Fine-Tuning Fine-Tuning

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Introduction:

The laws of physics are unexpectedly inhospitable to life. Scientists did not expect to discover that life depends on seemingly improbable values in the fundamental constants of physics. Scientists expected to discover that life would be possible given a wide variety of values in the fundamental constants. But so it goes. One learns all sorts of weird things from contemporary physics.

If this unexpected inhospitability were equally unexpected with or without the existence of God, then the fine-tuning of the fundamental constants would be irrelevant to the philosophy of religion. But the fine-tuning of the fundamental constants is substantially more likely given the existence of God than it is given the non-existence of God. Thus the fine-tuning of the fundamental constants is strong evidence that there is a God.

There are some real complexities to the fine-tuning argument, complexities regarding which controversy is appropriate. But the fine-tuning argument is more controversial than it ought to be. The basic idea of the fine-tuning argument is simple. It's as legitimate an argument as one comes across in philosophy.

We will formulate the fine-tuning argument using the machinery of Bayesian probability theory. We think that a good deal of structural insight can be obtained by doing so. (In particular, we find Bayesian analyses to be more illuminating than analyses which rely on explanation-theoretic vocabulary, such as “cries out for explanation”.) We hope that our theoretical preferences will be vindicated by our output. After some scene setting, we will sketch what we take to be a promising way of developing the fine-tuning argument, which we dub the “core argument”. Additional detail and explanation will be supplied as we engage with a series of potential concerns about the argument so sketched. Along the way, we will rebut a recent critique of the fine-tuning argument from a philosopher, Jonathan Weisberg, and will also rebut a range of critiques that are common in the popular and scientific literature. We will finally turn to atheistic replies that concede the lessons of the core argument, but which attempt to find a rational home for atheism with its scope. We

believe this to be the most promising approach for the atheist.

Probabilistic Foundations:

From a Bayesian perspective, most arguments for or against the existence of God are boring. Most arguments *in general* are boring. You've got some prior probabilities, you've got some likelihoods, you get some evidence—just turn the crank and out pop the posterior probabilities. There is some discussion to be had about what reasonable prior probabilities look like, and there is some discussion to be had about what one's evidence consists in. But once these issues are settled, it is a straightforward matter to turn the crank. And that is because, on a formal level, it's totally obvious how posteriors are generated from a combination of priors and evidence. Formal problems in Bayesian epistemology rarely come up.[1]

Traditional Bayesians impose two kinds of coherence requirements on rational credences, a synchronic constraint which applies at each time and a diachronic constraint which applies over different times. The synchronic requirement is probabilistic coherence: that the agent's credences at any time should form a probability function. That is, an agent's degrees of belief[2] must (at a minimum) conform to the following axioms of the probability calculus:

(1) $Pr(p) \geq 0$, for any proposition p.

(2) $Pr(t) = 1$, for any tautology t.

(3) $Pr(p \neq q) = Pr(p) + Pr(q)$, for any inconsistent propositions p and q.

The diachronic requirement is conditionalization. This constraint relies on a notion of conditional probability, which we can define given the axioms above. The probability of p conditional on q is equal to the probability of p and q divided by the probability of q (assuming that $Pr(q) > 0$).

$Pr(p|q) = Pr(p¨ q)/ Pr(q)$

Conditionalization mandates that when an agent has has evidence E at time a and evidence E+ at time b (where E+ implies E), then the probability of any proposition p at b should equal the conditional probability of p given E+ at a. That is, $Prb(p) = Pra(p \mid E+)$.

[1]One such complexity is, however, relevant to the fine-tuning argument: the epistemic status of self-locating beliefs. More on this later.

[2]For those unfamiliar with Bayesian epistemology, see Weisberg (2011) for a good overview. For those overly familiar with Bayesian epistemology, we note that we do not intend to weigh in on the subjectivist / objectivist debate about the interpretation of epistemic probabilities.

Putting this all together, the basic story of Bayesian epistemology goes something like this: Rational agents assign non-negative credence to various possible worlds in such a way that the sum of those credences is 1. When rational agents gain evidence which is inconsistent with some of those possible worlds, they adjust their credences in those worlds to 0, and proportionally increase their credences in the remaining worlds so that the sum of their credences returns to 1.

In this probabilistic setting, some evidence favors a hypothesis just in case that evidence is more likely given that hypothesis than it is given the negation of that hypothesis. If the evidence is a little bit likelier given the truth of the hypothesis than it is given the falsity of the hypothesis, then it is weak evidence for the hypothesis. If the evidence is much likelier given the truth of the hypothesis than it is given the falsity of the hypothesis, then it is strong evidence for the hypothesis. Specifically, what matters is ratio of the likelihood ratios, their geometric difference—is the evidence twice as likely if the hypothesis is true? Five times as likely? Ten times? A million times? Any two pieces of evidence with the same ratio of likelihood ratios will have the same effect on a hypothesis. If E1 is .1 likely if H is true and .01 likely if H is false and E2 is .05 likely if H is true and .005 likely if H is false, then E1 and E2 would have the same confirmatory effect on H. E1 and E2 have the same ratio of likelihood ratios—10—and so they give equally strong confirmation. The ratio of likelihood ratios determines the strength of evidential confirmation.[3]

One can look at any dispute in religious epistemology and elsewhere through the lens of Bayesian probabilities. And indeed, whether one is discussing fine-tuning, divine hiddenness, or the problem of evil, we believe that a Bayesian framework brings important epistemological issues into sharper focus. Hence our use of a Bayesian framework in this paper.

Terminological Clarifications:

At the outset, we should clarify the meanings of certain key terms. By ‘theism’ we mean the thesis that one or more agents designed the basic physical features of the universe. The most obvious

[3]The notion of confirmation we're using is not one of absolute change—it's not the case that all increases of .02 are of the same size. Our notion of confirmation is geometric, measuring the difference between the old ratio of H to not-H and the new ratio of H to not-H. Note that the prior probabilities are also of crucial relevance in determining what the probability of a hypothesis is after some new bit of evidence. Even given strong confirmation, if a hypothesis was sufficiently improbable antecedently to the new evidence it will remain improbable after the new evidence.

design hypotheses are ones where such agents create the universe according to a design. But there are also design hypotheses where such agents do not play a creating role, and instead merely give a guiding hand as to how things unfold.[4]

We shall use the hypothesis that there is a God interchangeably with 'theism', and shall use 'atheism' to mean the negation of theism. We are fully aware that these definitions allow for world-designing agents whom many would be loathe to dub 'God'. If you find yourself displeased by our choice of words, please feel free to mentally substitute more palatable terminology.

Next we turn to the ideology of 'fine-tuning'. The central notion here is that of the universe being fine-tuned for some property. The property can be anything you like – containing life, containing croquet, containing either life before the year two thousand or croquet after the year two thousand, et cetera. A key part of our fine-tuning ideology — and one that is also important to physicists — is that of a physically-respectable measure on a parameter of the universe's states. So let's clarify that notion bit by bit.

Parameter:

Physicists consider a variety of ways that universes with laws broadly like our universe's laws could differ from our universe. These universes could have this force be a bit stronger relative to that one, or could have this fundamental particle be a bit more massive relative to that one, or could have a vacuum state with a bit more or a bit less energy, and so on. These universes could also just have their matter in different positions and momentums. Moreover, physicists have a precise, mathematical way of characterizing these differences: parameters. A parameter can take any of a range of possible values, these values corresponding to a range of possible states for a universe.[5]

Measure on a Parameter:

[4]Note that sometimes one can leave it to chance which of a range of features F1 to Fn a thing has but still set the weights by which the chancy unfolding of events gets resolved. Suppose, for example, that an agent did not see to it that the universe is expanding, but instead let that issue be determined by rolling a die with a certain bias. Even here the agent does see to it that the universe has a certain feature. The agent did not see to it that the universe is expanding, but the agent did see to it that the issue of the universe's expansion would be determined by a certain kind of weighted, chancy process.

[5]These parameter-values don't correspond to maximally specific states. The parameters characterize certain features of the laws, not absolutely everything. Two worlds can agree regarding parameter-values and still disagree regarding other matters.

We need some way to talk about probabilities of parameter-values. Any probabilities regarding parameter-values—be they epistemic, physical—require a bit of formal finesse. There are some difficulties in talking about the probability that a parameter will take a value within some range of values.[6] Standard parameters can take uncountably infinitely many values, so it's hard to get much out of the probabilities of particular values. It's very natural to have a region of values such that the probability of each value is 0, but the probability of the region as a whole is greater than 0. (It's helpful to think about a continuous dart board. The probability of the dart hitting any particular point is 0. But the probability of the dart hitting some nice, visible region of the dartboard is greater than 0.) A measure on a parameter is, roughly speaking, a well-behaved way of characterizing the relative sizes of each region to the whole and ipso facto of any region to any other region.[7] There's no hope for simply having the size of a region of values be determined by the number of values in that region—far too many regions contain infinitely many values, so that methodology will quickly collapse. A measure over a parameter ensures that no such collapse occurs. So when we want to say that the probability of some region of values is 2/3, we can say that it has measure 2/3. Note that this gives us an easy way to talk about the probability that the universe will have some property. The probability that the universe will have some property is equal to the measure of the region of parameter-values corresponding to universes that have that property.

Physically-respectable Measure on a Parameter:

We've just been talking about the probability of the universe having some property. We therefore need to say what determines the value of such a probability. A measure over a parameter just guarantees that an assignment of probabilities is coherent; it doesn't guarantee an assignment of probabilities that is suitable for any particular purpose. There are lots of measures over parameter-values, but only some of them are relevant to the fine-tuning argument.

We're interested in the sorts of probability assignments that physicists use when theorizing about physics. Physicists routinely make judgments about how probable it is that a universe with such-and-such general features would have such-and-such particular features. Indeed, without such judgments physicists would be unable to do physics. In some cases, physicists judge that a uniform probability density is appropriate for a range of values. (This judgment is common when no value in

[6]As there are many sorts of probabilities regarding parameter-values, a probability is *the* probability only relative to an appropriate context.

