The Fine-Tuning Argument Against the Multiverse

by Kenneth Boyce and Philip Swenson

Abstract: It is commonly argued that the fact that our universe is fine-tuned for life favors both a design hypothesis as well as a non-teleological multiverse hypothesis. The claim that the fine-tuning of this universe supports a non-teleological multiverse hypothesis has been forcefully challenged however by Ian Hacking and Roger White. In this paper we take this challenge even further by arguing that if it succeeds, then not only does the fine-tuning of this universe fail to support a multiverse hypothesis, but it tends to favor a single-universe hypothesis instead.

Keywords: confirmation, design argument, fine-tuning, inverse gambler's fallacy, multiverse

I. Introduction

A striking phenomenon uncovered by contemporary physics is that many of the fundamental constants of nature appear to have arbitrary values that happen to fall within extremely narrow life-permitting windows.[1] It is also commonly held, furthermore, that this fact provides evidence for what we will call "the teleological hypothesis." According to the teleological hypothesis, there is some agent, power, or fundamental teleological principle governing the whole of reality (including other universes, if such there be) that promotes the existence of a life-permitting universe. Varieties of theism according to which there is an omnipotent, omniscient, and wholly good being who intentionally brings it about that there is at least one life-permitting universe afford a widely endorsed version of this hypothesis.[2] But the teleological hypothesis is also compatible with other views, such as axiarchism, according to which there are fundamental

[1] For lists of proposed examples, see (Collins 2003), (Rees 2000), and (Lewis & Barnes 2016). For criticisms of this claim see (Stenger 2011) and for a response to these criticisms see (Barnes 2012).

[2] Perhaps theism *simpliciter* fails to count as a version of the teleological hypothesis, however, since it is debatable whether it is discernible on purely *a priori* grounds that an omnipotent, omniscient, and wholly good being would likely promote the existence of life. On this point, see (Manson 2013) and (Hudson (2016).

metaphysical principles orienting reality toward the realization of the good.[3] In any case, if the teleological hypothesis is false and there is only one universe, the argument goes, it is extraordinarily unlikely that the constants of nature would just so happen to fall within the life-permitting windows. But given the teleological hypothesis, it is not that unlikely.[4]

One common response to the above argument is to concede that fine-tuning considerations provide strong evidential support for a teleological hypothesis *on the supposition there is only one universe* while denying that they lend strong support to the teleological hypothesis *overall*. That is because, these objectors claim, the same considerations also lend strong evidential support to a rival hypothesis. In particular, they argue, the phenomenon of fine-tuning strongly supports a *non-teleological multiverse hypothesis*. The thought is that if there is a sufficiently large number of universes whose constants vary widely, it is all but inevitable that at least some of them will be life permitting, and that any observers will find themselves in such universes.[5]

The claim that fine-tuning considerations lend support to a non-teleological multiverse hypothesis is subject, however, to a powerful objection originally articulated by Ian Hacking (1987) and expanded upon by Roger White (2000; 2003). Hacking and White argue that to make this claim is to commit what Hacking dubs "the inverse gambler's fallacy". Just as it would be probabilistically fallacious to judge it more likely that many dice rolls are taking place tonight merely because the dice roll one recently happened to make came up a double six, so it is fallacious, Hacking and White argue, to maintain that the fact that something improbable

[3] See (Leslie 1979). See also (Nagel 2012) and (Goff 2023) for additional examples of non-theistic views that accord well with the teleological hypothesis.

[4] See for example (Leslie 1989), (Swinburne 2004), (Collins 2009), and (Rota 2016).

[5] See for example (Rees 2003), (Dawkins 2006), and (Tegmark 2014: 140, 362-363).

happened with our universe provides evidence that there are many universes. The fact that *this universe* is life permitting, they argue, is (given the hypothesis that its life-permittingness is entirely a matter of chance) probabilistically independent of how many universes there are.

