There is a property that some facts have more than others, *strikingness*, which determines the fact's degree of calling for explanation.

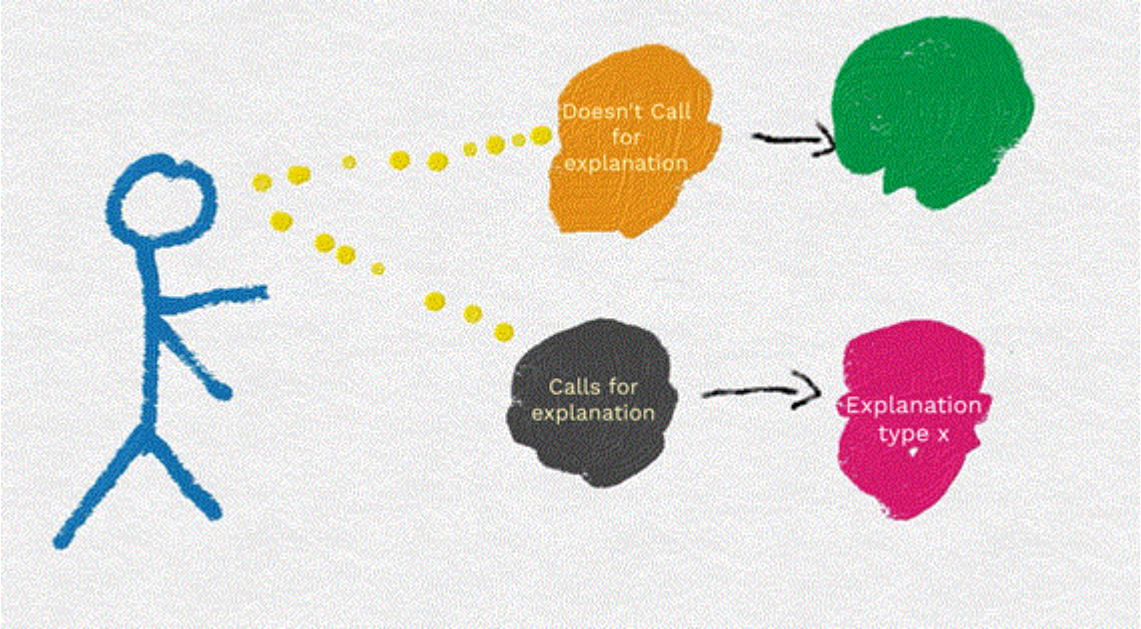
(2) To the extent that a purported fact *E* is striking, we have reason to believe that it has an *explanation of a special kind*.

The striking principle appeals to a property, "strikingness," that some facts have and to an "explanation of a special kind." These terms are place holders that a theory of

[25] Another reason is that I find the principle itself a bit striking.

calling for explanation will have to define. That is, we want to know in virtue of which property facts call for explanation and, when they do so, precisely what kind of explanation do they call for.

We will explore this way of thinking about calling for explanation in the next few chapters. It is represented in the following picture:



The blue person is us, looking around and noticing properties of various facts, represented by the blobs of paint. Some facts have the property of calling for explanation and some do not. It is as if facts are painted by different colors—those painted black call for explanation, and those painted orange do not. When we come across a fact that calls for explanation, we infer that it probably has another property, namely that its explanation must be of a special kind; for other facts, we make no such inference. The black arrows represent the striking principle, which is the rule of inference that allows us to infer from a striking fact that there is a special explanation.

I call this way of thinking the *naïve picture*. It is a way of thinking rather than a thesis because so long as no definition is provided for "striking" and "special explanation,"

it lacks enough substance to rule in or out any particular instances of reasoning. Indeed, as I explain in the beginning of Chapter 3, there is a way of filling in the details that makes the principle trivial. Thus, what we have here is not a substantive thesis, but rather a certain way to approach our topic—a scheme waiting to be filled in.

This picture—this way of thinking—suggests a philosophical project, which is to figure out three things. First, what is the property of strikingness? Second, what is the special kind of explanation that we should expect striking facts to have? Third, what is the nature of the striking principle that connects the two? We will engage with the first two questions in Chapters 3 and 4 and with the third in Chapters 2 and 5. Ultimately, the project reaches a dead end, which suggests that there should be a different way of thinking about calling for explanation. That's why I call the initial picture naïve—it is naïve in comparison to a better alternative, developed in the concluding chapter of this book (Chapter 6).

References

Baras, D., & Shenker, O. (2020). Calling for explanation: the case of the thermodynamic past state. *European Journal for Philosophy of Science*, *10*(3), 36. https://doi.org/10.1007/s13194-020-00297-7

Benacerraf, P. (1973). Mathematical Truth. *The Journal of Philosophy*, *70*(19), 661–679. https://doi.org/10.2307/2025075

Berker, S. (2018). A Combinatorial Argument against Practical Reasons for Belief. *Analytic Philosophy*, *59*(4), 427–470. https://doi.org/10.1111/phib.12140

Bhogal, H. (n.d.). *On Unexplained (Modal) Patterns*.

