Fine-Tuning and the Infrared Bull's-Eye

John T. Roberts

Department of Philosophy

University of North Carolina, Chapel Hill

jtrosap@gmail.com

phone: 336-370-1463

fax: 919-843-3929

Abstract

I argue that the standard way of formalizing the fine-tuning argument for design is flawed, and I present an alternative formalization. On the alternative formalization, the existence of life is not treated as the evidence that confirms design; instead it is treated as part of the background knowledge, while the fact that fine tuning is required for life serves as the evidence. I argue that the alternative better captures the informal line of thought that gives the fine-tuning argument its intuitive plausibility, and I show that the alternative formalization avoids all of the most prominent objections to the fine-tuning argument, including the objection from observation selection effects, the problem of old evidence, the problem of non-normalizable probability measures and a further objection due to Monton. I conclude that the alternative formalization is the one that attention should be focused on.

Keywords: Fine-tuning, design, natural theology, god, Elliott Sober, Bradley Monton

1. The Fine-Tuning Argument for Design

The informal line of thought behind the fine-tuning argument for design runs as follows: Our best current physical theories tell us that our universe is characterized and distinguished from other possible universes by the values of certain parameters, including the values of the fundamental physical constants and various features of the initial conditions. Those theories provide no explanation for why any of those parameters should have the values they do—the values of these parameters is as far as we can tell a matter of brute empirical fact. Recent research seems to show that if the values of any of these parameters had been outside of an astonishingly narrow range, then it would have been impossible for life to evolve.[1] And yet, our universe's parameter-values are within the tiny life-permitting range. Let's take the empirical claims here for granted. The facts just described are astonishingly unlikely given the hypothesis that the universe is set up the way it is by chance, or for no reason at all. By contrast, they are far less unlikely given the hypothesis that the parameters in question were set (or at least influenced) by an intelligent and purposive agent. So to that extent, these facts are evidence that favors design over chance.[2]

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[1]See (Barrow and Tipler 1986), chapters 5-6; (McMullin 1993); (Collins 2003).

[2]It's a vexed question just what "chance" amounts to in this context. I think it's best understood as the purely negative hypothesis that the fact that the parameters in question

This argument is naturally reconstructed using the Likelihood Principle:

Likelihood Principle In a context where the background knowledge is B, evidence E favors hypothesis H_1 over hypothesis H_2 iff $Pr(E|H_1 \wedge B) > Pr(E|H_2 \wedge B)$.[3]

Here is a more-or-less standard semi-formal presentation. First, we introduce some abbreviations:

R The universe is characterized by (among other things) the values of a number of real-valued parameters P_1, P_2, … P_N, and there exist narrow[4] ranges of real

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have values in the life-permitting range cannot be explained by either (i) physical laws that make it very probable, or (ii) any teleological process such as the activity of an agent.

[3]Of course, it's an important question how we interpret the probability function $Pr(-)$; different advocates of the fine-tuning argument give different answers here, and I'll leave the question open for now.

[4] Some critics of the fine-tuning argument have argued that insofar as the argument works at all, it would work so long as this premise said only that the ranges in question

numbers R_1, R_2, ... R_N such that laws of our universe imply that if $P_i \notin R_i$ for any i, then some condition necessary for the existence of life is not met.

V In our universe the value of each parameter P_i lies within the corresponding R_i.

L Life exists in our universe.

D In our universe, the values of the parameters P_1 ... P_N are set or influenced by the intentional actions of a purposive and intelligent being.

C In our universe, the values of the parameters P_1 ... P_N are a matter of chance.[5]

The argument proceeds as follows:

Premise 1: R belongs to our background knowledge B.

Premise 2: If R belongs to our background knowledge B, then $Pr(L|D \wedge B) > Pr(L|C \wedge B)$

Step 3, by 1 and 2: $Pr(L|D \wedge B) > Pr(L|C \wedge B)$

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are finite; so long as they are finite, they could be as broad as you like. (McGrew, McGrew and Vestrup 2003) call this the problem of the "Coarse-Tuning Argument.")

[5]See note 2.

Conclusion, by 3 and the Likelihood Principle: Given our background knowledge, L evidentially favors D over C.

Premise 1 is an empirical assumption. Premise 2 is supposed to be plausible since it seems so unlikely for the universe to sustain life if this requires the values of the parameters–which, according to C, are a matter of chance–to be in a narrow range, whereas a life-sustaining universe seems much less likely on the hypothesis of a designer.[6] Once those two premises are accepted, the rest of the argument seems to go through without a hitch. The conclusion states that the fact that our universe is life-sustaining is evidence that favors the hypothesis that our universe was designed over the alternative hypothesis that it is the result of chance.

On this way of setting up the argument, the evidence that favors design over chance is L. An alternative way of setting up the argument[7] lets V be the crucial

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[6]Again, see note 2.

[7] (Sober 2009) focuses on what is essentially this form of the argument. On the version he considers, the crucial likelhood inequality is:

(I)   Pr(constants are right | ID) > Pr(Constants are right | Chance)

evidence–informally speaking, it is the fact that the values of the constants are right for life (rather than the actual existence of life) that serves as evidence of design.

Premise 1': R belongs to our background knowledge B.