We may give a more precise formulation of these claims by taking for granted the standard Bayesian/likelihoodist framework in which the fine-tuning argument is frequently cast.[6] A central feature of this framework is what has come to be known as "the likelihood principle":

> (LP) Evidence e favors hypothesis h_1 over h_2 relative to background knowledge k if and only if $P(e|h_1\&k) > P(e|h_2\&k)$. I.e. if and only if the likelihood of e given h_1 and k is greater than the likelihood of e given h_2 and k.

Now let 'L' stand for the claim that this universe is life permitting, 'S' for the claim that there is only a single universe, 'T' for the teleological hypothesis, and 'K' for a proposition encapsulating background knowledge that includes both the fact that this universe exists and the fact that any life-permitting universe is fine-tuned (and the extent to which fine-tuning is required for life) but no other relevant information.

The central claim of the fine-tuning argument for the teleological single-universe hypothesis may now be expressed as follows:

(1) $P(L|T\&S\&K) > P(L|\sim T\&S\&K)$.

That is, the likelihood that this universe is fine-tuned given the teleological single-universe hypothesis is greater than the likelihood that this universe is fine-tuned given the non-teleological single-universe hypothesis (relative to the specified background information).

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[6] See (Collins 2009) for a representative example.

Likewise, the central claim behind the this-universe objection to the fine-tuning argument for a non-teleological multiverse hypothesis may be stated as:

(2) P(L|~T&S&K) = P(L|~T&~S&K).

That is, on the assumption that the teleological hypothesis is false, the likelihood of this universe being fine-tuned is independent of the claim that it is part of a multiverse (relative to the specified background information).

A few more clarificatory remarks regarding these conditional probability claims are in order. First, the conditional probabilities at issue are to be understood as *epistemic* probabilities. Our preferred view of conditional epistemic probabilities, furthermore, is that they are measures of degrees of evidential support between propositional statements, rather than measures of actual or hypothetical credences.[7] None of our arguments turn on adopting this view however. What is important for our purposes is that the conception of epistemic probabilities at hand allows for their being well-defined with respect to extremely sparse bodies of background information – in particular, with respect to background information that excludes a great deal of what we might consider "old evidence." Indeed, the background information must be allowed to exclude even such "Cartesian" facts as that there are conscious beings.[8] The claim that such epistemic probabilities are available is controversial,[9] but also frequently taken for granted in the literature on the fine-tuning argument.[10]

[7] See (Williamson 2000: 209-10) and (Climenhaga 2023) for articulations and defenses of this sort of conception of epistemic probability.

[8] See (Monton 2006) and (Meacham 2016) for further discussions of such conceptions.

[9] See Pust (2007) for an argument against this claim.

[10] Although see (Roberts 2012) for a version of the fine-tuning argument that does not depend on such a conception.

Second, we do not deny that the mere fact that this universe exists may provide some evidence for a multiverse. Often the discovery that a single instance of a kind exists provides evidence for there being other things of that kind. Since L entails, furthermore, that this universe exists, had we failed already to include that fact in the background information, it might have turned out for this reason (contrary to 2) that P(L|~T&S&K) < P(L|~T&~S&K). However, as Kai Draper, Paul Draper, and Joel Pust (2007) point out concerning White's argument:

> White takes the existence of our universe to be a part of the background information K. Further, he does this presumably for the good reason that he is interested in evaluating a *fine-tuning* argument for [the multiverse hypothesis]. He does not address the question of whether the mere existence of our universe confirms [the multiverse hypothesis over the single-universe hypothesis]. (9)

There is, in any case, already a large body of literature surrounding these issues.[11] And it is not our purpose to contribute directly to these debates. Rather, we will argue that if claims 1 and 2 are true, they lend themselves to an additional, surprising result. In particular, we will argue that if both are true, then not only do fine-tuning considerations fail to provide evidence for the multiverse hypothesis, but also that there is an important sense in which they tend to confirm the single-universe hypothesis instead.