[7]Here and in what follows we ignore complications having to do with the fact that measures will leave the size of certain regions undefined. For more detail, feel free to consult a textbook on measure theory; they're more approachable than you might have expected.

that range seems particularly special.) In some cases, physicists judge that some specific values in a range get more probability than other values in that range. (This judgment is common in when some values seem particularly special. A parameter having a value of 0 seems more plausible than that parameter having a value of .000041769271593...)[8] Physicists differ a bit in their theoretical sensibilities, but only a bit. Much of contemporary physics is widely agreed upon, although there's still plenty of controversy. But for our purposes, what matters is not contemporary physics, but ideal physics. We shall call the measures that are suitable for ideal physics "physically-respectable". We find it plausible that contemporary physicists aren't far off, and thus that the measures physicists employ give good guidance about the measures that ideal physics would employ.

Note that the physically-respectable measures don't correspond to the epistemic probabilities even of ideal physicists.[9] Physics is methodologically naturalistic. Physicists formulate their measures given the presupposition that nothing supernatural is occurring. So if you asked a physicist what the probability was that you'd walk cleanly through a solid concrete wall, the physicist would calculate the extremely minute probability that you'd quantum tunnel through the wall.[10] The physicist would ignore the epistemic possibility that you are a sorcerer, and that you can magically pass through the wall. The physicist is rather convinced that you won't magically pass through the wall, of course, but the physicist is also rather convinced that you won't quantum tunnel through the wall. And if the physicist did see you pass through the wall, the physicist would be more likely to think that you're a sorcerer than to think that you quantum tunnelled through the wall. But the physicist's epistemic probabilities regarding sorcery are immaterial to his response. The physicist will answer with a physically-respectable measure in mind, and physically-respectable measures give no weight to sorcery.[11] Even if physics were perfected, physicists would still not use physically-respectable measures for their epistemic probabilities.[12]

[8]It's need not be obvious that a value is special. It isn't obvious that there's anything special about 0.3183098861..., but that number is 1 / π. And any value that made physics simpler or more elegant would thereby be special.

[9]And not merely because of the plurality of physically-respectable measures. Even ideal physicists need not be certain of ideal physics, and they could well have additional evidence.

[10]Generally less than 1 in 10 ^ (10 ^ 30). See Mohsen (2003) for more about quantum tunnelling.

[11]Since physical probabilities and epistemic probabilities are different, one can't move directly from a claim about one to a claim about the other. The word "probable" is flexible; its meaning can shift from context-to-context. A theist scientist can say that it's probable (in the epistemic sense) that God would do something improbable (in the physical sense) just as a believer in sorcery could say that it's probable (in the epistemic sense) that a sorcerer would do something improbable (in the physical sense).

[12]We certainly allow that physics is possible given theism, and are agnostic regarding whether a theistic physics would employ different measures than naturalistic physics. But the details of theistic physics are not relevant here; our argument turns only on the details of naturalistic physics.

We are now in a position to say what it is for a universe to be fine-tuned for a property: A universe is fine-tuned for a property just in case that universe possesses that property and the probability of that property is extremely low in all physically-respectable measures.[13]

Probability and Explanation:

This paper is about the probabilistic impact of certain evidence. We emphasize that our discussion is not conducted in the ideology of explanation. Our argumentation will not rely on claims of the form 'The atheist has no explanation of the fact that…' or 'Theism is a better explanation of the fact that….' and so on. Yet it's not as though we are baffled by all claims of relative explanatory goodness. And we allow that there are interesting subtleties to the ideology of explanatoriness, particularly as articulated within physics and other areas of science. Nevertheless, it seems to us the mechanics of evidential impact are clearer when modelled probabilistically. We further believe that, in the context of the fine-tuning argument, little is lost and a great deal is gained by framing issues in a probabilistic rather than explanation-theoretic way.

Let us illustrate. Suppose the leaves on the grass one morning spell out the opening verse to the Gospel of St. John. Consider two candidate styles of explanation: (1) Something along the lines of : an agent or some agents so arranged the leaves. (2) Something along the lines of: The wind and disposition of the leaves just happened to be so arranged as to produce that resulting configuration of leaves. There is no point in saying that, strictly speaking, (2) can't count as an explanation. Supposing (2) was true, something along those lines would constitute an excellent answer to 'Why are the leaves so configured". An answer to such a why question is an 'explanation' in a perfectly good ordinary sense of the word. And (1) and (2) are each perfectly good possible answers to the question 'why are the leaves so configured". The technicalities of what does and does not count as an explanation seem beside the point.

Furthermore, it seems that the relative merits of (1) and (2) as explanations of the evidence amount to their relative probabilities given the evidence. If the garden were known to be so to be so extraordinarily well-protected from agents that (2) remained more likely than (1) even given the new evidence, then it would seem that on the whole (2) would be the most plausible – or "best all things considered" - explanation. In more ordinary circumstances, (1) would be vastly more likely

[13]It is, of course, vague what counts as 'extremely low'. But more precision is available when more precision is required.

than (2), and (1) would be a much better explanation than (2). We think this pattern holds generally; thus there is little to be gained by asking about explanatory betterness instead of asking about relative probability given the evidence.

As we've said, facts about explanatoriness seem to track facts about probabilities. But even if explanatoriness sometimes comes apart from probability, it's probability that we care about. Theists would not feel vindicated if theism offered an impeccable explanation of the world, but one which was nonetheless overwhelmingly improbable. Atheists would not feel vindicated if theism offered no explanation of the world, but was nonetheless overwhelmingly probable.

Here's another illustration. Suppose an atheist takes the facts about evil to be evidence against theism. It would muddy the waters for such an atheist to say "the theist can't explain this". The atheist should realize that there are all sorts of theodicies which, even if wildly implausible, offer perfectly good candidate answers to "why do those facts obtain". The atheist might instead resort to qualitative language like "that is not a good explanation". But then the theist will seize on the fact that if the theodicy is true, it would be an excellent explanation of the pertinent facts about evil. The epistemological situation is thrown into much sharper relief if one focuses instead on the probabilistic situation. Everything will turn on the ratio between the likelihood of the facts about evil given theism to the likelihood of the facts about evil given atheism. If the facts about evil are much less likely given theism than given atheism, the facts about evil are strong evidence against theism. If the facts about evil are not much less likely given theism than given atheism, the facts about evil are not strong evidence against theism. Whether some theodicy would count as an explanation if true is beside the point. We recommend that the proponent of fine-tuning focus similarly on the probabilistic facts, and let the chips fall as they may as far as the ideology of explanation is concerned.

One piece of explanation-theoretic ideology that plays a prominent role in the fine-tuning literature is 'crying out for explanation'.[14] Once again we think that this notion gestures at phenomena that could be put into sharper relief if framed probabilistically. When a piece of data is said to be "crying out for explanation" here is what is typically going on: One is initially confident of a certain theory. But then one gets some new data, and on the basis of that data some alternative theory is rendered much more likely. In such a case, the data is said to cry out for explanation. If the morning

[14] See Parfit (1998) for a particularly striking use of the phrase.

leaves spell out a Gospels chapter, that "cries out for explanation" because one's previously favoured hypothesis about the forces that brought about the morning leaf distribution comes to have low probability and some alternative hypothesis comes to have much higher probability. Its not that there is no explanation possible within the framework of one's originally favoured hypothesis. There is. Its just that the original hypothesis is still rendered very unlikely and an alternative hypothesis takes over the bulk of one's credence. Similarly, if a gambler won fifty times in a row on calling a coin toss, talk of this "crying out for explanation" just encodes a fact about the probabilities: that due to the evidence, the antecedently very plausible hypothesis that the gambler is not a cheat was overtaken by the subsequently very plausible hypothesis that the gambler is a cheat. As we see it, there would be little point in saying that fifty wins in a row cries out for explanation if one was certain that the coin was fair and that the gambler was guessing. Similarly, if initially it was *fantastically* unlikely that the gambler would cheat, then even given the evidence of fifty wins, it would remain solidly likely that the coin is fair and the gambler was guessing. In that case, one would be disinclined to say that the series of wins "cries out for explanation". In short, that whole notion of 'crying out for explanation' is a potentially confusing way of getting at some coarse grained facts about probabilities.[15]

The Core Argument:

It is arguable that the fact of life is favorable for theism. The key judgment would be that life is at least a bit less likely conditional on atheism than it is conditional on theism. If that is right, then learning that there is life would make theism a bit more probable than it was antecedently.[16] But the epistemic impact of life is not our topic. We are interested in the epistemic impact of certain claims from physics, claims that (among other things) entail that the universe is fine-tuned for life.

The epistemic impact of the fine-tuning argument is, however, complicated. And while the complications do need to be dealt with eventually, it's nice to start out evaluating simpler models of our epistemic situation. To that end, we're going to make a couple of simplifying assumptions, if only for the time being.

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[15] For more on connections between explanation and probability, see White (2005).

[16] Some readers might worry that it is a bit hard to have no evidence suggesting that there is life. In that case, the antecedent epistemic probabilities might need to reflect an agent's aprioristic sensibilities. For more on such aprioristic probabilities see Meacham (2008).

First, we're going to assume that there's no funny-business about versions of atheism that are oddly like theism. We call such oddly theistic atheism "quasi-theism".[17] Recall that we defined theism as the thesis that one or more agents designed the basic physical features of the universe, and atheism as the negation of theism. The hypothesis that beings that were just short of agency designed the basic features of the universe, the hypothesis that agents did something just short of designing the basic features of the universe, and the hypothesis that agents designed the not-quite basic features of the universe are thus all atheistic hypotheses—but they're awfully similar to theism. We're most interested in seeing how fairly proper theism and fairly proper atheism fare against one another. So for the time being, we're going to set quasi-theism aside.[18] Second, we're going to assume that physical reality consists of a single universe. Multiverses introduce myriad complications, and we'd like to avoid them for as long as possible.

We thus focus on a package of three propositions: (i) the proposition that given the general laws, only a minute fraction of values of the cosmological constant (as judged by any of the physically-respectable measures) are life-permitting[19], (ii) the proposition that quasi-theism is false, and (iii) the proposition that physical reality consists of a single universe. We will call this “the package”. Our core argument is that if one supposes the package to be true, then theism is significantly more plausible than atheism. We are not claiming that we know that the package is true; we're just trying to figure out what its epistemic significance would be.

At this point we brazenly gloss over the physics that underlies our core argument. We will not justify or even explain our claim that the physically-respectable measures for the cosmological constant all give minute probability to life-permitting values. Not yet anyway. Sadly, simple and intuitive presentations of the relevant physics are liable to be gravely misleading. Our complex and unintuitive presentation of the relevant physics will come later, when we criticize other presentations of the fine-tuning argument. For now, let's just take it for granted that the physics has the features we've alleged, and focus on what the epistemological upshot of those features is.

