Recent theories of physics (such as string theories) apparently allow many ways the universe could have been—many values, for instance, that the fundamental constants in its physical laws could have taken. These theories seem to offer little reason why the universe turned out the way it did instead of one of the myriad other ways that were equally possible. That lack of an explanation looks bad for such theories, unless one maintains that the vast array of possibilities allowed by the theory is an accurate description of reality—that all of the possibilities allowed by the theory did in fact eventuate, and that our universe is but one of many universes that exist, each instantiating a different setting of the fundamental constants consistent with the theory.

It seems a bit much to postulate an infinite array of universes just to make an abstract theory of physics less awkward. But defenders of the Multiverse argue that we already had independent evidence for the existence of many universes with a variety of physical constants. Recent investigations suggest that in order for life to arise, the physical constants in a universe must be set within a very narrow band of the conceivable possibilities. If there were only one universe, with its constants selected at random from all the possible combinations, it would be very unlikely that conditions in that universe would allow life to arise. But if there were many universes (or even, one universe for each possible combination of constants), there would be many more chances for the settings to fall right and for life to arise at least once. That is, the multiverse hypothesis makes it much more likely that life would arise than the single-universe hypothesis does. So the fact that life exists is evidence for the multiverse hypothesis.

This Anthropic Argument for the multiverse may also answer a major puzzle of non-theistic modern physics. Those who believe the singleverse hypothesis have not yet figured out what sets the physical constants in our universe; they have not yet explained why those constants are what they are. But even if an explanation is eventually found, it seems very unlikely that our universe’s constants were set by a mechanism which favors combinations of constants that make life possible. This leads us to wonder why life is possible in our universe at all—how we got so lucky that the universe’s fundamental constants were set in such a way that we could come about.\(^1\) The multiverse hypothesis says that there’s nothing to explain here, because we *didn’t* get lucky: with a multitude of universes, it was highly likely that at least one would have a combination of constants allowing for life.

\[1\text{Historically one popular answer has been that God set the constants, and He intentionally set them to bring us about. So the Anthropic Argument bears many resemblances to the Argument from Design. I won’t be discussing arguments for the existence of God here, with one small exception in note 5 below.}\]
There’s something fishy about this argument—for one thing, it uses empirical
evidence about our universe (that it permits life) to argue for conclusions about
other universes. But more fundamentally, the Anthropic Argument misconstrues
our evidence. Our evidence isn’t just that some universe permits life; it’s that this
universe permits life. That fact isn’t any more likely if there are multiple universes
than it would be if our universe were the only one around. So our evidence doesn’t
provide better evidence for the multiverse than the singleverse after all. And the
multiverse hypothesis can’t explain how we got so lucky as to be around.

That’s the argument of this paper. Let’s go through it again, but this time more
slowly and in more detail.\textsuperscript{2}

The Anthropic Argument works with probabilities relative to some set of back-
ground information. We will express those probabilities using the function $P$. The
Argument doesn’t specify exactly what belongs to the background set or where it
comes from.\textsuperscript{3} But there are some things the background set can’t be. For instance,
it can’t be the background beliefs of any actual person, because that set would
include the fact that life exists. Standard probability mathematics tells us that
if this fact were one of the background assumptions of $P$, it would automatically
receive a $P$-value of 1, and could not be made more or less probable by hypotheses
about the number of universes.

Beyond that, the Anthropic Argument needs say very little about the background
to $P$, because it needs assume very little about the values of $P$ themselves. For
instance, suppose every universe that exists has the same non-zero probability of
permitting life, given the background information. We’ll refer to that $P$-value as $L$.
Suppose also that if there are multiple universes, one’s permitting life doesn’t affect
the $P$ that another will. Regardless of the specific value of $L$, these conditions will
make the Argument run.\textsuperscript{4}

To see why, let’s calculate the probability that there exists a universe whose
constants permit life on each of our two hypotheses. On the singleverse hypothesis,
which we’ll call $H_s$, the probability $P$ that there exists a universe permitting life is
just $L$. That’s because there’s only one universe to worry about, and its probability

\textsuperscript{2}I realize there is a vast literature analyzing the Anthropic Argument in terms of Observation
Selection Effects. OSE analyses argue by drawing analogies between the Anthropic Argument and
other probabilistic scenarios, and I’m never quite sure if the analogies are apt. Moreover, OSE
analyses talk a lot about selection processes and how we come to have the evidence we have, and I
can’t understand the selection processes involved in setting a universe’s constants or how we came
to have the evidence that we exist. The present paper tries to rebut the Anthropic Argument
directly, by examining the probabilities in the Argument and being very careful about what our
evidence is.