Premise 2': If R belongs to our background knowledge B, then $\Pr(V|D \wedge B) > \Pr(V|C \wedge B)$

Step 3', by 1' and 2': $\Pr(V|D \wedge B) > \Pr(V|C \wedge B)$

Conclusion, by 3' and the Likelihood Principle: Given our background knowledge, V evidentially favors D over C.

where ID stands for "intelligent design" (see p. 81). What makes (I) plausible is the assumption that it would be improbable for the constants to be right if they were set by chance, whereas it is what we should expect if they were set by design. This in turn is plausible only insofar as the constants have to be right in order for life to be possible, and only insofar as the range of possible values for the constants that would make life possible is narrow; so (I) seems to take it for granted as part of the suppressed background knowledge that what I have called R is true. So Sober's (I) is essentially equivalent to my Premise 2'. Sober grants that (I) is true, but denies that it is the inequality we need to focus on in assessing the fine-tuning evidence. This is because of the problem of observation selection efects, which I will consider below.

These two versions of the argument need not stand or fall together, for Premise 2 is logically independent of Premise 2'.[8] Nevertheless, the objections I will consider below work the same when applied to either version. I will focus on the first version.

The conclusion of the argument (on either version) makes no claim about how probable we should think the design hypothesis is, and it makes no claims about what characteristics we should attribute to the designer. So it is a modest argument. Nevertheless, it has attracted much attention and caused much controversy.

Many objections have been raised against the argument thus formulated. I will argue that the standard objections raise problems for the semi-formal presentation of the argument I just gave, but do not cause any trouble for the informal line of thought sketched in the first paragraph of this paper. I will do this by presenting an alternative formalization of the argument that is more faithful to that informal line of thought and evades the standard objections.

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[8] Given R, L is strictly stronger than V. So this is an instance of the general fact that whether one piece of evidence favors one hypothesis over a second is logically independent of whether a strictly stronger piece of evidence also favors the first over the second.

2 Three Objections

The first objection is that the relevant background knowledge B must also include either L or something that entails L. So B is equivalent to the conjunction of L and some B'. Thus:

$$Pr(L|D \wedge B) = Pr(L|D \wedge L \wedge B') = 1$$

and:

$$Pr(L|C \wedge B) = Pr(L|C \wedge L \wedge B') = 1$$

therefore:

$$Pr(L|D \wedge B) = Pr(L|C \wedge B)$$

contradicting Premise 2. What follows from the Likelihood Principle then is that the fact that our universe is life-sustaining is evidentially neutral between design and chance. (Moreover, since R and L jointly entail V, if B includes L (in addition to R) then it must also include V – so the same objection applies to the second version of the argument, in which V plays the role of evidence.)

But why must B include L? Two reasons have been given in the literature. The first is that unless L is included in B, we neglect to take account of an observation selection effect. An observation selection effect occurs when ordinarily your evidence E would be more likely given H than it would be given not-H, but something about the way you gathered your evidence makes E very likely, in a way that is independent of whether H is true. (For example, as (Eddington 1939) pointed out, ordinarily, if all the

fish you caught in a certain lake were very large, that would be evidence that most of the fish in the lake are very large—but if you were fishing with a net that is incapable of catching smaller fish, then you were likely to catch only big fish regardless of the demographics of the lake.) A standard view in the literature is that the right way to keep from getting misled by observation selection effects is to conditionalize on all the information you have about the manner in which you gathered your evidence. So, if J is all the information you have about your evidence-gathering method that is relevant to what evidence you will find, then your background B should include J. But, in the case of the fine-tuning argument, the method whereby we gathered our evidence involved making observations, something we would hardly be in a position to do if our universe were not life-sustaining. Therefore, J includes L; so the background B should include L as well. (Thus, it should include V too.)[9]

The second reason that has been given for including B in L is that the probability function $\Pr(-)$ that is in question here must represent our credences, or our ideally rational credences, or the credences that ideally rational beings would have if they were in our epistemic situation, at the time when we consider the fine-tuning evidence. By

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[9]E.g. (Sober 2003) gives this objection. (Weisberg 2005) criticizes Sober's argument. In an unpublished paper entitled "Selection Biases in Likelihood Arguments," Matthew Kotzen gives what seems to me to be a decisive objection to this argument for including L in B. But this still leaves us with the second argument for including L in B.

that time, of course, we have long been acquainted with the fact that out universe is life-sustaining, so it belongs to our background knowledge B. (Or at any rate, Pr(L)=1 which yields the same result.) This is of course just the problem of old evidence applied to the fine-tuning argument.[10]

A quite different objection is due to (Monton 2006).[11] Let's grant that the premises of the fine-tuning argument, as reconstructed above, are true, and the logic is flawless. The conclusion then follows. But this doesn't necessarily vindicate the claims of the fine-tuning argument, as it is usually presented informally (and as I presented it in the first paragraph of this paper). For it doesn't follow that *fine tuning* as such has anything to do with why L (or V) evidentially favors D over C. Recall how things seemed to you before you learned about the existence of apparent fine tuning in the universe: You might have thought there were some features of the universe that tend to support the hypothesis that it is designed, and others that tend to support the hypothesis that it is not. It's plausible that L was among the former. What's more, the fact that our universe is life-sustaining is not only in itself (perhaps) at least some reason to suspect

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[10] Of course, Bayesians have proposed ways of coping with the problem of old evidence; perhaps one of them can help out the fine-tuning argument here. Or, perhaps we can avoid this problem by interpreting the probabilities as something other than credences.