II. Rota's Fine-Tuning Argument for a Theistic Multiverse

[11] See (Friederich 2021) for an overview of literature surrounding the fine-tuning argument for design. See (Bostrom 2002), (Holder 2002), (Manson and Thrush 2003), (Juhl 2005), (Rota 2005), (Draper *et. al.* 2007), (Bradley 2009), (Metcalf 2018), and (Isaacs *et al.* 2022) for discussions of the this-universe objection.

It will help set up our own discussion to consider a different argument, offered by Michael Rota (2016: chapter 8), for the conclusion that fine-tuning considerations strongly favor a theistic multiverse hypothesis over a non-teleological multiverse hypothesis. In Rota's own words,

> For each given physical universe that God creates, that universe would exhibit more value if it contained living beings (especially rational beings) than if it contained no life at all. So God would have some reason to make an appreciable proportion of universes life permitting. On the other side, there doesn't seem to be any very strong reason God would have to create many lifeless universes. So the expected proportion of life-permitting universes should not be very low… If there is no Mind behind the multiverse, we would expect the proportion of life-supporting universes to be miniscule … Surely the proportion would be much, much higher if the cause of the multiverse were a purposive being likely to value life. (pp. 129-130)

For this reason, Rota concludes, it is more expectable given a theistic multiverse hypothesis than it is given a non-teleological multiverse hypothesis that this universe is life-permitting.

We intend neither to challenge nor endorse Rota's more general contention that the fact that our universe is fine-tuned for life strongly supports a theistic multiverse hypothesis over a naturalistic one. Even so, we believe there is *some* reason to doubt that, given the teleological hypothesis (in either its theistic or non-theistic versions), "the expected proportion of life-permitting universes should not be very low." These sources of doubt spring both from *a priori* considerations as well as empirical ones.

As far as *a priori* considerations go, there are at least some reasons to doubt that if an agent, power, or fundamental teleological principle (whether God or something else) promotes the *existence* of life-permitting universes, it also promotes there being a high proportion of life-

permitting universes. Consider, for example, a teleological multiverse hypothesis according to which reality is ordered according to a principle of plentitude and thereby ordered so that it manifests all manner of diverse kinds (and thereby ordered so that it contains a large number of life-excluding universes). Some philosophers have argued that such a hypothesis is entailed or at least made probable by theism.[12] We need not make any such positive argument however in order to note that the sort of considerations Rota provides fail to *rule out* such a hypothesis on purely *a priori* grounds.

As far as empirical reasons are concerned, astronomical observations indicate that on a number of natural ways of partitioning the observable universe into potentially life-sustaining, connected regions, and at a number of scales, the ratio of life-permitting regions to non-life permitting ones is quite low. On most such partitions, the vast majority of regions of our universe are hostile to life. We have also so far detected no clear evidence of life anywhere else except on Earth. Attempts to scan nearby galaxies for advanced civilizations that we would expect to leave thermal traces have come up empty.[13] Life, or at least intelligent civilization, appears to be quite rare.

If there is some agent, power, or teleological principle that is responsible for ensuring that our universe is capable of sustaining life, it did not take the extra step of ensuring that our universe is densely packed with life. This in turn affords at least some empirical reason to doubt teleological hypotheses according to which the agent, power, or teleological principle in question ensures that a high proportion of the potentially life-permitting regions that exist are in fact life permitting, even if it does take care to ensure that *some* are. And so, empirical considerations

[12] See for example (Kraay 2010) and (O'Connor 2012).
[13] (Griffith *et al.* 2015)

offer some reason to doubt versions of the teleological multiverse hypothesis that would lead us to expect that a high proportion of universes are life permitting. Granted, these considerations may not be relevant to Rota's argument as stated (since that argument presupposes background knowledge that does not include those observations), but even so, they would have to be taken into account as part of our total evidence.