We think it helpful to divide and conquer a little. First, we think it's worth comparing the epistemic

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[17] We thank Cian Dorr for both the idea of quasi-theism and his helpful thoughts regarding it.

[18] Note that we said no funny-business. If quasi-quasi-theism is importantly different than proper atheism, we're setting quasi-quasi-theism aside too.

[19] We use the term "life-permitting" in the colloquial sense, not in a strict sense. For example, we consider the heart of the sun to not be life-permitting, even though it is nomically possible for someone to survive in the heart of the sun. The heart of the sun is staggeringly inhospitable, and that's enough for us. But if you want to frame things in terms of hospitability rather than in terms of life-permittingness, feel free.

probability of atheism given only the fact of life to the epistemic probability of atheism given the package plus the fact of life. If it turns out that atheism is more probable given only the fact of life than it is given the package plus the fact of life, then we can see that the package provides additional evidence for theism.[20] Second, we think it's worth investigating the unconditional probability of atheism given the package plus the fact of life. If it turns out that atheism is highly unlikely simpliciter given the package plus the fact of life, then we learn that atheists have to think that their evidential situation is substantially different from that of someone who knows that the package is true, that life exists, and nothing else of note.

We should emphasize just how small we take the life-permitting parameter values to be according to the physically-respectable measures. “Small” here doesn’t mean “1 in 10,000” or “1 in 1,000,000”. It means the kind of fraction that one would resort to exponents to describe, as in “1 in 10 to the 120”. The kind of package that we have in mind tells us that only a *fantastically* small range is life permitting.

So, from the point of view of the priors, how does atheism fare conditional on the package plus life? It is quite easily to make the case that it fares badly. The central thought is that the package plus life is fantastically unlikely conditional on atheism but not nearly as unlikely conditional on theism. Let's suppose that theism was not anything like fantastically unlikely to begin with (as seems reasonable to us). The result will be that, conditional on the package plus life, theism will be substantially more probable than atheism. We've put this argument in qualitative terms, foregoing particular numbers. But the particular numbers do not matter. If the prior probability of P is not extremely low and one’s evidence E is fantastically unlikely on not-P but nothing like fantastically unlikely on P, then the result of updating on E will be that P is substantially more probable than not-P.

Let us run through the key judgments underlying this argument. One key judgment is that the combination of the package plus life is incredibly unlikely given atheism. The central thought behind this judgment is that life is incredibly unlikely given atheism plus the package. Thus whatever the likelihood of the package is given atheism, the likelihood of life plus the package given atheism will be incredibly low.

[20]From this it would not follow that the package on its own would confirm theism. It might be that the package only confirms theism given the existence of life.

So why think life is incredibly unlikely given atheism and the package? Note that there is no logically forced march from the facts of the package to this judgement about epistemic probability. After all, the package contains no direct judgments about epistemic probability. It supplies a fact about the set of physically-respectable measures over a certain parameter, not a fact about the epistemic probabilities regarding that parameter. But supposing that atheism is true, it seems outlandish for the epistemic probabilities to radically diverge from all of the physically-respectable measures. After all, the physically-respectable measures are the probabilities that are appropriate for physics in a naturalistic context. So in a naturalistic context, divergence from the physically-respectable measures can only be a rejection of physics itself.

Another key judgment is that the package plus life is far from fantastically unlikely given theism. After all, there are all sorts of things that, from the perspective of the priors, are fantastically unlikely given atheism but equally fantastically unlikely given theism. Such fantastically unlikely things have no evidential impact for the philosophy of religion. But we don't think that the package plus life is that sort of thing. First off, it seems that life is not especially unlikely given theism. Life doesn't have to be overwhelmingly likely given theism or even particularly likely given theism. But surely life is at least modestly plausible given theism. Secondly, it seems that, given theism and life, it would be far from fantastically surprising that life is fine-tuned in the way that the package describes. This is not to say that one should *expect* a theistic universe to contain fine-tuned life (even conditional on life). But one shouldn't think fine-tuned life fantastically unlikely either. After all, supposing god is designing for life, it is far from obvious or to be expected that he should accomplish his goals by means of non-fine tuned laws. So the package plus the fact of life is far from fantastically likely conditional on theism.

A third key judgment is that theism is nothing like fantastically unlikely from the point of view of the priors. This seems reasonable enough and we will not comment on it at this stage.

If one agrees with these judgments – and we do agree with them – then a substantial part of the fine-tuning issue is settled. Conditional on the package plus life, atheism fares very badly.

The committed atheist has two possible strategies for dealing with this core argument. First, she can try to poke holes in it. We'll call this the Narrow Strategy. But she can also try to find ways of justifying atheism while acknowledging the lessons of the core argument. We'll call this the Broad

Strategy. We will look at each strategy in turn.

Narrow Strategy:

We will explore seven objections to the core argument.

Objection One: The God of Tungsten

One might think that there is something amiss about the reasoning thus far. We've been talking about the laws of physics being fine-tuned for life, but the fine-tuning in question isn't particular to life. The existence of tungsten is equally dependant on the cosmological constant.[21] It seems then that there's an equally good argument for the existence of a God who loves tungsten, and this seems ridiculous. But if that is so then it seems that we have made some sort of mistake, and that there is something fundamentally amiss with the reasoning advanced so far.

This sort of response is mistaken. First, one should not balk at the existence of evidence for the God of tungsten. After all, if there were no tungsten then that would be rather strong evidence against the existence of a tungsten-loving God.[22] It therefore seems only reasonable that the existence of tungsten should count in favour of the existence of a tungsten-loving God.[23]

It is not at all odd to think that there is strong evidence for the existence of the God of tungsten. But even with strong evidence for the existence of the God of tungsten it does not follow that one's credence in that ridiculous hypothesis should be even moderately high.

It's helpful to think about a simpler case. Suppose you draw a 7 of clubs from a deck of cards. This will certainly confirm the hypothesis that a sorcerer cast a spell to ensure that you would draw the 7 of clubs. After all, you were likelier to have drawn a 7 of clubs given that a sorcerer cast a spell to ensure that you drew a 7 of clubs than given than you would otherwise have been. But note that this is not to say that drawing the 7 of clubs confirms the hypothesis that a sorcerer cast a spell which

[21] And the triple alpha process, among other standard fine-tuning phenomena. For more, see Rees (2003).

[22] In general, if E is evidence for H, then not-E is evidence for not-H. Note though that E can be stronger evidence than not-E or weaker.

[23] It would be a mistake to press issue of how little tungsten there is. Such qualms can be sorted out in a tungsten-based theodicy about which we do not wish to speculate. The point here is the mere fact of tungsten. Note also that as one looks across the universe, there isn't that much life in it either.

would ensure which card you drew. Your drawing the 7 of clubs falsifies the hypotheses that a sorcerer cast a spell to ensure that you would draw the queen of hearts, or the ace of spades, or any other card in the deck. One sorcerous hypothesis goes up, but the rest go down. Assuming (as seems reasonable to us) a roughly uniform prior over what card a sorcerer would ensure you drew, drawing a 7 of clubs will leave your credence that a sorcerer ensured the card you drew roughly flat. There will be thoroughly respectable evidence to the effect that a sorcerer ensured that you drew the 7 of clubs, but the upshot of this evidence needn't be assigning that silly hypothesis even moderate credence.

In general, it is unavoidably the case that weird hypotheses are confirmed by some evidence. This does not mean that the weird hypotheses wind up being probable full-stop. It only means that that the the weird hypotheses wind up being more probable than they would have been otherwise. One thing worth emphasising here is that the existence of tungsten is compatible with all sorts of design hypotheses that do not involve a God that loves tungsten. For example, it might be that a tungsten-containing universe was be created by a life-loving God who merely tolerated tungsten – tungsten being perfectly tolerable. It might be that a tungsten-containing universe was created by a solar-system-loving God who instituted a chance process that guaranteed solar systems but left the existence of tungsten a chancy matter (which just happened to produce tungsten). And so on. Regardless of the relative probabilities of theism versus atheism, the probabilities of a tungsten-loving god does not seem all that high even conditional on the existence tungsten and theism. So there is little risk that the probability of a tungsten-loving God will end up being all that high.[24]

Objection Two: Carbon-based Life and Other Forms of Life

It is often claimed that proponents of fine-tuning erroneously presuppose that only carbon-based life is possible. Once that assumption is dropped, it is no longer quite so easy to claim that the cosmological constant is fine-tuned for life. But the fine-tuning of cosmological constant has nothing to do with carbon per se. It would be very hard to have physical life in any form if an inhospitable cosmological constant led to a universe that expanded so rapidly that particles did not interact with one another or to a universe that collapsed back in on itself only moments after its generation. But one might suppose that immaterial life is possible, with the appropriate functional structure instantiated by (say) ectoplasm. It is far from clear that any of the parameter settings for the cosmological constant are nomically incompatible with *that* kind of life.

[24]The existence of a tunsten-loving God might wind up being more probable than atheism. But that just goes to show how strongly the package plus life would disconfirm atheism.

Now we can imagine a sensibility according to which immaterial life is impossible. Following Kripke, there is widespread agreement that it is impossible to have water without having hydrogen and oxygen, whatever the structural features of alternative substances might be. And it is not clear why similar reasoning should not militate in favour of an essential, albeit a posteriori, link between life and physical matter. But we do not wish to place much weight on this sort of thought; it is not necessary for our argument.

Let us grant that non-physical life is perfectly possible. And let us also grant the conditional on God creating life there is no special expectation that God would make physical life. Indeed, let us grant that conditional on God making life it is more likely than not – let us say 80 per cent likely – that he would only make non-physical life. These concessions, while substantive, do not actually make much of a difference to the fine-tuning argument. The fact is that there is physical life. Conditional on theism, fine-tuned physical life is not fantastically unlikely. Theism is also far from fantastically unlikely from the point of view of the priors. Conditional on atheism, fine-tuned physical life is not fantastically unlikely. So…..

In short, the defensive resources afforded to the atheist by non-carbon based life are in fact much more limited than some of the literature would have us believe. The possibilities of non-carbon-based physical life and even of non-physical life change nothing of note.