[11] I here present Monton's objection in a somewhat different form than he does, but he agrees that this is essentially the same objection (personal communication).

that things were designed, but it is a necessary precondition of almost everything else

that anyone is likely to think is a sign of design—religious experience, moral

consciousness, aesthetic experience, particular historical religious traditions and

institutions, and love, for example. Even those of us who deny that such things add up

to a very strong case for theism might well admit that at least some of them lend at least

some (perhaps very meager) evidential weight to the case for a designer. And none of

these things would be here if the universe were not life-sustaining. These reflections

suggest that the fact that $\Pr(L|D \wedge B)$ is greater than $\Pr(L|C \wedge B)$ may be true for reasons

that are quite independent of any considerations about fine-tuning.[12] So, the argument as

reconstructed establishes less than it would need to establish in order to bear out the

informal line of reasoning that it is intended to capture.

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[12]Here's another way to put this point. Suppose that B is the conjunction of R and B',

where B' is some body of information that has nothing to do with the fine-tuning

considerations. Then perhaps $\Pr(L|D \wedge B') \gg \Pr(L|C \wedge B')$, and perhaps conditionalizing on

R on both sides does not change the inequality. In that case, even though each step of

the fine-tuning argument (as reconstructed above) is true and its conclusion follows, it

lends no support whatever to the idea that the fine tuning of the universe is evidence that

favors design over chance.

3 The Argument Re-Reconstructed

The semi-formal reconstruction of the fine-tuning argument that I presented in the first section of this paper is essentially the one found in most of the careful presentations of the argument in the literature. But I think it fails to capture the structure of reasoning at work in the argument as it is usually presented informally. Once we recognize this, we can give a better semi-formal reconstruction of the argument that evades the objections considered in the preceding section.

On the standard way of formulating the fine-tuning argument, the fact that fine-tuning is required for life—what I called R—is treated as part of the background knowledge B. L on the other hand (or, on the alternative version, V) is treated as the new evidence we are considering. This suggests that we have known all along that fine tuning is required for life to exist in our universe, and then one day we discovered that life does exist in our universe—a striking discovery that forced us to reconsider the case for a designer. Of course, that gets things exactly backwards. We have known all along that our universe is life-sustaining (L). What comes as a surprise and makes us think that maybe we should rethink the matter of chance vs. design is the more recent discovery that fine tuning was required for life. This suggests that when we treat the fine-tuning argument as a likelihood argument (or more generally, when we formulate it

in Bayesian terms), we should let our background knowledge include L, and let R be the item that plays the role of evidence. After all, the thing that we discovered which suddenly seemed to favor the hypothesis of a designer over the chance hypothesis in a new way was not that there is life in the universe, nor that e.g. the ratio of the strengths of the gravitational and electromagnetic forces has the value it does, but rather that the life we know to exist in the universe depended on a set of conditions balanced on the head of a pin in a way we had never suspected before. So, the crucial move in the argument is this: The precariously-balanced nature of life in our universe is far less surprising given a designer than it would be given chance, and so it evidentially favors design over chance.

One worry is that R is not really "new evidence"; the discovery of it was really the discovery that it was a consequence of theories we had already accepted. But what is really doing the evidential work here is the discovery that *there are certain real-valued physical parameters which need to be within surprisingly narrow boundaries in order for life to exist*—in other words, the fact of R. That fact, of course, is something that was discovered empirically, albeit over a long period of time rather than all at once. But evidence propositions need not be discovered instantaneously in order to serve as evidence. And by the time the discovery of this fact began, it was already well-known that life exists. So there is no problem with considering a context in which the background knowledge includes L, and the new evidence under consideration is R. The

fine-tuning argument, then, claims that when our background knowledge includes L (which of course it always does), the discovery of the truth of R evidentially favors design over chance, because R is more likely given design than it is given chance.

So here's how we should reformulate the fine-tuning argument:

Premise 1+: L belongs to our background knowledge B.

Premise 2+: If L belongs to our background knowledge B, then $\Pr(R|D \wedge B) > \Pr(R|C \wedge B)$.

Step 3, by 1+ and 2+: $\Pr(R|D \wedge B) > \Pr(R|C \wedge B)$

Conclusion, by 3 and the Likelihood Principle: Given our background knowledge, R evidentially favors D over C.

None of the objections considered in the preceding section carry any weight against this argument. Note first that this argument clearly depends on fine tuning as such: What serves as evidence here is the very fact that there are physical parameters that need to be fine-tuned in order for life to exist. So Monton's objection is not a problem for this argument. Next note that the likelihoods that figure in this argument are already conditionalized on a background that includes the existence of life. Adding the fact that life exists to the background knowledge is not going to change anything, because that

fact is already in the background knowledge. This shows that neither the old-evidence objection nor the observation-selection-effect objection even arises for this form of the fine-tuning argument.