Our claim here is merely that these empirical reasons provide us with some *reason to doubt* that whatever agent, power, or teleological principle there may be was interested in ensuring that every universe in the multiverse is life permitting. Accordingly, what we say is compatible with there being alternative explanations of these observations. Given physics like ours, for instance, in order for there to be life, there must be adequate time for heavy elements and second-generation stars to form. And these requirements, coupled with a life-permitting universe expansion rate, will tend to ensure that any life-permitting universe with physics resembling ours will contain vast regions of space and time that are devoid of life.[14] If the relevant agent, power, or teleological principle is bound by those constraints, or has reason to work within them, it may have some reason to produce universes where the density of life is much as we observe, even if it otherwise prefers to ensure that reality contains as many life-permitting regions as feasible.

But then again, if that power is subject to physics-based constraints on just how densely packed with life a single universe can be, there may also be such constraints on how plentiful life can be within a multiverse. Perhaps the most elegant sets of physical laws governing life-permitting multiverses, for example, also ensure that the proportion of life-permitting universes

[14] We thank an anonymous referee for pressing us to address this alternative explanation. See also (Ross 2008: ch. 2).

is relatively low. Indeed, apart from fine-tuning considerations, one motivation behind proposing the existence of a multiverse is that the specific values of the constants of nature seem unacceptably arbitrary. Why these values and not others? This apparent arbitrariness can be seen as a flaw marring an otherwise remarkably elegant set of physical laws. Positing the existence of a multiverse governed by laws that allow for significant variation among these constants permits us to maintain that the most fundamental laws governing reality are considerably less arbitrary.[15] These thoughts push in the direction of the view that if there is some agent, power, or teleological principle interested in having a multiverse governed by elegant physical laws, it will produce one in which the constants of nature vary widely, and thereby one with a low proportion of life-permitting universes.

In any event, it does not matter for the arguments that follow whether we have given any strong *a priori* or empirical reasons to *believe* that if the teleological multiverse hypothesis is true, the proportion of life-permitting universes is low. All that matters for the arguments that follow is that we have given some reason to assign teleological multiverse hypotheses according to which that proportion is low a non-zero probability.

III. The Teleological Hypothesis and the Density of Life

Now, keeping the above in mind, suppose there is some agent, power, or teleological principle that promotes there being at least one life-permitting universe. And consider the likelihood (given that supposition and the background information K) that this universe is life permitting. If in fact there is only one universe, then it will turn out fairly likely (given K, which includes the

[15] Reasoning along similar lines motivates some to posit a multiverse as a solution to the so-called "landscape problem" for string theory. See (Read and Le Bihan 2021) for a critical discussion.

fact that this universe exists) that this one is life permitting, since in that case there are no other opportunities for life-permitting universes. On the supposition that there is a multiverse, however, it is less likely that this one is life permitting, since in that case there are many more opportunities. And as we have seen, while the agent, power, or teleological principle in question might effectively promote the existence of life, there is less reason to believe that it effectively promotes reality's being densely packed with life. So while the considerations raised by Hacking and White suggest that the probability of this-universe being life-permitting is independent of how many other universes there are on the assumption that the teleological hypothesis is false, the same cannot be said on the assumption that the teleological hypothesis is true. Given the teleological hypothesis, life is more likely in this universe if there are no other universes.

These considerations alone provide reason to endorse the following claim:

(3) $P(L|T\&S\&K) > P(L|T\&\sim S\&K)$.

That is, the considerations offered so far provide reason to endorse the claim that (relative to the specified background knowledge) the likelihood that this universe is life permitting on the assumption that the teleological single-universe hypothesis is true is greater than the likelihood that this universe is life permitting on the assumption that the teleological multiverse hypothesis is true.

There are additional considerations that can also be marshaled in favor of the above claim. For ease of exposition, let 'A' abbreviate the phrase 'whatever agent, power, or teleological principle there may be'. We should lend at least some credence to the hypothesis that A also has other goals that at times dispose it to prevent certain universes from being life permitting. There may well be types of value that A also aims to realize, for example, that

require the existence of universes that are life excluding. Such goals might even dispose A to prevent *this* universe from being life permitting, provided there are other opportunities for life-permitting universes.