Objection Three: Anthropic Objections

There's a line of thinking according to which fine-tuning argumentation is defective. People sometimes talk about "the" anthropic principle, but the definite article is a misnomer. There are over 30 anthropic principles[25], and they range from trivially true to obviously false. Many deal with the ideologies of surprisingness or explanatoriness, ideologies which we abjure. We just want to know if fine-tuning provides evidence that God exists. We're happy to let the surprisingness and explanatoriness chips fall where they may.

The sort of anthropic reasoning we'd like to address goes something like this: "The putative evidence for the fine-tuning argument is the observation that we exist. But the observation that we exist cannot be evidence. If we didn't exist we couldn't observe that we didn't exist, and if you can't

[25]See Bostrom (2002) for more on such principles.

observe that something doesn't obtain then observing that it does obtain is evidentially null."

This reasoning is wrong on two counts. First, the putative evidence for the fine-tuning argument is not the observation that we exist. Humanity has known that it existed for quite a while; no cutting-edge physics needed. It was (and is) epistemically possible for life to be realized in all sorts of ways. What we learned were some facts about how physical life is realized in our universe. It was entirely possible for us to have observed laws that were not fine-tuned for life—laws that made life-permitting parameter-values much more probable. That was, in fact, what we were expecting. But instead we observed our laws are fine-tuned, so now have to reckon with that. Thus even granting the epistemological conceit of anthropic reasoning, the fine-tuning argument goes on. Anthropic reasoning would only undermine the argument from life. It has literally no effect on argument from fine-tuning.

We are not, however, content to dismiss the argument from life on anthropic grounds. This is not to say that the argument from life is a particularly powerful argument. But there's nothing formally wrong with it, whereas there is something formally wrong with anthropic principles.

Bayesianism provides a quite general framework for probabilistic reasoning. There are no exceptions. It's not as though Bayesianism applies always except on Thursdays, or everywhere except in Paraguay, or to everything except turnips. It applies always, everywhere, to everything. There is no exception to Bayesianism when it comes to our status as observers. Similarly, there is no exception to classical logic when it comes to our status as observers. It is as ludicrous to say that conditionalization doesn't hold when it comes to the observation that we exist as it would be to say that modus tollens doesn't hold when it comes to the observation we exist.

The evidential significance of the observation that we exist needn't be probabilistic, but can be deductive. Suppose you learn that years ago someone flipped a coin—Heads they put deadly poison into something you drank and Tails they didn't. The fact that you're alive now entails that you did not consume deadly poison a year ago, and thus entails that the coin didn't land Heads. There's no getting around the deduction. But now suppose a slightly different setup. Suppose you learn that years ago someone flipped a coin—if it landed Heads they would then roll a 6-sided die a thousand times. If that die landed 6 all thousand times then that would be it, but if any other number was rolled at any point then the person put deadly poison into something you drank. Once again, if the coin landed Tails then no poison. The fact that you're alive still entails that you didn't drink poison, but it no longer entails that the coin didn't land Heads. It is, however, extremely strong

evidence that the coin didn't land Heads. The fact that you're alive entails that coin didn't land Heads and any die sequence other than all 6s. Lots of Heads possibilities are falsified but no Tails possibilities are falsified. So your current life confirms Tails relative to Heads. Our earlier comparison between conditionalization and modus tollens was not flippant—conditionalization is falsification and renormalization, and falsification is modus tollens.

The notion that in order for observing P to be evidence for H it has to be possible to observe not-H and for that to be evidence for not-H is totally wrong.[26] It is no part of the standard probabilistic notion of "evidence for" that, if not-P is to count as evidence for not-H[27], then not-P has to be a proposition that you could feasibly *have as evidence*. What is true is just that in order for P to be evidence for H, not-P has to be evidence for not-H. The former principle does not follow from the probability calculus, whereas the latter principle does.

Objection Four: Dismissive Priors

The core argument assumed that theism was not fantastically unlikely a priori. But some atheists might incline to priors that take an extraordinarily dim view of theism. They might reason, "Even prior to getting evidence, theism seemed like a *really* stupid theory. Thus my prior for theism was extraordinarily low. Accordingly, I could take the hit provided by the package and still remain an atheist."

If the prior for theism is low enough, the atheist can indeed take the hit and remain an atheist without probabilistic incoherence. But its worth emphasising just how low such a prior has to be. If theism's prior is 1 in 1,000,000 or 1 in 1,000,000,000 that won't be remotely close to enough. A prior of 1 in 1,000,000 or 1 in 1,000,000,000 would only be enough if the evidential impact of the package plus life favored theism by a factor of 1,000,000 or 1,000,000,000. But the package of theism plus life favors theism by a factor of 10 ^ 120. Your odds of guessing a person randomly selected from Rhode Island are around 1 in 1,000,000. Your odds of guessing a person randomly selected from India are around 1 in 1,000,000,000. But your odds of guessing an atom randomly

[26]Inapt analogies sometimes cloud this point. For example, Elliott Sober writes, "Suppose you use a net to fish in a lake and observe that all the fish in the net are over 10 inches long. At first, this observation seems to favor the hypothesis that all the fish in the lake are more than 10 inches long over the hypothesis that only 50% of them are. But then you learn that the net has holes that are 10 inches across. This makes you realize that you were bound to obtain this observation, regardless of which hypothesis about the lake is true." This is quite so, but it's a bad analogy for the case of fine-tuning. In Sober's example there are sure to be big fish in the lake. But it was not sure that there would be life, nor that if there was life it would be found in universes which required fine-tuning.

[27]That is, if Pr (not-H | not-P) > P(not - H | P).

selected from the known universe are a mere 1 in 10 ^ 80—which is not even close to 1 in 10 ^120.[28] In order to think theism sufficiently improbable that it would remain improbable even after the evidential impact of the package plus life, you'd have to think that the odds of theism being true were massively worse than the odds of your guessing an atom randomly selected from the known universe. Theism may seem like an odd and implausible hypothesis, but it's nowhere near so outlandish as to justify such extraordinary aprioristic disbelief.[29] Sufficiently extreme priors seem so eccentric as to be unworthy of respect.

Objection Five: Questioning Theistic Likelihoods

Subsection: A Sharp Alternative

Suppose that there is a God. How likely would it then be that God would pick laws like ours—complex laws that need fine-tuning to permit life—and then fine-tune them so that they permitted life? It seems pretty plausible that God would be interested in life. And as far as the laws like our part goes, it shouldn't be all that implausible. Admittedly, we have an imperfect grasp of what sorts of alternatively structured laws could have produced life: alternatives like simple physical laws, something based on cellular automata, or even something non-physical. Those seem like pretty reasonable ways for God to produce life, but this universe's way seems pretty reasonable too. So while we weren't hugely confident *a priori* that God would go for laws like ours, neither were we hugely confident *a priori* that God wouldn't go for laws like ours. There are things God might like about laws like ours: maybe he likes quasars, maybe he likes theoretical physics, maybe he likes the fine-tuning argument itself. These seem like tepid reasons—and indeed they are—but that's all they have to be. God might be very unlikely to choose laws like ours, but the fine-tuning argument would be viable nonetheless.[30]

The probability of atheism producing the package plus life is staggeringly small—less than 1 in 10^120 given the fine-tuning of cosmological constant alone. The probability of theism producing the package plus life may well be very small, but it is not staggeringly small. The package plus life is therefore extremely strong evidence for theism, sufficiently extreme that given the package plus life, the probability of theism easily exceeds the probability of atheism.

[28]Geometrically speaking.

[29] Some hypotheses have low prior probabilities because of their specificity. There's nothing outlandish about the exact positions of every hair on someone's head, but it's still very improbable that every hair should be exactly where it happens to be. But theism is not a particularly specific hypothesis, and so specificity-based improbability is immaterial here.

[30]The strength of the argument will vary. This variability in strength will be important when we consider naturalistic hypotheses other than our just getting really, really lucky.

Suppose that prior to the discovery of fine-tuning one thought that there was a one in a million chance that there was a God and further that there was a one in a million chance that God would go for life through laws like ours. Then if atheism produces life and laws like ours with a probability of less than 1 in 10^120, one's posterior credence in theism will constitute virtual certainty in theism. This is not to say that atheism should be understood to make the fine-tuning evidence so staggeringly unlikely; we'll consider better atheistic tacks later on. This is just to say that if atheism is understood to make the fine-tuning evidence staggeringly unlikely then there is no hope for it.

Unfortunately, a number of philosophers have tried to pin atheism's hopes on arguing that the fine-tuning evidence is also staggeringly unlikely given theism. These philosophers have failed to appreciate that a thoroughly pedestrian uncertainty about divine psychology is all that it takes to make the fine-tuning argument work. For example, Jonathan Weisberg argues that discovery of fine-tuning is evidentially null. He asserts that the comparative probabilities for naturalism producing various life-supporting universes and the comparative probabilities for theism producing various life-supporting universes are exactly the same. That is, he asserts that if naturalism is 3 times as likely to make life through cellular automata as through simple physics, then theism is 3 times as likely to make life through cellular automata as through simple physics. Similarly, that if naturalism is 10^120 times as likely to produce life through simple physics as through complex physics, then theism is 10^120 times as likely to produce life through simple physics as through complex physics.

But this is ludicrous. There is no justification whatsoever for expectations of God's predilections among life-supporting worlds to match up exactly with expectations for the accidental, naturalistic production of life-supporting worlds. Any sort of ordinary uncertainty about divine sensibilities will mean that there's massively more chance[31] of God creating a fine-tuned world than 1 in 10^120

A bit more formally, Weisberg's argument centers around his denial of

(1*): p(S | D&O) > p(S | not-D&O). In our terms, S is the proposition that the physically-respectable measures for our laws give extremely low probability to life-permitting worlds, D is the proposition that theism is true, and O is the proposition that there is life.

[31]Geometrically speaking.

He explains his reasoning as follows:

"My objection was that we have no reason to accept (1*), since we have no reason to think that a designer would choose stringent laws (laws that are hugely unlikely to produce life naturalistically) as her way of creating intelligent life. She could easily have chosen lax laws (laws that are not hugely unlikely to produce life naturalistically) as a means of creating intelligent life" Weisberg (2010).