This is a crucial point, so it is perhaps worth dwelling on it a bit longer. Sober (2009) describes the observation-selection-effect problem as arising in the following manner (see p. 80). We can analyze the situation into four components: a Source, about which we are theorizing; a Trace which is left by the Source; a Process by which we make our observation; and an Observational Result which is our evidence. The Trace is an effect of the Source, and the Observational Result is an effect of both the Process and the Trace. In the version of the fine-tuning argument that Sober considers, the Trace is the fact that the constants are right for life. Sober concedes that this is indeed more likely given that the Source is an intelligent designer than it is given that the Source is chance. So, from a likelihoodist point of view, it does indeed seem that the Trace serves as evidence that favors design over chance. But to stop here would be to overlook the fact that our evidence is not just the Trace; it is our Observational Result, which is the product of both the Trace and the Process. And in the case at hand, the Process all by itself is enough to guarantee the Observational Result, regardless of what the Source is like. For the Process involves the activities of living human beings, and the Observational Result is the result that the constants are right for life; there is of course no way that a process involving living human beings could correctly arrive at the

result that the constants are not consistent with the existence of life. So the Process screens off the Observational Result from the Source. And for this reason, the Observational Result cannot evidentially bear on the question of whether the Source is design or chance.

On the version of the fine-tuning argument presented above, though, the Trace is not the fact that the constants are right for life; it is the fact that there are constants that have to be with a certain narrow range in order for life to be possible.[13] It is still true that the evidence is our Observational Result, and it is still true that our Observational Result is not the Trace alone, but rather a joint effect of the Process and the Trace. But it is not true that the Process alone is enough to guarantee the Observational result, regardless of what the Source is like. There are possible universes in which a Process involving the activities of living beings produces the empirical result that the laws are such that the life-permitting range of all the parameters is infinite. So

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[13] It is a bit misleading to call this evidence a "Trace," since it might not be an effect of the Source; I return to this issue below. But this point does not effect the point I am making here.

the outcome we actually found is not at all guaranteed by the Process alone. Sober's

problem just not arise for this version of the fine-tuning argument.[14]

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[14] In more detail: (Sober 2009) argues (on p. 83) that the likelihoods that we need to

consider in order to figure out whether fine-tuning is evidence for design are:

Pr(I observe at t_3 that the constants are right | the values of the constants are set

by an intelligent designer at t_1 & I am alive at t_2)

and

Pr(I observe at t_3 that the constants are right | the values of the constants are set

by chance at t_1 & I am alive at t_2)

These likelihoods, he persuasively argues, are equal, so by the likelihood principle the

observation that the constants are right does not evidentially favor design over chance.

But in the version of the fine-tuning argument that I am discussing, these are not the

likelihoods we need to look at. In my version, the evidence is not the observation that

the constants are right; instead, it is the empirical discovery that there are constants that

have to be right (i.e., there is a certain narrow range they need to be inside of) in order

for life to exist. So in order to treat my version of the fine-tuning argument in a manner

analogous to Sober's treatment of the version he criticizes, we need to replace "I observe

that the constants are right" with "I discover that the constants need to be right in order

for there to be life."   Therefore, the likelihoods we need to look at are these:

Pr(I discover at t_3 that there are constants that need to be right in order for there

to be life | the values of the constants are set by an intelligent designer at t_1 & I

am alive at t_2)

and

Pr(I discover at t_3 that there are constants that need to be right in order for there

to be life | the values of the constants are set by chance at t_1 & I am alive at t_2)

In my formal presentation of the argument, R is equivalent to the fact that there are

constants that need to be right in order for life to exist, and the background B includes

that I am alive at t_2. So in my notation, the important likelihood inequality by Sober's

lights is:

(a) $\Pr(\text{I discover at } t_3 \text{ that } R \mid D \wedge B) > \Pr(\text{I discover at } t_3 \text{ that } R \mid C \wedge B)$

The likelihood inequality that figures in my formalization of the argument is:

(b) $\Pr(R \mid D \wedge B) > \Pr(R \mid C \wedge B)$

These are not quite the same, of course. But (a) and (b) are obviously equivalent, given two plausible assumptions:

(c)   Necessarily, I discover at t_3 that R only if R

(d) $\Pr(\text{I discover at } t_3 \text{ that } R \mid R \wedge D \wedge B) = \Pr(\text{I discover at } t_3 \text{ that } R \mid R \wedge C \wedge B)$

(that is, given that R is true, and given my background knowledge B, whether chance or design is true makes no difference to how probable it is that I will discover R at t_3).

Summing up: Sober's objection to the fine-tuning argument is that it focuses on the wrong likelihoods; when we focus on the right ones, we see that they are equal, so that there is no evidential support for design over chance. But I have just shown that the

Of course, you might wonder whether switching to this new presentation of the argument introduces new problems that weren't found in the original formulation. And indeed, the second premise in the new version is not as straightforward as it was in the original version. In the original version, in order to evaluate each likelihood, what we had to do was imagine either a designer or a chance process getting ready to set the values of the parameters, and ask how likely it is that they would hit the narrow target. It is easy to motivate our intuitions in favor of the original Premise 2, because the case seems so analogous to the case of a dart being thrown at a large target with a small bull's-eye: If the dart is thrown by a skillful aimer, then we naturally think it is much more likely that the dart will hit the bull's-eye than it would be if the dart were being flung up there via some chance process. But in the new Premise 2+, things aren't that simple.

However, there are good reasons to think that that the new version of Premise 2+ is true. A Lesliesque thought-experiment will help here.[15] Imagine that you are

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likelihood inequality that my version of the argument focuses on is equivalent to the one that, by Sober's lights, we should be focused on, given what my argument treats as the evidence.