Now, consider the following hypothesis:

(F) A favors the life-permittingness of other universes over the life-permittingness of this one.

It is evident that

(3a) P(L|T&S&K) > P(L|F&T&~S&K).

It is evident, that is, that the likelihood of this universe being life permitting given the teleological single-universe hypothesis is greater than the likelihood of this universe being life permitting given that there is a multiverse and an agent, power, or teleological principle that favors the life-permittingness of other universes over this one.

Now let us assume the negation of F. That is, let us assume that A *does not* favor the life-permittingness of other universes over this one. Note that this assumption does not tell us anything about the degree to which A *does* favor the life-permittingness of this universe. It may be, on the supposition that ~F is true, that A strongly favors the life-permittingness of this universe, just as strongly, perhaps, as A would if this were the only universe there is. But it may also be true, for example, that while A is disposed to bring it about that at least some universe is life-permitting, A is completely indifferent to whether this one is. These considerations suggest that

(3b) P(L|T&S&K) ≥ P(L|~F&T&~S&K).

They suggest, that is, that the likelihood of this universe being life-permitting given the teleological single-universe hypothesis is at least as great as the likelihood of this universe being

life-permitting given the teleological multiverse hypothesis and the supposition that A does not favor the life-permittingness of other universes over this one.

It can be proven that the conjunction of 3a and 3b entails 3.[16] Note furthermore that it does not matter for the purposes of this argument whether the epistemic probability of F given K is high. The argument requires only that this probability is non-zero.

IV. Independence and Confirmational Tendencies

We intend to argue that it follows from the likelihood claims we have endorsed so far that there is an important sense in which fine-tuning considerations *tend to* favor the single-universe hypothesis over the multiverse hypothesis. We must also be careful, however, not to overstate the case. In particular, it does *not* follow from the above claims alone that the life-permittingness of this universe is *in fact* more likely given the single-universe hypothesis than it is given the multiverse hypothesis. I.e. it does not follow that $P(L|S\&K) > P(L|\sim S\&K)$.

For all we have said, it might turn out that the truth of the proposition that there is a multiverse would itself count as strong evidence for the teleological hypothesis, and correspondingly, that the truth of the proposition that there is only one universe would count as strong evidence against it. It is consistent with all we have said, for example, both that $P(T|\sim S\&K) \approx 1$ and that $P(T|S\&K) \approx 0$. And since many proponents of the fine-tuning argument maintain that $P(L|T\&K) >> P(L|\sim T\&K)$, it could also turn out (for these reasons) to be true that $P(L|\sim S\&K) > P(L|S\&K)$. And so it could end up being the case, *all things considered*, that the

[16] Provided that all the conditional probabilities are well defined (which follows from the supposition that 3a and 3b are both true), it follows from the theorem of total probability that $P(L|T\&\sim S\&K) = P(F|T\&\sim S\&K)P(L|F\&T\&\sim S\&K) + P(\sim F|T\&\sim S\&K)P(L|\sim F\&T\&\sim S\&K)$. It follows from this together with 3a and 3b that $P(L|T\&\sim S\&K) < P(F|T\&\sim S\&K)P(L|T\&S\&K) + P(\sim F|T\&\sim S\&K)P(L|T\&S\&K) = P(L|T\&S\&K)[P(F|T\&\sim S\&K) + P(\sim F|T\&\sim S\&K)] = P(L|T\&S\&K)[1] = P(L|T\&S\&K)$. And so it follows that $P(L|T\&\sim S\&K) < P(L|T\&S\&K)$.

life-permittingness of this universe ends up favoring the multiverse hypothesis over the single-universe hypothesis.[17]

But if the fact that this universe is fine-tuned for life does end up favoring the multiverse hypothesis for this sort of reason, the manner in which it does so is (in an important sense) *indirect*. Instead of directly confirming the multiverse hypothesis, the fact that this universe is fine-tuned simply ends up strongly confirming *another hypothesis* (the teleological hypothesis) which in turn confirms the multiverse hypothesis. But what we are interested in is the evidential impact that fine-tuning *taken by itself* has on the multiverse hypothesis. Or to put it another way, we are interested in the question of whether the fact that this universe is fine-tuned for life *tends directly to confirm* or disconfirm the multiverse hypothesis, without doing so *by way of* confirming or disconfirming the teleological hypothesis.