Note that the right side of the inequality in (1*) is staggeringly small. Naturalistic laws that are stringent are, by definition, hugely unlikely to produce life. Similarly, naturalistic laws that are not stringent are, by definition, hugely more likely to produce life. Thus the overwhelming majority of the share of not-D & O worlds are worlds in which not-S.[32] All (1*) needs is for the odds of God being interested in quasars, physics, or the fine-tuning argument to be greater than 1 in 10^120. But 1 in 10^120 is an absurdly small number; o*f course* the probability that God is interested in quasars, physics or the fine-tuning argument is greater than 1 in 10^120! The odds that the next person you meet will be Borneo's finest Badminton player who just won a million dollars in a Powerball lottery before being struck by lightning and surviving is *massively* greater than 1 in 10^120.[33] There may well be no reason to think that the next person you meet will be Borneo's finest Badminton player who just won a million dollars in a Powerball lottery before being struck by lightning and surviving. In fact, even that is overselling it—there's decisive reason *not* to think that the next person you meet will be Borneo's finest Badminton player who just won a million dollars in a Powerball lottery before being struck by lightning and surviving. But so what? One cannot blithely move from "there is no reason to think that *p*" to "the probability of *p* is 0" or even to "the probability of *p* is less than 1 in 10^120".

Weisberg gives a very helpful toy model. We'll develop it a bit; it makes clear what went wrong in Weisberg's reasoning. Suppose that there two cell blocks each with 10 prisoners: Cell Block G houses 9 guilty prisoners and 1 innocent prisoner, and Cell Block I houses 9 innocent prisoners and

[32]Taking for granted that the prior probability of not-D & S is not staggeringly greater than the prior probability of not-D and not-S. But this is uncontroversial. No one thinks that atheism was *a priori* overwhelmingly likely to produce a universe that would need to get massively lucky in order to allow for life. Any such person would have to find the argument from life to be compelling.

[33]A back-of-the-envelope calculation, just to get the general feel: There are 7 billion people in the world. You're more likely to meet some of them than others, and let's suppose that Borneans less likely than average to make your acquaintance. Let's give that a further factor of 1,000. Now let's say that this Badminton player is unlikely to play the lottery the day you meet him; we'll give that 1 in 1,000. The odds of a Powerball ticket winning a million dollars are around 1 in 5,000,000. Lightning strikes but does not kill around 250,000 people per year, so the per-day odds of being struck by lightning and surviving are around 1 in 10,000,000. And the order matters: lottery win, then lightning, then meeting you. So let's add in another factor of 6. All-in, the odds are roughly 1 in 2 * 10^36. That's not even *remotely* close to 1 in 10^120.

and 1 guilty prisoner. Suppose a prisoner will be released, and that there are two possibilities for how that prisoner is selected: either (1) by random chance, or (2) by a judge. It's easy to say how random chance works—each of the 20 prisoners have equal probabilities of being released. Suppose you know that the judge can tell whether a prisoner is innocent or guilty and that the judge is guaranteed to select an innocent prisoner for release. But the judge's propensities for choosing among the innocent prisoners are unknown.

Suppose you learn that an innocent prisoner was released. What effect should that have on your credences about randomness vs. judge? That's easy. Enough information has been stipulated that one can calculate it straightforwardly. Given randomness there was probability 1/2 that an innocent prisoner would be released and given the judge there was probability 1 that an innocent prisoner would be released. So the release of an innocent prisoner confirms the hypothesis that the judge did the releasing. But the release of an innocent prisoner is only twice as likely given the judge than given randomness, so the judge hypothesis receives only modest confirmation.

But now suppose that you learn something else: the prisoner released was from cell block G. What effect should this have on your credences about randomness vs. judge? It's harder to say. The likelihood of this new evidence given randomness is 1 in 10, but the likelihood given the judge will depend on the prior probabilities in ways we haven't stipulated. Given a very permissive subjectivism one could take the likelihood to be anything from 0 to 1. Still we can say a bit about how to think about this situation.

We think there's a pretty good case that the likelihood of the judge picking the innocent prisoner in Cell Block G is greater than 1 in 10. Maybe the prisoners' files are arranged by cell block and maybe the judge reads through them sequentially until he finds an innocent person to release. In that case the judge would be guaranteed to release the one innocent prisoner in Cell Block G if the Cell Block G files were on top of the Cell Block I files. Or maybe the judge knows everything and thinks it's unpalatable that an innocent prisoner should be housed with all those guilty prisoners. There are various modestly plausible hypotheses according to which the one innocent prisoner in Cell Block G's odds of being released by the judge are quite high. Of course, there are also a variety of modestly plausible hypotheses according to which the his odds of being released are quite low. Maybe the judge is disgusted by the turpitude of cell block G and so wants nothing to do with anyone in it. But it's pretty easy for a mixture of hypotheses according to which that prisoner's odds of being released are high and hypotheses according to which that prisoner's odds of being released are low to give overall odds of his being released greater than 1/10. It only takes a modest credence

in the favorable hypotheses to more than compensate for substantial credence in the unfavorable hypotheses.

If instead of 10 prisoners in each cell block there were 1,000,000,000 (again, with only 1 innocent prisoner in Cell Block G and only one guilty prisoner in Cell Block I) the odds that the judge would release the one innocent prisoner from Cell Block G are tremendously better than the odds that the judge would release some particular nondescript innocent prisoner from Cell Block I. The hypotheses according to which the judge is likely to release the one innocent prisoner from Cell Block G are decently plausible, and therefore the probability that the judge would release that prisoner are is far greater than 1 in 1,000,000.

Note that this reasoning does not rely on any dubious assumption that the Judge is equally likely to pick an innocent prisoner from Cell Block G as from Cell Block I. Even if the judge had only 1 chance in 1,000 of choosing an innocent prisoner from Cell Block G, that would still give the one innocent prisoner in Cell Block G a far greater chance of being released than any of the nondescript innocent prisoners in Cell Block I have.

Simply put, Weisberg pins his hopes on the probability of fine-tuning and life given God being astronomically low. But while that probability is low, it is not astronomically low.

Subsection: An Unsharp Alternative

We mention in passing a more thoroughgoing but flatfooted objection to the kinds of priors we have considered. Some have thought it is inappropriate to have any priors whatsoever about God. The rough thought is that were theism true, God would be so alien that we have no right to views about how likely it is that God would be one way rather than another.

We disfavor such indistinct skepticism. To us it seems unnatural to abjure particular judgments about probability. Consider the following, apparently unimportant integer: -4,991,438,543,760. What are the odds that it's God's favorite integer? We are extremely confident that -4,991,438,543,760 is not God's favorite integer, and we think that you should be too. It's not enough to retort, "Sure, *I* don't see anything special about -4,991,438,543,760. But I'm not God. I'm sure that God's thoughts about integers are radically different from my own. Maybe there is something special about -4,991,438,543,760, and maybe that's why it's God's favorite integer." Sure, maybe—but what are the odds? God could have, at most, one favorite integer. Probabilistic

coherence therefore demands that infinitely many integers be staggeringly unlikely to be God's favorite integer.[34] The overwhelming majority of integers are almost certainly not God's favorite integer, and that's just as it should be.[35]

Objection Six: Back to Tungsten

Earlier we accepted that fine-tuning for tungsten provides evidence for a tungsten-loving God just as fine-tuning for life provides evidence for a life-loving God. The mere fact of evidence for a tungsten-loving God is no reductio of the reasoning underlying the fine-tuning argument. Tungsten does provide evidence for a tungsten-loving God, but not so much that it's unreasonable to doubt that a tungsten-loving God exists.

But tungsten presents a different potential concern. The data on fine-tuning suggest that—conditional on atheism—the conjunction of fine-tuning for tungsten and tungsten is fantastically unlikely. But even if the existence of a tungsten-loving God is fantastically unlikely, the conjunction of fine-tuning for tungsten and tungsten does not seem fantastically unlikely conditional on theism. Suppose that God had no particular interest in tungsten but had no deep aversion to it either. He would still have to somehow decide whether or not to make laws whose physically-respectable measures give extremely low probability to the existence of tungsten and he would also have to somehow decide whether or not to make tungsten. Now God might be inclined to follow the physically-respectable measures of the laws he creates. In this case, God would be extremely unlikely to make a world that is fine-tuned for tungsten. But we are far from certain—or even confident—that God is so inclined.[36] There are plenty of other imaginable sensibilities – ones which are far from fantastically improbable — conditional on which fine-tuning for tungsten is much more likely. This kind of thinking will naturally lead to the thought that fine-tuning for tungsten is far from fantastically unlikely conditional on theism. And so the core argument can proceed as usual. It thus seems that insofar as one finds some naturally occurring phenomenon that is fine-tuned, that phenomenon is significant evidence for theism *whether or not one thinks that God would have a special interest in bring that phenomenon about*.[37] One might think that this

[34]In particular, probabilistic coherence demands that that for any non-zero probability, only finitely many integers have probability equal to or greater than that probability of being God's favorite integer.

[35]We think the odds aren't too bad that 2 is God's favorite integer; 2 is pretty great as far as integers go.

[36]Just as we were suitably cautious about the method that the judge used in the cellblock case.

[37]Note that it is not the case that one should think that every phenomenon is at least modestly likely given God's existence. Indeed, such thinking would straightforwardly violate probabilistic coherence. Nonetheless, any reasonably natural phenomenon—such as life or tungsten—is at least modestly likely given God's existence.

result shows that something has gone very wrong our reasoning. But we do not think so.

Consider another version of the cell block case. Suppose the prison contains four blocks and only a few prisoners are in the North Block, with many more in each of the East, West and South Blocks. And suppose we are certain the judge has no special desire or aversion to releasing prisoners that are in the north block, caring only about releasing the innocent. The random process, again, is equally likely to release any particular prisoner. We learn that a North Block prisoner is released but do not learn whether or not that prisoner is innocent. The fact that a North Block prisoner was released is still evidence that the judge, and not the random process, orchestrated the release. After all, conditional on the random process, it is extremely unlikely that a North Block prisoner would be released. But conditional on the judge being in charge, it would not be that surprising for the judge to use a method such as the following: Pick a block and then pick an innocent person within that block. Thus, even conditional on geographical indifference, the fact of the North Block release is evidence that the judge was in charge. We think very similar reasoning goes through in the tungsten case. Thus a fine-tuning argument does not need to assume a divine predilection towards the fine-tuned phenomenon underlying it. We should simply learn to live with the fact that a fine-tuning argument about tungsten can be effective, even assuming that there is no tungsten-loving god.