Bhogal, H. (2020). Induction and the Glue of the World. *Australasian Journal of Philosophy*, 1–15. https://doi.org/10.1080/00048402.2020.1793788

Carroll, S. (2010). *From eternity to here: the quest for the ultimate theory of time*. Penguin.

D'Alessandro, W. (2020). Proving quadratic reciprocity: explanation, disagreement, transparency and depth. *Synthese*. https://doi.org/10.1007/s11229-020-02591-6

D'Arms, J., & Jacobson, D. (2000). The Moralistic Fallacy: On the "Appropriateness" of Emotions. *Philosophy and Phenomenological Research*, *61*(1), 65. https://doi.org/10.2307/2653403

Della Rocca, M. (2010). PSR. *Philosopher's Imprint*, *10*(7), 1–13.

Enoch, D. (2009). The Epistemological Challenge to Metanormative Realism: How Best to Understand it, and How to Cope with it. *Philosophical Studies*, *148*(3), 413–438. https://doi.org/10.1007/s11098-009-9333-6

Enoch, D. (2011). *Taking Morality Seriously*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199579969.001.0001

Field, H. (1989). *Realism, Mathematics, and Modality*. Basil Blackwell.

Friederich, S. (2017). Fine-Tuning. In *Stanford Encyclopedia of Philosophy*.

Friedman, M. (1974). Explanation and Scientific Understanding. *The Journal of Philosophy*, *71*(1), 5. https://doi.org/10.2307/2024924

Grimm, S. R. (2008). Explanatory Inquiry and the Need for Explanation. *The British Journal for the Philosophy of Science*, *59*(3), 481–497. https://doi.org/10.1093/bjps/axn021

Hume, D. (1779). *Dialogues Concerning Natural Religion*.

Leslie, J. (1989). *Universes*. Routledge.

Liquin, E. G., & Lombrozo, T. (2020). A functional approach to explanation-seeking curiosity. *Cognitive Psychology*, *119*(December 2019), 101276. https://doi.org/10.1016/j.cogpsych.2020.101276

Melamed, Y. Y., & Lin, M. (2016). Principle of Sufficient Reason. In *Stanford Encyclopedia of Philosophy* (Fall 2016).

Nagel, T. (2012). *Mind and Cosmos*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199919758.001.0001

Nozick, R. (1981). *Philosophical Explanations*. Harvard University Press.

Paley, W. (1802). *Natural Theology*. American Tract Society.

Parfit, D. (1998). Why Anything? Why This? *London Review of Books*, *20*(2).

Penrose, R. (2004). *The Road to Reality*. Random House.

Price, H. (1997). *Time's Arrow and Archimedes' Point*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195117981.001.0001

Price, H. (2002). Boltzmann's Time Bomb. *The British Journal for the Philosophy of Science*, *53*(1), 83–119. https://doi.org/10.1093/bjps/53.1.83

Pruss, A. R. (2006). *The Principle of Sufficient Reason: A Reassessment*. Cambridge University Press.

Schechter, J. (2010). The Reliability Challenge and the Epistemology of Logic. *Philosophical Perspectives*, *24*(1), 437–464. https://doi.org/10.1111/j.1520-8583.2010.00199.x

Schechter, J. (2013). Could Evolution Explain Our Reliability about Logic? In *Oxford Studies in Epistemology* (Vol. 4, Issue 1989, pp. 214–239). https://doi.org/10.1093/acprof:oso/9780199672707.003.0008

Schechter, J. (2018). Is There a Reliability Challenge for Logic? *Philosophical Issues*, *28*(1), 325–347. https://doi.org/10.1111/phis.12128

Smolin, L. (1997). *The Life of the Cosmos*. Oxford University Press.

Street, S. (2006). A Darwinian Dilemma for Realist Theories of Value. *Philosophical Studies*, *127*(1), 109–166. https://doi.org/10.1007/s11098-005-1726-6

Street, S. (2015). Does Anything Really Matter or Did We Just Evolve to Think So? In G. Rosen, A. Byrne, J. Cohen, & S. V. Shiffrin (Eds.), *The Norton Introduction to Philosophy* (pp. 685–693). Norton.

Street, S. (2016). Objectivity and Truth: You'd Better Rethink It. In R. Shafer-Landau (Ed.), *Oxford Studies in Metaethics* (Vol. 11, pp. 293–334). Oxford University Press. https://doi.org/10.1093/acprof:oso/9780198784647.003.0012

van Inwagen, P. (1993). *Metaphysics* (1st ed.). Westview Press.

van Inwagen, P. (2015). *Metaphysics* (4th ed.). Westview Press.

White, R. (2014). William Paley. In N. Trakakis & G. Oppy (Eds.), *Early Modern Philosophy of Religion : The History of Western Philosophy of Religion* (Vol. 3). Routledge.

White, R. (2018). The Argument from Cosmological Fine-Tuning. In G. Rosen, A. Byrne, J. Cohen, S. V. Shiffrin, & E. Harman (Eds.), *The Norton Introduction to Philosophy* (2nd ed., pp. 29–35). Norton.

Wong, W. hung, & Yudell, Z. (2015). A normative account of the need for explanation. *Synthese*, *192*(9), 2863–2885. https://doi.org/10.1007/s11229-015-0690-8