[15]The reference here is to (Leslie 1989), which is full of imaginative examples well-chosen to pump intuitions about fine-tuning arguments. The present thought-experiment is not one of Leslie's, but it is in the same spirit.

standing in front of an extremely large wall, which as far as you can tell is homogeneously white, with nothing to distinguish one part of it from another. From somewhere behind you, a dart is launched, and it zooms over your head and then hits a point on the wall. It occurs to you to wonder whether the dart was thrown carefully by a skillful aimer or flung up there by some chance process. You might reason as follows:

> Well, it is extremely improbable that the dart would land at that very point, if it were flung up there at random. Someone might think this favors the hypothesis of a skillful aimer. But that would be a mistake. For there is nothing to distinguish the point on the wall that the dart struck from any other. So on the hypothesis of a skillful aimer, it's really no more likely that the dart would hit just that spot than it is that it would hit any other. So, the skillful-aimer hypothesis doesn't make the dart's hitting this point any more likely than the random-flinger hypothesis does. And so, thus far, all my evidence seems to be neutral between the skillful-aimer hypothesis and the random-flinger hypothesis.

Then you open your birthday present, and it's a pair of infrared-vision goggles. You put them on, and when you look at the wall again, you see that it bears a standard dartboard design done in infrared paint, and the center of the bull's-eye is at precisely the point

where the dart is sticking out of the wall. Now what do you think? It seems obvious that the only reasonable thing to think at this point is that you now have excellent evidence that the dart was carefully aimed. (And by someone or something that can see in the infrared part of the spectrum.) Why? We can reconstruct your reasoning as a likelihood argument: There being something special and aim-worthy about the point where the dart struck the wall is much less surprising and much more to have been suspected if the dart were thrown by a skillful aimer than if it were flung up there by some random process. And so, to that extent, it is evidence that favors the skillful-aimer hypothesis over the random-flinger hypothesis.

Of course, the infrared bull's-eye is not the only target on the wall that a sensible skillful aimer might aim to hit. For example, there is the exact center of the wall, and the very top of the circumference of the target, and for all we know there might be an ultraviolet bull's-eye or two on the wall as well. (This is analogous to the fact that a life-supporting universe is not the only kind of universe that an intelligent agent might find choiceworthy.) Nevertheless, the infrared bull's-eye does stand out conspicuously as the kind of thing a skillful aimer who we could make sense of as an agent might well find particularly aim-worthy, in a way that you didn't know about before you put on your infra-red goggles. So your discovery of the bull's-eye should make you more confident than you were before that the dart was thrown by a skillful aimer.

The analogy between this case and that of the fine-tuning argument is obvious. Our discovery of R corresponds to the discovery of the infrared bull's-eye: It shows us that there was something intelligibly (even if not uniquely) aim-worthy or choiceworthy about the values of our universe's parameters which they do not share with generic possible parameter-values. Just as the discovery of the heretofore invisible bull's-eye ought to strike us as more likely given a skillful aimer than given a random flinger, so should the special feature of the actual parameter-values strike us as more likely given that they were set by design than given that they were set by chance.

The intuitive force of the analogy is considerable. But let's not let too much weight rest on it. In both the case of the fine-tuning argument and the case of the inference to the skillful aimer, the defense of the crucial likelihood inequality stands or falls with this assumption:

Assumption: Suppose that event X has happened, rather than the alternatives Y, Z, etc. And suppose that as far as we know now, X may have been the result of an intentional act of an agent or a result of chance. And as far as we know now, there is nothing that distinguishes X from Y, Z, etc. that makes it more choiceworthy or aim-worthy for any agent, though there might turn out to be something that does. Consider the proposition *that X has some feature which distinguishes it from Y, Z etc. and makes it intelligibly choiceworthy or aim-*

worthy in a way that not all of Y, Z etc. are. This proposition is more likely given that X was the result of an intentional act of an agent than it is given that X was the result of chance.

I think the case of the infrared bull's-eye makes **Assumption** quite plausible. But we can also argue for it directly. Suppose that conditions are as stipulated in **Assumption**. Then **Assumption** is true just in case:

$$\Pr(W \mid X \wedge Ag) > \Pr(W \mid X \wedge Ch) \tag{1}$$

where *W* is short for *X has some feature which distinguishes it from Y, Z etc. and makes it intelligibly choiceworthy or aim-worthy in a way that not all of Y, Z etc. are*, *Ag* is short for *X was the result of an intentional act of an agent* and *Ch* is short for *X was the result of chance.*[16] Using Bayes's Theorem, we can rewrite each side of (1):

$$\frac{\Pr(W)\Pr(X \wedge Ag \mid W)}{\Pr(X \wedge Ag)} > \frac{\Pr(W)\Pr(X \wedge Ch \mid W)}{\Pr(X \wedge Ch)}$$

Dividing both sides by Pr(W) yields:

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[16]See footnote 2.

$$\frac{\Pr(X \wedge Ag \mid W)}{\Pr(X \wedge Ag)} > \frac{\Pr(X \wedge Ch \mid W)}{\Pr(X \wedge Ch)} \qquad (2)$$

We have good reason to accept (2), because it follows from (3) and (4):

$$\Pr(X \wedge Ag \mid W) \gg P(X \wedge Ag) \qquad (3)$$

$$\Pr(X \wedge Ch \mid W) \approx P(X \wedge Ch) \qquad (4)$$

(3) just says that it is much more likely for X to occur as the result of an agent's action if X is particularly (though not necessarily uniquely) choiceworthy for an agent than it is otherwise. This is surely correct: Agents are much more likely to do choiceworthy things than they are to do things in general.[17] (4) says that the likelihood of X occurring as a