We don't claim that any arbitrary thing will be far from fantastically unlikely given theism—that's impossible. There are infinitely many possible values that the cosmological constant could take, so even given uncertainty about the methods God could use to determine the value of the cosmological constant, only finitely many possible values can receive more than minute probability. And there are plenty of weird, gerrymandered things for which fine-tuning is staggeringly unlikely given either theism or atheism. But the fine-tuning of anything reasonably natural which is plausibly tolerable to God makes for strong evidence for God's existence.[38]

Although this line of reasoning does not reveal a flaw in the fine-tuning argument, it does reveal an interesting truth about the fine-tuning argument: Even granting that the universe's fine-tuning for life provides very strong evidence for the existence of God, it need not provide particularly strong evidence that God cares about life. Thus although the fine-tuning argument has more value than one might have expected in the philosophy of religion, it has less value than one might have expected in theology.

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[38] Note that it does not have to be plausible that God cares at all about something in order for the fine-tuning of that thing to be modestly likely given God's existence. For example, there are plenty of gerrymandered propositions that God almost certainly doesn't care about at all that are just slightly different from natural propositions that God might well care about.

Objection Seven: Spinozistic Sensibilities

Fine-tuning discussions are often conducted with liberal attitudes about metaphysical possibility. For example, discussion typically proceeds as if all of the parameter-values for the cosmological constant are metaphysically possible. But what if one believed that modal space was less flexible? Suppose, for example, that one thought that whatever parameter-value for the cosmological constant was actual was also metaphysically necessary? At the extreme, what if one thought, with Spinoza, that only one world was metaphysically possible?

Now we don't think that probabilistic argumentation would be problematized by Spinozism (let alone by illiberal but not fully Spinozistic views). Bayesian updates rely on a a probability space over epistemic possibilities, not metaphysical possibilities. No epistemological catastrophe occurs even if it is known that only one of the epistemic possibilities is metaphysically possible.[39] There are a variety of candidate individuals for being Jack the Ripper. A non-Spinozist but good Kripkean will know that it is either metaphysically necessary or metaphysically impossible that Aaron Kosminski was Jack the Ripper. But most of us still assign middling probability to that hypothesis. The Spinozist will extend this attitude—that modality does not problematize epistemology—to every hypothesis. Credences can operate in the usual way even given a Spinozistic outlook.

That said, a Spinozistic outlook will interfere with the details of the fine-tuning argument, as some of its key ideology usually draws on metaphysical modality. We have said that a parameter is fine-tuned for life just in case, relative to the physically-respectable measures, only a small sliver of parameter-values are life-permitting. But a parameter-value can hardly be life-permitting if it is metaphysically impossible for a world to have that parameter-value and life. So if all non-actual parameter-values are metaphysically impossible all on their own, then it's trivial that none of them are life-permitting—no physics needed. This sort of fine-tuning comes about too easily; Spinozism entails that the world is fine-tuned for every instantiated property. The fact of fine-tuning would then be evidentially null.[40]

[39]We note that there is a good argument that only one of the epistemic possibilities is metaphysically possible. Since 'P iff actually p' is epistemically necessary, then if P is true at an epistemically possible world so will 'Actually P' But there is only one metaphysically possible world where that schema holds: the actual world.

[40]Beyond the mere fact of life.

Spinozism can easily raise problems for other presentations of the fine-tuning argument as well. For example, some other presentations involve counterfactual questions about what would have happened if some constant had taken some alternative value. But on standard treatments of counterfactuals, any counterfactual with an impossible antecedent is trivially true. Thus, in a Spinozistic setting, once one knows that the antecedent to a conditional is false, the truth of that conditional is completely uninformative.

The project of tailoring a fine-tuning argument for those with Spinozistic tendencies is interesting. Perhaps there is an alternative framework that is stripped of modal metaphysical baggage, and which is instead purely epistemic. (An example: A parameter-value is life-permitting just in case it is not a priori impossible for a world with that parameter-value to have life.) Perhaps one could develop a notion of nomic possibility which did not entail metaphysical possibility (and develop a framework of counterfactuals which does not make metaphysically impossible antecedents go trivial). Since there is no general problem with Bayesian epistemology in a Spinozistic setting, we are hopeful that such reconfigurations could prove viable.[41]

We do not wish to assume that such reconfiguration is all clear sailing. For for all we have said, perhaps there is some defensive territory that can be staked out by an atheist with Spinozistic sensibilities. That being said, the vast majority of atheists that engage in fine-tuning debates place little stock in the kind of modal inflexibility being discussed here. If the fine-tuning argument showed that the only viable atheism was Spinozistic atheism, that would be instructive enough. Moreover, we suspect that many atheists would prefer non-Spinozistic theism to Spinozistic atheism.

Broad Strategy

We have been exploring the first strategy for defending atheism against the core argument, a strategy that tries to pick holes in the core. We turn now to the second strategy for defending atheism against the core argument, a strategy that concedes the main lesson of the core argument—that atheism fares badly given the package—but tries to find reasonable space for atheism despite that concession. Here we take the main lesson of the core argument to be this: From the point of view of prior probabilities, the likelihood of theism given the package plus life is quite high.

[41]Similar issues would arise if one thought—perhaps inspired by Barry Loewer—that the actual parameter-values were nomically necessary. A reconfiguration of our argumentation would be equally viable in that case.

Supposing one wished to cling to atheism in even after that concession, there are two ways to go. One sub-strategy is to appeal to *additional evidence* that one has beyond the package plus life. After all, just because theism has high probability conditional on the package plus life, that does not mean that theism has high probability conditional on another total body of evidence that merely includes the package plus life. A second sub-strategy denies that we have the package as part of our evidence: some element of the package is questioned. Let us look at each sub-strategy in turn.

First Sub-strategy: Additional Evidence

If our total evidence were merely the package plus life, the probability of atheism would be very low. Yet it might nonetheless be the case that we have additional evidence which puts atheism in a better position.[42] One might, for example, think that the facts about evil are powerful evidence for atheism over theism.[43] Perhaps our total body of evidence militates towards atheism, even if there are some bits of our evidence that militate towards theism.[44]

It is worth mentioning the cleanest version of the first sub-strategy. One foundational issue in Bayesian epistemology is that of what it takes for a proposition to be evidence. Without claiming to be exhaustive, let us sketch two approaches. One popular approach takes it that one's evidence consists in propositions that describe the intrinsic character of one's phenomenal states – call this the phenomenal conception of evidence. But according to a competing conception, one's evidence consists in the propositions that one knows, which (on a non-sceptical view of knowledge) can extend far beyond propositions about one's phenomenal state – call this the knowledge-based conception of evidence. (It is worth noting in passing that the knowledge-based conception most easily allows the details of the package to constitute at least part of one's evidence. On a phenomenal view, one's evidence will at best consist in phenomenal states that, for example, present scientists as saying that world is thus and so.) It is at least easy in principle to see how the sub-strategy under discussion might play out within the knowledge-based approach. Most

[42] Note that just as the existence of life and the existence of tungsten provide are evidence for theism, the non-existence of anything that would have been evidence for theism is evidence against theism.

[43] Remember, the facts about evil are powerful evidence for atheism over theism if and only if those facts are much more less likely conditional on theism than they are conditional on atheism.

[44] We don't see much hope for this strategy. The evidential impact of the package plus life *massively* favors theism over atheism. For this sub-strategy to succeed, the evidential impact of evil (and anything else one cares to include) would need to be comparably massive. But we don't think it can be. We freely grant that evil is more likely—much more likely—conditional on atheism than conditional on theism. But the degree to which it is more likely can be expressed without exponentiation. The evidential impact of evil would barely dent the evidential impact of the package plus life.

obviously, someone might already know that theism is false! It is easy to show that theism will have zero probability conditional on that person's total evidence. We have no transcendental argument that such knowledge of atheism is impossible. And we certainly have no argument to show that, supposing one had that knowledge, it would somehow be destroyed or "defeated" by fine-tuning evidence.

Note that someone who took herself to know the truth of atheism and who also took herself to know the truth of the package might still be concessionary in important ways: "Given *my* total body of evidence, it is certain that atheism is true. But if someone had the package plus life and, unlike myself, failed to know the truth of atheism, they would have fantastically good evidence that atheism is false." One rarely finds this kind of concessionary atheism articulated in the literature, but it seems to us to be an interesting position.[45]

Second Sub-Strategy: Challenging the Package

Let us explore the second sub-strategy, the one that relies on questioning the package (we assume that the fact of life will not be questioned).[46] There are all sorts of alternatives to the package that might be contrived. Perhaps there is a conspiracy – physicists know that the package is false but are trying to deceive us into accepting it. More plausibly, perhaps physicists misunderstand the structure of laws. Current physics is certainly open to substantial revision.[47] Perhaps such revision would show that the true laws render life compatible with most of the values of the relevant parameters.[48] And one alternative to the package that figures prominently in the literature is one that denies that physical reality consists in a single universe.

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[45]We note in passing that the knowledge-based conception of evidence also permits a bold kind of theism. Just as we have no transcendental argument that knowledge of atheism is impossible, we also have no transcendental argument that knowledge of theism might not be triggered by knowledge of life plus the package. But it if were, and the knowledge as evidence view is correct, then the possessor of knowledge would have an *enhanced* body of evidence that includes not just life plus the package but also theism itself. For the person that was so lucky, the likelihood of atheism conditional on her evidence would be zero!

[46]Note that it's quite difficult think that one has the package as evidence. The package could only be evidence if evidence is knowledge-based and knowledge about controversial issues in physics is surprisingly easy to come by. But even if the package isn't evidence, it's very helpful to think about how things would turn out if the package were evidence. If one grants that theism does very well given the package, then an abundance of evidence for each element of the package is good news for theism.

[47]We certainly can't rule this sort of scenario out. We have no expertise in contemporary physics, and even if we did, expertise in contemporary physics is not expertise in ideal physics. Still, it should be uncomfortable to pin one's objections to the fine-tuning argument on a claim about physics that would be widely rejected by actual physicists. Physicists do make mistakes, but their field's batting average is still rather impressive (especially in comparison with the batting averages of some other fields we could mention).

[48]Where "most" is judged by at least one of the physically-respectable measures over those parameters.