We can discover the answer, furthermore, by attending to the relationships between the *likelihoods* established above, while *blocking off* any indirect confirmational path that runs from the fact that this universe is fine-tuned for life, *through* raising or lowering the probability of the teleological hypothesis, to confirming or disconfirming the multiverse hypothesis. We can do so by choosing a setting of the *prior probabilities* that makes these hypotheses *independent*, thereby severing any confirmational connection there may be between the teleological hypothesis and the multiverse hypothesis. That is, we may accomplish this by choosing our prior probabilities so that $P(T|{\sim}S\&K) = P(T|S\&K)$.

[17] See (Kray 2010) and (O'Connor 2012, chapter 5) for examples of arguments that the probability of our being in a multiverse is high (or even entailed by) theistic versions of the teleological hypothesis.

We want to emphasize that by choosing to examine what takes place given such a setting of the prior probabilities, we are not insisting that this setting is *correct*. We want merely to focus on the confirmational relationships that interest us. If you think, for example, that in fact P(T|~S&K) > P(T|S&K), you may imagine adding hypothetical information to the background knowledge in a way that leaves the relationships between the likelihoods discussed above intact while screening off the confirmational relationship between ~S and T. Or, if you take a more subjective Bayesian approach, you might imagine inquiring into how the situation looks from the perspective of an agent who has followed our reasoning about the relevant likelihoods and who also sets their prior probabilities so that P(T|~S&K) = P(T|S&K).

V. Fine-Tuning Against the Multiverse

So far we have endorsed the following three claims:

(1) P(L|T&S&K) > P(L|~T&S&K).

(2) P(L|~T&S&K) = P(L|~T&~S&K).

(3) P(L|T&S&K) > P(L|T&~S&K).

We also argued in the previous section that it is dialectically appropriate to set our prior probabilities so that

(4) P(T|S&K) = P(T|~S&K).

It follows from all of the above furthermore that

(5) P(L|S&K) > P(L|~S&K).[18]

[18] Provided that all the relevant conditional probabilities are well defined (which follows from the assumption that 1-4 are true), it follows from the theorem of total probability that P(L|S&K) = P(T|S&K)P(L|T&S&K) + P(~T|S&K)P(L|~T&S&K). It follows from 4 that 1 – P(~T|S&K) = 1 – P(~T|~S&K) and therefore that P(~T|S&K) = P(~T|~S&K). So it also follows from 4 and the previous result that P(L|S&K) = P(T|~S&K)P(L|T&S&K) + P(~T|~S&K)P(L|~T&S&K). It follows from this together with 2 and 3 furthermore that

That is, relative to probability assignments that make whether there is a multiverse independent of the teleological hypothesis, the fact that this universe is fine-tuned for life disconfirms the multiverse hypothesis.

Thus, there is an important sense in which the fact that this universe is fine-tuned for life tends to count as evidence against the multiverse hypothesis. In light of the fact that many have believed the exact opposite to be the case, this is a surprising result.[19]

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P(L|S&K) > P(T|~S&K)P(L|T&~S&K) + P(~T|~S&K)P(L|~T&~S&K). Since it also follows from the theorem of total probability that P(L|~S&K) = P(T|~S&K)P(L|T&~S&K) + P(~T|~S&K)P(L|~T&~S&K), it follows that P(L|S&K) > P(L|~S&K).

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