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[17]One exception is when X's choiceworthiness is itself something that makes it very unlikely that X could be the work of an agent. E.g., perhaps it is choiceworthy to change the total number of agents in the universe to one just in case the total number of agents now is zero. In this case, if X = the changing of the number of agents to one, then X's choice-worthiness rules out X's having been caused by an agent. There is no reason to suspect that this sort of exception is going to arise in the application to the fine-tuning

matter of chance is unaffected (or anyhow, affected very little) by whether X is particularly choiceworthy. This is overwhelmingly plausible. In fact, it is almost a conceptual truth about chance (see footnote 2); if X is more likely to occur via a certain process given that X is choiceworthy for an agent than it is otherwise, then that process is not chance—instead, it is some process that involves a bias toward choiceworthy outcomes.[18] So (3) and (4) are plausibly true.[19] It follows that (2) is true, from which follows (1). Therefore, **Assumption** is true, and so is Premise 2+.

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argument, where the intended value of *X* is a a fact about the parameter-values, and makes no reference to choice-worthiness.

[18]There are exceptions here too, e.g. when *X* is the truth of the self referential proposition S, which states that *The truth of S is choiceworthy only in those possible worlds where it is a matter of chance that S is true.* Again, there is no reason to suspect that exceptions like this will come into play in the fine-tuning argument, where the intended value of *X* concerns the numerical values of parameters and involves no self-reference or direct reference to chance itself.

[19]Note that this defense of (3) and (4) requires very few constraints on the probability measure $P(-)$. In particular, it does not presuppose any version of the principle of indifference. (3) and (4) are both naturally construed as expressions of judgments of relative plausibility that are extremely intuitive—namely, that it is much more plausible that something was done by an agent given that it was choiceworthy than given that it

4 An Objection: What Would a Designer Find Choiceworthy?

There is a common objection to the fine-tuning argument that might appear to raise trouble here. The case for (3) depends on the assumption that an agent is more likely to do a given thing if that thing is intelligibly choiceworthy than it is if that thing isn't intelligibly choiceworthy. But what do we know about what an agent capable of setting up a universe would or would not find choiceworthy? Why should we think that the things that are intelligibly choiceworthy to us are in any way correlated with the things that are intelligibly choiceworthy to such a being? Is it not the height of arrogance to assume that any being with the power to make a universe would want a universe with us in it?

The answer to this objection is that the hypothesis D should be understood as the hypothesis that the parameter-values were influenced by a being that we could recognize as an agent—a being whose actions we could understand as those of a rational agent

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was not choiceworthy, and that it is about equally likely that something happened by chance given either that it was or was not choiceworthy. Both are vindicated if we interpret $P(-)$ as representing the degrees of belief of a rational subject who affirms both of these extremely intuitive judgments of comparative plausibility. I will return to the topic of the interpretation of $P(-)$ in section 5.

acting for ends that could intelligibly be viewed as choiceworthy. It shouldn't be controversial that such a being could see a life-sustaining universe as choiceworthy. And it isn't necessary to make the much stronger assumption that any such being would necessarily see such a universe as choiceworthy—let alone the assumption that any such being would want a universe with human beings in it. All that is necessary for the argument to go through is that a life-sustaining universe is intelligibly choiceworthy in a way that not all kinds of universe are. And this seems obviously true.

One possible riposte is that this line of reasoning makes it all too easy to cook up well-supported theistic hypotheses of ludicrous specificity. For example, the existence of Tiger Woods would seem to provide evidence for the existence of a designer who specifically wants Tiger Woods to exist.

The answer to this is that the discovery that our universe contains Tiger Woods does indeed provide some evidence in favor of such a designer: This discovery should lead us to shift some credence away from other hypotheses to the hypothesis H_{TW} of a Tiger-Woods-desiring designer. At the same time, it should lead us to shift some credence away from the hypothesis H_{NTW} of a designer who specifically desires that there be no such person as Tiger Woods. Note that H_{TW} and H_{NTW} are both special cases of the more general hypothesis H_I of a designer who has specific desires concerning which individual organisms do or do not exist; while the discovery that Tiger Woods (or anybody else) exists in our universe might give us a reason to redistribute our credence

among the various special cases of H_I, it need not lead us to assign any more credence to H_I itself. So the discovery that our universe contains Tiger Woods should increase our credence in a designer who specifically wanted a Tiger-Woods-containing universe—but it might do this at the expense of other hypotheses about cosmic micromanagers, rather than at the expense of the hypothesis that there is no cosmic micromanager at all. This all seems perfectly reasonable, and not at all an embarrassing consequence.

5 An Objection: Would a Designer Make Fine-Tuning Necessary?

Another important objection needs to be addressed.[20] The hypothesis D says that the value of the parameters $P_1 \ldots P_N$ are influenced by the choice of a purposive and intelligent being—henceforth the Designer. D says nothing about whether the Designer had the power to influence whether R is true—that is, the power to influence whether fine tuning would be required for life in our universe. Let's consider both possible cases.

First, suppose that the Designer (if there is one) did not have the power to influence whether R would be true; fine tuning is required for life quite independently of the Designer's wishes. In this case, it seems that since the Designer had nothing to do with R's coming to be true, the discovery that R is true cannot be evidence for the

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[20]Versions of this objection have been pointed out to me by Matthew Kotzen and Bradley Monton.

existence of the Designer. On the other hand, suppose that the Designer did have the power to influence whether R would be true. Then, given that the Designer wanted a life-sustaining universe, it seems that it would have every reason to want to make R false. After all, R only makes the Designer's job harder. Thus it seems that R must be evidence against D. Either way, it seems that R cannot be evidence that favors D.