Supposing that there is a multiverse, one cannot claim that if the universe's laws are inhospitable to life, then life is unlikely. Supposing that there is a multiverse, it does not even make sense to talk about *the* universe's laws——there are lots of universes in a multiverse, after all. But neither can one claim that if some universe's laws are inhospitable to life, then life is unlikely. Given a multiverse, it may well be that a wide variety of – and perhaps all -- the parameter values are represented somewhere—in which case life would be pretty much inevitable despite the fact that the laws were inhospitable to life. But we won't say anything much about how to reason about the possibility of a multiverse. The epistemological status of multiverses is highly controversial, and every extant view has appallingly implausible entailments.[49] But there is certainly reasonable hope that the probability of life conditional on atheism, fine-tuning, and a multiverse is not nearly so dire as the probability of life conditional on atheism, fine-tuning, and a single universe.

Quasi-theism is also an interesting possibility. Proper atheism might make single-universe fine-tuning staggeringly improbable, but an atheism with, say, non-agential teleological causation might make single-universe fine-tuning reasonably probable. There are lots of weird sorts of atheism that make fine-tuning more likely. We don't expect that quasi-theism will appeal to most atheists, but it is an option.

General Remarks about the Two Sub-strategies:

By our lights, some version of the broad strategy is the best bet for atheism. But it's not all clear sailing. The strongest version of its first sub-strategy relies on both a contentious view of evidence and a contentious view of the extent of that evidence. The second sub-strategy would be clear sailing if the alternatives to the package were appealing—but they are far from appealing. Our default is to have significant confidence in the broad outlines of physics, not to cry conspiracy or to be confident that physics has it all wrong. Granted, the multiverse hypotheses are taken seriously by certain physicists. But it remains quite strange indeed to suppose that we are living in a multiverse. To our minds, reasonable priors will have a much more sizeable chunk of the atheist part of epistemic space taken up by a single universe than by a multiverse. The facts of physics deal a significant blow to that portion of our epistemic space, making it shrink wildly relative to the other portions. As a result, the proponent of the second sub-strategy will likely concede that the facts of physics appealed to by the fine-tuning argument provide evidence for the existence of God as well as for the existence of a multiverse.

[49]For more, see Arntzenius and Dorr (forthcoming).

But how much evidence? How much likelier is fine-tuning given the existence of God than given the non-existence of God?

To give a feel of how the probabilities might work out, let's take a look at some numbers. We don't take these numbers particularly seriously, but it's nice to get some broad sense of how the numbers might work out.[50] How unlikely is fine-tuning given God's existence? For a ballpark figure, let's say it's 1 in 10. It's a bit strange to think that God would fine-tune a universe for life (rather than just do without life or realize life in some way that doesn't require fine-tuning) but not horribly strange. How unlikely is fine-tuning given God's non-existence? We put that figure somewhere between 1 in 100 and 1 in 10,000. It's quite strange to think that contemporary physics has blundered, it's quite strange to think that we live in a sprawling multiverse, and it's quite strange to think that there's any other remotely plausible atheistic explanation for fine-tuning.

The ratio of likelihoods at stake in the fine-tuning argument is therefore between 10 and 1,000. That makes it quite a strong argument. A ratio of 100[51] is sufficient to take someone who antecedently thought that the probability of God's existence was just under 10% to thinking that the probability of God's existence is just over 90%. Even staunch atheists would be softened up a bit. Given a ratio between 10 and 1,000, someone who thought that the prior probability of God's existence was 1 in 1,000,000 would revise the odds of God's existence to between 1 in 100,000 and 1 in 1,000.

Concluding Remarks:

What should atheists say about fine-tuning? That's a bit unclear—atheists have various ways to account for the evidence that points to fine-tuning. Perhaps there's a flaw in the physics underlying the fine-tuning argument.[52] Perhaps there's more to the natural world than a single universe, and that the sprawling, Godless multiverse is of a sort that's quite likely to contain universes which make the existence of life look like staggering good fortune.[53] These each seem like respectable hypotheses for an atheist to entertain; conditional on atheism, the bulk of our credences are split between them.

What atheists should not say is that we got lucky. The likelihood ratios at stake in the fine-tuning

[50] We find quasi-theism sufficiently implausible that it doesn't make a difference to this calculation. But you can easily take quasi-theism more seriously if you're inclined to.

[51] A ratio of 100 being the geometric mean of a ratio of 10 and a ratio of 1,000.

[52] There is precedent for such flaws. The biological design argument seemed like an exceedingly strong argument before the development of Darwinian evolution.

[53] Reasoning about the possibility of multiverses forces involvement in the staggering messiness of the epistemology of self-locating belief.

argument are simply too huge. It's massively more plausible that a secret cabal of theistic experimental physicists falsified all the fine-tuning data in order to concoct an argument for God's existence. That's not a plausible hypothesis, but it's *way* more plausible than 1 in 10^120. The sensible thing for an atheist to think about fine-tuning is that it substantially confirms a variety of antecedently implausible possibilities: a relevant and substantial mistake in the standard model of physics, quasi-theism, a multiverse, and God.

Appendix One: How not to run a fine-tuning argument—Against the Ideology of Small Changes:

Presentations of the fine-tuning argument generally focus on the numerical values of the constants of fundamental physics. It is commonly said that if the values of these constants were even very slightly different, life would be impossible.[54] Let us grant for the moment that small changes to the values of the constants would make life impossible. (We will revisit this posit more critically very soon.) Even so, we do not think that this ideology of small changes is helpful. The ideology of small changes suffers from three problems: it is irrelevant, it is not well-defined, and it is inaccurate.

Irrelevant

Let's say that a fact is *modally fragile* insofar as it fails to hold in some worlds only slightly different than the actual world. Similarly, let's say that a fact is *modally robust* insofar as it is not modally fragile. Let's suppose that the fact of life is modally fragile. How would that modal fragility feature in an argument for the existence of God?

Frankly, we don't see how it could. Remember that a fact is evidence for H over –H when it is likelier given H than it is given –H. To be strong evidence for theism, some fact would have to be much likelier given the existence of God than given the non-existence of God. So what are these likelihoods?

Fragility seems plausible given theism. We can't think of any compelling reasons why God would

[54]A representative quote from Leslie (1989): "With electromagnetism very slightly *stronger*, stellar luminescence would fall sharply. Main sequence stars would then all of them be red stars: stars probably too cold to encourage Life's evolution and at any rate unable to explode as the supernovae one needs for creating elements heavier than iron. Were it very slightly *weaker* then all main sequence stars would be very hot and short-lived blue stars."

prefer robustness to fragility. Of course, its equally true that we can't think of any compelling reasons why God would prefer fragility to robustness. Our grasp of divine psychology is (like everyone else's) somewhat limited. This is not to say that we're endorsing a strict 50/50 split of probabilities between them; that sort of indifference-based reasoning—though tempting—leads to trouble. We're happy with any prior according to which the probability of fragility given theism and the probability of robustness given theism are in the same ballpark. The differences between the priors we accept won't be important. According to any such prior, if fragility is hugely unlikely given atheism then fragility is strong evidence for the existence of God, and if fragility isn't hugely unlikely given atheism then fragility isn't strong evidence for the existence of God.

But fragility also seems plausible given atheism. Again, we can't think of any compelling reasons why atheism would lead to robustness. Again, it is equally true that we can't think of any compelling reasons why atheism would lead to fragility. So once again we're happy with any prior according to which the probability of fragility given atheism and the probability of robustness given atheism are in the same ballpark.

In general, there is no reason to think that a fragile fact is (absent divine intervention) improbable. Consider Barack Obama's height in nanometers. Let's suppose it's even (it makes no difference). That fact is modally fragile. Only slight changes to the world would make Barack Obama's height in nanometers odd. But this doesn't mean that Barack Obama's height in nanometers being even is a priori improbable. With some small changes his height would be odd, but with some further small changes it would be even again, and so on. A priori, it's roughly equally likely that Barack Obama's height in nanometers be even or odd. The modal fragility of the fact has nothing at all to do with its probability.[55]

What's important isn't any sort of modal fact, but is just a claim about probabilities. The laws of our world are of a sort that, given atheism, is hugely unlikely to allow for life. It may well be that talk of small changes is meant to evoke that idea. But modal fragility and a priori improbability are quite different, and careless elision between them engenders confusion.

Not Well-Defined

In the previous section we equated the claim that small changes to the numerical values of the

[55]If one imagines modal space as a sort of physical space, one can imagine propositions as holding in various bubbles in that space. A modally fragile proposition would then one with a small average bubble size, whereas an improbabile proposition would be one with a small total bubble size.

fundamental constants of physics would preclude life with the claim that small changes to the physical laws would preclude life. This was overly charitable. The notion of similarity between worlds is well-defined (if defined a bit murkily).[56] But there no single meaning of what a small change in numerical values amounts to. There are multiple, inequivalent ways to parameterize any numerical change.

Let's start with an easy case. Consider the roll of an ordinary 6-sided die. Consider the change from a '1' to a '2' and the change from a '4' to a '6'. Which change is bigger? The first change alters the value by 1 whereas the second change alters the value by 2. In that arithmetic sense, the second change is bigger. But the first change is a doubling of the value whereas the second change merely increases the value by 50%. In that geometric sense, the first change is bigger. Higher powers alone give infinitely many ways to parameterize these changes. This is not a problem per se——but one has to be clear what one is talking about.

If the only variability in parameterization were in how differences in values were evaluated, even that would be a great deal. But there's even more variability in how to judge the values themselves. Instead of thinking about the die rolls, let's think about 1/n of the die rolls. Instead of the possibilities being 1,2,3,4,5,6 they are 1,1/2,1/3,1/4,1/5,1/6. Whereas before the arithmetic difference between 1 and 2 was less than the arithmetic difference between 4 and 6, now the arithmetic difference between 1 and 1/2 is greater than than the arithmetic difference between 1/4 and 1/6.

The arbitrary choice of how to represent a value can have an enormous effect on naïve expectations regarding it. Suppose that there's a constant that must have a positive value. What seems more likely: that its value is between 0 and 1 or that its value is greater than 1? It seems very natural to be very confident that the value is greater than one. After all, it seems very natural to think that there are far more possible values greater than 1 than there are between 0 and 1. Of course, this thought is totally bogus. There are just as many possible values between 0 and 1 as there are above 1——continuum many. One might reason a bit more coarsely, and think instead that only a finite stretch of the possible values is between 0 and 1 whereas there's an infinite stretch of values greater than 1. But this coarse thinking won't do either. For consider another constant whose value is equal to 1/n of the first. The same reasoning should work equally well for this second constant, leading to the judgment that it, too, is far more likely to have a value greater than 1 than a value in between 0 and 1. But those two judgments cannot be simultaneously held. Since c2 = 1/c1 the values at which c1 is

[56]See Lewis (1973).

greater than 1 are just those at which c2 is less than 1, and the values at which c1 is less than 1 are just those at which c2 is greater than 1. As such, it's easy for difference that looks small in c1 to look huge in c2 and for a difference that looks huge in c1 to look small in c2.[57] The lesson is clear: naïve impressions about random variables are of little epistemic value.[58]

Inaccurate

We're not physicists, and we do not pretend to have knowledge of the physics relevant for fine-tuning. But we have talked to physicists and they explained some things to us. So please don't take our word for what follows, but please do take theirs.