\textsuperscript{3}The Argument also doesn’t specify how we should interpret the probabilities represented
by $P$—as objective chances? as evidential probabilities relative to the background set? as the
subjective credences a rational agent would assign if the background set were his total evidence?
To be charitable to the Argument I’ll just assume there’s an interpretation of $P$ available that
makes sense for its purposes.

\textsuperscript{4}The Argument can also run with much weaker assumptions about $P$. For instance, the
Argument will work if one universe has the same probability $P$ of permitting life on either the
singleverse and multiverse hypothesis, and on the multiverse hypothesis that universe’s permitting
life doesn’t drop all the other universes’ $P$-values for permitting life to 0. But the assumptions in
the main text will make our lives easier, and won’t interfere with the main point.
$P$ of permitting life is $L$. So if $E$ is the evidence that at least one universe permits life,

$$P(E \mid H_s) = L$$

(The expression on the left is the probability that $E$ is true given the truth of $H_s$.)

On the multiverse hypothesis, the probability $P$ that a particular universe permits life is $L$. But even if that universe doesn’t permit life, there’s still a positive probability that another one will. (After all, this is a multiverse hypothesis.) So if $H_m$ is the multiverse hypothesis, we’ll find that

$$P(E \mid H_m) > L$$

Putting these two equations together yields

$$P(E \mid H_m) > P(E \mid H_s)$$

The Anthropic Argument concludes that because the multiverse hypothesis gives us a higher probability $P$ that some universe permits life than the singleverse hypothesis does, our evidence supports the multiverse hypothesis over the singleverse hypothesis.

For the sake of argument I’ll grant the Anthropic Arguer most of his Argument—I’ll even grant that the fact that some universe permits life supports the multiverse hypothesis over the singleverse hypothesis. But that fact isn’t our evidence, and so it’s unclear what relevance it has for what we should believe. Our evidence includes more than just the fact that some universe supports life. And probabilistic support is funny; even if you have a piece of evidence that clearly supports one hypothesis over another, additional evidence can make that support disappear.

For example, suppose a wife is investigating the hypothesis that her husband is buying her diamond earrings for Christmas. She discovers that he withdrew $4000 from their checking account. This is good evidence that he is buying the earrings. But suppose instead she discovers that he withdrew $4000 from their checking account to pay their property taxes. This evidence provides no support for her hypothesis. And it does no good to tell the wife, “Look, you’re in possession of one piece of evidence that supports your hypothesis—you still know that your husband withdrew $4000!” In the presence of her additional evidence, this fact no longer gives her good reason to expect diamonds.

A moment ago we assessed hypotheses by calculating how probable they made particular pieces of evidence. Probability math allows us to compare how probable a hypothesis $H$ makes a piece of evidence $E'$ with how probable $H$ makes the conjunction of $E'$ with another fact $E$:

$$P(E' \& E \mid H) = P(E' \mid H) \cdot P(E \mid E' \& H)$$

So in Anthropic case, what pieces of evidence do we have besides the fact that some universe permits life? Well, besides knowing that at least one universe has constants capable of supporting life, we know that at least one universe actually has life. Moreover, we know that it has life of particular kinds (carbon-based, bipedal, etc.). Come to think of it, we also know that that life achieves a number of very particular things over the course of its existence—such as the invention of the wheel, fascism, and situation comedy.

Yet none of these facts nullifies our earlier support judgment. If anything, they support the multiverse hypothesis even more strongly. Even in a universe with constants fine-tuned to support life, it’s unlikely that life would actually develop,
and even less likely that sitcom-inventing life would occur. So the more shots we have at it, the more probable each of these events occurs at least once.\(^5\)

Come to think of it, it’s unclear why arguments for the multiverse invoke life at all, or why they should depend on the narrowness of the range of physical constants that make life possible. Take any event that we know has occurred, and that wasn’t guaranteed to occur. The more universes there are in which that event might have occurred, the more probable that it did occur at least once.\(^6\) So the existence of life, the existence of quasars, or even the existence of sitcoms is evidence for the multiverse.\(^7\)

All of these facts are facts of the form “Such-and-such exists in at least one universe.” But facts of that form aren’t the only things we know. Our evidence isn’t just that life exists in some universe, it’s that life exists in this universe. When I say “this” in that particular way, I want you to picture me pointing at the universe around me, the universe in which you and I live, indicating it in what philosophers call a de re fashion. If it helps, I can give this universe a name—I hereby dub it “Gaiu”.\(^8\) Our evidence includes the fact that Gaiu permits life.

The multiverse hypothesis is no help with that fact. That there are other universes with an array of constant settings makes it no more probable that Gaiu should have its constants set in a way that supports life. If, for instance, we adopt the assumptions about \(P\) made earlier, then the probability \(P\) that Gaiu supports life is \(L\) even if the multiverse hypothesis is true, making it no higher than the probability that the single existing universe would support life on the singleverse hypothesis.