Let me take this dilemma one horn at a time. Consider first the first horn: The Designer, supposing there to be one, has no control over whether R is true. The objection then is that R cannot be evidence for the Designer's existence, since even if there is a Designer, it had nothing to do with causing it to be the case that R.

But this presupposes that E can serve as evidence for H only if H, if true, helped to cause E; in other words, nothing can be evidence for H except H's effects or traces. But this is plainly false: A falling barometer level can be evidence that there will soon be a storm, even though the fact that there will soon be a storm is not any part of the causal history of the barometer's falling; the blowing of the hooters in Manchester can serve as evidence that the workers in London are now going home even though there is no causal connection between the one and the other. Another sort of case in which a hypothesis H can be supported by evidence E that it does not cause or causally explain is one in which the evidence E shows that some item of old background knowledge K would have been a lot less likely had H been false. For example, if we already know that Jill left home this morning without her blue umbrella (because we have seen it

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resting in the umbrella stand all morning), and then we discover that it has been raining cats and dogs all day, this latter discovery can serve as evidence for the hypothesis that Jill owns another umbrella in addition to her blue one. For, in the light of the rain, if this hypothesis were false, then her having left home without the blue one (an item of our background knowledge) would have been a lot less likely than it would have been if the hypothesis were true. So the rain serves as evidence that Jill owns a second umbrella, even though presumably her owning a second umbrella had nothing to do with causing the rain. Just so, since in the light of the dependence of life on fine tuning, if the design hypothesis were false, then the existence of life (an item of our background knowledge) would have been a lot less likely than it would have been had the hypothesis been true. So the need for fine tuning can serve as evidence for a designer, even if we assume that the designer had nothing to do with causing it to be the case that fine tuning is required for life.

The second horn of the dilemma rests on the presupposition that a designer with the power to do so is more likely to create a universe in which fine tuning is not required for life than one in which fine-tuning is required for life. That is:

$$Pr(\neg R \mid D \wedge B) > Pr(R \mid D \wedge B) \tag{5}$$

I have no idea how to figure out whether (5) is true. But let's suppose that it is true. The crucial claim made by the fine-tuning argument is that R is more likely given that there is a designer and that our background knowledge B—which includes V and L—is all true than it is given that our background knowledge is true and that the parameter values are a matter of chance. That is:

$$Pr(R \mid D \wedge B) > Pr(R \mid C \wedge B) \tag{6}$$

If (6) is true, then the fine-tuning argument goes through. Note that (5) and (6) are perfectly consistent with one another.[21] So there is really no objection to the fine-tuning argument here at all. The main claim of the objection, stated informally, seems to raise trouble for the fine-tuning argument, because it seems to show that by the likelihood principle, R must be evidence against a designer rather than evidence for one. What the objection overlooks is that the fine-tuning argument does not claim that R is evidence for D in an absolute sense; the claim is that it favors D over C given our background knowledge, which includes L. What the fine-tuning argument needs in order to work is not for it to be more likely than not that a designer would make R be true if it could;

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[21]One quick way to see this: Let R = "Person X resides in St. Louis and has done so for at least 30 years"; D = "Person X is an American citizen"; C = "Person X is a Chinese citizen"; B = some tautology.

rather, it needs it to be more likely that R is true given both L and D than it is given L and C. This latter claim is perfectly compatible with its being the case that if there is a Designer, it would most likely make a world where fine tuning is not required.

It might be helpful to consider an analogy. I have an uncle who is not at all famous, is not a model, and does not work in the computer industry or know anybody who does. So if you notice that my screen saver features a picture of my uncle, you can reasonably be quite confident that I set up my own screen saver, instead of just using the one that came pre-installed on the computer. This doesn't change if you also happen to know that my uncle and I are not particularly close, so that it is rather unlikely that I would choose a picture of him for a screen saver if I were setting it up myself. That doesn't matter: As unlikely as it is that my uncle's photo would be in my screen saver had I set it up myself, it is surely far more unlikely that his photo would be in my screen saver had my screen saver been the one provided by the manufacturer. (After all, I am at least related to the guy.) So when you see my uncle's photo there, you have excellent grounds for favoring the hypothesis that I set up my own screen saver over the hypothesis that I used the one that came pre-installed—even though what you see is quite surprising, given the hypothesis thus favored. In other words, even though:

$$P(\neg U | S \wedge B) > P(U | S \wedge B) \tag{7}$$

nevertheless:

$$P(U|S \wedge B) > P(U|P \wedge B) \tag{8}$$

where B is our background knowledge, U = My screen saver features a photo of my uncle, S = I set up my screen saver myself, and P = My screen saver is the one that came pre-installed with my computer. (7) can make it look as if U must be evidence against S, but in fact if what we want to know is whether U favors S over P, the inequality that matters is (8). And (8) is perfectly consistent with (7). Here (7) is analogous to (5), as (8) is to (6). In each pair, the first inequality creates the misleading appearance that a given proposition must be evidence against a given hypothesis, but the second inequality (which is logically consistent with the first one) is the one that it actually relevant and it shows that the proposition actually evidentially favors the hypothesis over the salient alternative.