Not all instances of fine-tuning involve constants which could not be changed much without precluding life. Most notably, the fine-tuning of the cosmological constant does not fit that model.

The cosmological constant measures the energy density of the vacuum. Life would be possible were the value of the cosmological constant slightly larger or smaller than it is. The remarkable fine-tuning of the cosmological constant is that we have good reason to think that the absolute value of the cosmological constant should be hugely greater than it is, roughly 10^120 times greater. As we understand contemporary physics, each fundamental constant has an effect on the value of the other constants. Since the cosmological constant is what physicist call 'a relevant parameter', that is, a parameter whose effect increases as the region of space being considered increases, at a cosmic level the values of these contributions are huge. A few dozen numbers of order 10^120 are added to and subtracted from one another, and their sum is a small, positive number. This is not what one would expect. One would expect that the value of the cosmological constant would be of order 10^120, just like the contributions. It is an astonishing fact that these huge numbers cancel one another out. (When a physicist says that a dimensional analysis of effective field theory led him to expect a radically different value for the cosmological constant, this is how he reached that conclusion. The underlying math is straightforward.) One would anticipate that the sum of these numbers would either be huge and positive or huge and negative. Were the value of the cosmological constant huge and positive, the universe would expand too rapidly for the sustained, reciprocal interaction of particles, and thus any life would be impossible. Were the value of the

[57] Note that physically-respectable measures do not provide a privileged way of parameterizing the parameter-values over which they are defined. The ideology of small changes is insuperably sensitive to an arbitrary choice of units.

[58] Naive applications of the principle of indifference will also violate countable additivity. For more on such pitfalls see McGrew, McGrew, and Vestrup (2001).

cosmological constant huge and negative, the universe would have collapsed almost immediately into a big crunch.

Apppendix Two: White on Weisberg

Roger White forcefully rejects the probability assignment which Weisberg supports. But White is a bit more forceful than he should be; while White is correct that Weisberg's probabilities are unreasonable, the probabilities that White offers instead are also unreasonable. (And although we do think that White's probabilities are not as unreasonable as Weisberg's, we're primarily interested in seeing how things shape up given reasonable probabilities. More on that soon.) White's argument assumes more than it should, more than it needs to.

White relies on a dubious premise:

(6) $P(D \mid S) \geq P(D \mid -S)$[59]

This premise means that—supposing God exists—the odds that the physically-respectable measures would give extremely low probability to life are at least as good as the odds that—supposing that God doesn't exist—the physically-respectable measures would give extremely low probability to life . This premise seems deeply dubitable. Why should a God-created world be at least as likely to have such measures as a godless world? Is it really unreasonable to think that God would be a bit more likely to make nice, life-friendly laws than it would be for the godless laws to just happen to be nice and life-friendly? It is unreasonable for White to be so strict about what priors regarding divine inclinations are tenable.

So what happens when one is a bit more flexible about priors regarding divine inclinations? We're amiably disposed to a wide variety of such priors. If you think that God-created laws are 100 times as likely to be life-friendly as godless laws are, you'll hear no quarrel from us. If you think that godless laws are 100 times as likely to be life-friendly as God-created laws are, you'll hear no quarrel from us. We're not theologians and we're not particularly quarrelsome. And we note that given any prior in that range the fine-tuning argument will proceed just fine. All one needs to make the fine-tuning argument work is a modicum of uncertainty about divine inclinations.[60] But if you have no

[59]Remember that S is the proposition that the physically-respectable measures for our laws give extremely low probability to life-permitting worlds and D is the proposition that theism is true.

[60]Note that the strength of the fine-tuning argument will vary according to one's level of uncertainty about divine

such modicum of uncertainty—if you think you can predict God's tastes with so much precision that you need exponentiation to express the minuteness of your probability of error—only then will we object.

Appendix Three: A Lesson from Statistical Mechanics:

There's good precedent for the sort of reasoning we've engaged in. The same sort of reasoning can be found in the illustrious history of statistical mechanics. Good reasoning doesn't need scientific precedent, of course. But we think that the parallel is illuminating, so here goes:

Suppose that there is a big pool of water. Half the water is clear and half the water is blue, the latter having had blue food coloring added to it. There's a little divider separating the two sorts of water. Now suppose that the divider were gently removed, thus bringing the clear water and the blue water into contact. What will happen? We know from experience that the clear water and the blue water will mix, and that we'll wind up with a pool of uniformly light-blue water.

There's a good story from physics about why we should make that prediction. It goes like this: If you knew the micro-state of the water you could just evolve that state forward using the laws of motion. [61] But you don't know the micro-state of the water, you just know its macro-state. That macro-state excludes plenty of micro-states (ones without a pool of water divided the way it is) but there's no real reason for you to think of any of the remaining micro-states as more or less probable than any of the others. There are infinitely many remaining micro-states, but indifference about them can be made formally tractable with Lebesgue volume measure. Thus, using the laws of motion, it's possible to determine what the micro-states consistent with the macro-state tend to do. We can prove that the overwhelming majority of those micro-states will evolve to a pool of uniformly light-blue water, thus vindicating confidence that micro-state will evolve to a pool of uniformly light-blue water.

This methodology doesn't just work for mixing clear water and blue water. It works for mixing hot water and cold water, smoke diffusing, ice melting, wood burning, paper yellowing, skin wrinkling, and on and on. Predictions regarding enormous numbers of apparently unrelated phenomena can be

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inclinations. The more you expected fine-tuning from God, the stronger the argument is; the less you expected fine-tuning from God, the weaker the argument is.

[61] It's standard to employ Newtonian mechanics for such thought experiments. The vicissitudes of quantum mechanics don't make a difference at this macroscopic scale.

evaluated with this methodology.

This methodology is great for predictions, but what about retrodictions? It's great for where we're going, how about for where we've been? Here the methodology runs into serious trouble. Newtonian mechanics are time-reversal symmetric. This implies that just as most micro-states of an ice cube in tepid water evolve to uniformly cool water, most micro-states of an ice cube in tepid water evolved from uniformly cool water. While an ice cube melting is an entirely ordinary phenomenon, an ice cube spontaneously forming in a glass of cool water is a weird fluctuation. But following this methodology leads to the bizarre conclusion that everything we see is the result of weird fluctuations. It's as though a box of puzzle pieces were shaken so that the random motion of its pieces just happened to complete a section of the puzzle. Our thoughts about the past is completely unreliable, as we should think our putative evidence about the past is actually the result of a recent, weird fluctuation. And it's not just ancient history we lose. It's not as though we lose Greece and Rome but everything local is hunky-dory. Books weren't printed—they recently emerged from high-entropy goop. Photos weren't taken—they recently emerged from high-entropy goop. Basically anything that you can tell isn't high-entropy goop recently emerged from high-entropy goop, and anything you can't tell isn't high-entropy goop is high-entropy goop.[62]

This is clearly wrong. But these retrodictions are no cause for alarm. We shouldn't believe the crazy retrodictions, just as we wouldn't have believed crazy predictions.. If the retrodictions are insuperably crazy, then we just need to find some other way to do retrodictions. But since this methodology did so well with predictions, it would seem odd if there was no way to patch it to deal with retrodictions. And indeed there is. The crucial posit is that the universe's initial conditions were in a state of very low entropy. Results from statistical mechanics show that this posit doesn't affect predictions, but with it retrodictions come out right.[63]

Everything depends on the universe's initial state having low entropy. If one could take such a thing for granted *a priori* then that'd be fine. But one can't. It's not as though anyone knew knew that the universe started in a low entropy state before figuring all this out. The prior probability of the universe's starting in a low entropy state has to be intermediate. Happily, there's plenty of latitude regarding this prior probability. One could think the initial low entropy state enormously unlikely *a priori* and still wind up virtually certain of it. Thus a person who was *a priori* certain of the initial

[62]The knowledge-based conception of evidence is ineffective against this skeptical worry. High-entropy goop would engulf anything not known not to be high entropy goop. If you know that you have hands you can deduce that you're not a brain in a vat. But even knowing that you have hands you cannot deduce that your hands did not recently emerge from high-entropy goop.
[63]For more see Albert (2000).

low entropy state and the person who was *a priori* doubtful of the initial low entropy state will make virtually identical predictions and retrodictions. The order that we see is so staggeringly unlikely given high entropy initial conditions that even if one gave low entropy a prior of 1 in a million its posterior will be virtually 1.

Why is it reasonable to give low-entropy initial conditions that little bump relative to its probability in the uniform measure?[64] Why is it physically-respectable to think that low entropy initial conditions had probability of at least 1 in 1,000,000 instead of around 1 in 10^10^120?[65] Well, the idea of low entropy initial conditions doesn't seem unnatural as far as naturalistic physics is concerned. Low entropy seems like the sort of thing that a respectable physics could afford special status to (in much the same way that 0 seems like a value that a respectable physics could afford special status to). Such special possibilities may reasonably receive more probability than analogous non-special possibilities. Thus although there is a very natural measure according to which low entropy initial conditions have truly minuscule probability, there's nothing even remotely unreasonable about thinking that there is a physically-respectable measure that assigns greater probability to low-entropy initial conditions.[66] But in that case there's no argument based on the fine-tuning of initial conditions to be had.

Naturalistic physics has an easier time accounting for low-entropy initial conditions than it has accounting for parameter-values that are fine-tuned for life. It isn't strange for naturalistic physics to afford a special status to low-entropy initial conditions, but it would be strange for naturalistic physics to afford a special status to life (or tungsten, or any other medium-sized dry good). Thus although there isn't a good argument for theism based on low-entropy initial conditions, there is a good argument for theism based on the fine-tuning of parameter-values.[67]

[64]Little arithmetically. *Huge* geometrically.

[65]For more see Penrose (1999).

[66]For a detailed treatment of low-entropy initial conditions which nonetheless neglects this approach, see Collins (1999).

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