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\(^5\)Here we come to my one point about the Argument from Design: It’s not enough to note that having a universe fine-tuned to support intelligent life is more probable given a Creator. One also has to factor in the probability that that Creator as we understand Him would bring about all the other things we observe in the universe. The idea that we shouldn’t believe in God because the universe we observe isn’t one He would be likely to create is one way to understand the Argument from Evil.

\(^6\)There might be a concern that even given a favorable setting of the physical constants in a given universe, some of these events still have probability 0 of occurring within that universe. Setting the constants in a universe doesn’t guarantee that initial conditions in that universe will be what is required, and even with the right initial conditions there are still a huge number of indeterministic quantum events that have to come out favorably. The worry here is that some of the events we observe have probability 0 on both the singleverse and the multiverse hypothesis, making equation (3) fail and the support for the multiverse evaporate. Perhaps, then, we need a multiverse hypothesis on which not only are there universes for various settings of the constants, but also universes in which various combinations of initial conditions eventuate and universes in which quantum indeterministic events fall various ways. (Though if one believes in Everettian interpretations of quantum mechanics, the latter are already guaranteed.) For simplicity’s sake I’ll consider all these things built into the multiverse hypothesis in what follows.

\(^7\)One strategy for derailing the Anthropic Argument as it is typically presented is to argue that life is highly probable given any setting of the universe’s constants—that life would arise in any high-energy system of considerable complexity. But even if that’s true, we still would have an argument for the multiverse based on any other fact that isn’t highly probable on every setting of the constants, such as the existence of quasars.

\(^8\)I realize that as I’m doing this, there may be other individuals in other universes who look somewhat like me and are busy dubbing their universes a name spelled with a “G”, then an “a”, then a “i”, then a “u”. Utterances by those individuals will refer to the universes in which they live, the universes in which their dubblings occurred. But those dubblings don’t interfere with the fact that when I utter or use “Gaiu”, I refer to the universe in which I live.
Putting this in terms of equation (4), suppose $H$ is the multiverse hypothesis, $E$ is the evidence that some universe supports life, and $E'$ is the evidence that Gaia supports life. The probability of our evidence conjoined is the probability that Gaia supports life given that the multiverse hypothesis is true times the probability that some universe supports life given that the multiverse hypothesis is true and Gaia supports life. The former value is $L$ and the latter is clearly 1, so their product is $L$. This calculation works the same way if we let $H$ be the singleverse hypothesis; so the product is $L$ again. Thus equation (3) fails; the multiverse hypothesis makes our evidence no more probable than the singleverse hypothesis, and neither is supported over the other.

Perhaps I’ve gotten the original question wrong. Perhaps our question wasn’t how we got lucky enough that this universe supports life, but instead how we got lucky enough that we should be alive. The question focuses not on a here, but on a who.

Adding us in doesn’t help, though. Make the reasonable assumption that even if living, sentient creatures existed in another universe, they wouldn’t be us. With our possible existence confined to Gaia, our probability of existing will have a particular value once Gaia permits life, and the crucial question once more will be how probable Gaia is to permit life given the multiverse or the singleverse. I’ve already argued that there’s no reason to think one hypothesis makes that higher than the other.\footnote{And even if we could exist in other universes, I don’t think that would help the math. If we aren’t tied to Gaia then our existence somewhere is going to factor into the equations much like the existence of life somewhere factored in. That evidence will support the multiverse hypothesis, but then the support will be neutralized once we take into account further, de re evidence that is no more probable given the multiverse than the singleverse—such as the evidence that Gaia supports life (or that we exist in Gaia).}

We could go on and on here considering various extra bits of evidence we have, but the lesson will always be the same. At least part of our evidence is about this particular universe. Those facts aren’t more probable given the multiverse than the singleverse, and if they aren’t more probable than the multiverse support generated by other facts is neutralized.\footnote{One might think I’ve overlooked the probability $P$ that Gaia exists at all, and that this piece of evidence favors the multiverse. After all, if there’s a multiverse Gaia has many opportunities to come into existence, whereas if there was only ever going to be one universe it could’ve easily been a universe other than Gaia. But I think this misunderstands the singleverse hypothesis, which holds that there was only ever going to be one universe, namely the one we’ve got.}

Moreover, if we accept the suggestion just made that the possibilities for our existence are confined to this universe, then the Anthropic Argument can’t explain the puzzle of our existence either. If we want to know how we got so lucky as to exist, the existence of many universes doesn’t make our existence any more probable than a single universe would.

Jerry Seinfeld looks at his bank balance and is glad he lives in a world with situation comedies. A string theorist points out that in a big enough array of universes, sitcoms are guaranteed to exist somewhere. Seinfeld wonders what that has to do with him.