6 Interpreting Probabilities, and Further Objections

On my proposed way of recasting the fine-tuning argument, how should we interpret the probabilities? The interpretation of them as chances seems inappropriate, because there is no remotely plausible chance set-up that has the existence of life and a designer as its initial state and the requiredness of fine-tuning for life as one of the

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possible outcomes. If we interpreted them as logical probabilities, then we would

presumably need to appeal to some form of the principle of indifference in order to

justify a prior distribution that yields the likelihood inequality in Premise 2+. But it is

far from clear how this could possibly go; there would need to be constraints on the

distribution of probability over a set of possibilities including some in which the laws

imply that fine tuning is required for life and some in which the laws require no fine

tuning for life, and it is hard to see how to justify any way of carving up this space into

"equipossible" alternatives. The frequency interpretation is a non-starter here. This

leaves us with credences.

Some authors have criticized versions of the fine-tuning argument that employ a

credence interpretation of the probabilities involved on the grounds that this weakens the

argument by making it depend on non-trivial assumptions about the priors, when the

work was supposed to be getting done by results of modern physics and cosmology

together with probability calculations (e.g., (McGrew, McGrew and Vestrup 2003), p.

206). But this would be an odd objection to the version of the fine-tuning argument that

I proposed above. The fine-tuning argument thus construed depends on certain

assumptions about what is more credence-worthy than what (viz. (3) and (4)). But the

fact that it depends on such assumptions does not render it worthless, any more than the

fact that an argument depends on some premises that not all people believe renders it

worthless. The important question to ask is exactly what assumptions about the prior

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credences are required by the fine-tuning argument, and whether those assumptions

should be plausible to a reasonable person who is not already convinced of the existence

of a designer. The one controversial assumption that the fine-tuning argument (as I just

reconstructed it) requires is Premise 2+. As the argument of section 3 shows, this

premise is very plausible for reasons that do not take for granted anything about the a

priori likelihood of theism. True, a person with perfectly coherent degrees of belief

might reject this assumption. But that shows only that the fine-tuning argument relies on

a premise that is logically and mathematically contingent. The premise is extremely

plausible nonetheless, and for anyone who grants it the fine-tuning argument has force.

The formulation of the fine-tuning argument I have presented, with the

probabilities interpreted as credences, is also immune to another common objection

against fine-tuning arguments: namely, that they make illegitimate use of probability

theory since they employ non-normalizable probability distributions.[22] The idea is that

the fine-tuning argument needs to assign probabilities to the various possible values of

the parameters $P_1 \dots P_N$. But these parameters can take any real numbers as their values.

So there is no way to distribute probabilities over them uniformly, and any non-uniform

distribution would be arbitrary. But in the new version of the argument I have just

presented, this is not a problem: The only probability distribution that we need to use

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[22]For this objection, see (McGrew, McGrew and Vestrup 2003) pp. 203-204; for a

closely related one, see (Colyvan, Garfield and Priest 2005), p. 327.

assigns a probability of 1 to the proposition that all of our universe's parameters are in their life-permitting ranges, and to the proposition that there is life in our universe. (For these propositions are assumed to be in our background knowledge from the beginning.) The great, infinite space of possible parameter-values plays a role in the argument—the non-life-permitting regions within that space play the role of Y, Z etc. in **Assumption**. But at no point does the argument need to employ a probability distribution defined over this space.

7 Conclusion

The new semi-formal presentation of the fine-tuning argument I have presented is immune to the objection from observation-selection effects, the objection from the problem of old evidence, and from Monton's objection. When the probabilities in it are interpreted as credences, it is immune from the familiar objections having to do with non-normalizable probability measures. It does depend on a non-trivial premise about how some prior credences are related to one another (namely **Assumption**), but this assumption is not question-begging, seems plausible on its face, and can be defended on independent grounds. What's more, this semi-formalization is truer to the spirit of the familiar informal line of thought that makes it plausible in the first place that fine-tuning is evidence of design, for what it treats as evidence and what it treats as background

knowledge are the items that actually play those roles in that familiar informal line of thought. So this is the version of the argument that attention should be focused on.

Where should we go from here? I'll close by saying a few things about this argument that, for whatever it's worth, seem obviously correct to me. First of all, the argument really does show that the phenomenon of fine tuning (assuming it to be genuine) provides some evidence in favor of the existence of a designer. Second, on its own, this argument certainly does not establish that we ought to believe that there is a designer—that depends on what other evidence is available and on the prior plausibility of the hypothesis, matters that the fine-tuning argument does not address. Third, the fine-tuning argument lends no support to any hypotheses about the desires or motives of the designer, except that it must be enough like us for us to be able to recognize it as a purposive agent at all, and enough like us for it to be able to share our sense that a life-sustaining universe is a particularly (if perhaps not uniquely) choiceworthy kind of universe to make. Fourth, the fine-tuning argument lends no support to any hypotheses about how powerful the designer is, except that it had the power to influence the values of the finely-tuned parameters. (So in particular, there is no support here for a being with the power to create the universe *ex nihilo*, or even to determine the mathematical form of the laws of physics.) Fifth, the fine-tuning argument lends little if any support to any hypotheses about how much knowledge the designer had, except that it must have thought it likely that a universe with parameter-values within the life-permitting range

would lead to something interesting. Despite these limitations, the argument does seem to show something interesting and surprising.

Acknowledgements

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