# Anthropic Contingency

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# 6. Anthropic Contingency

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**Abstract:** Distinguish contingency in general from *anthropic contingency*. The former is what really could happen; the latter is what really could be observed to happen. Quantum histories which host no life cannot, as a matter of obvious necessity, be observed. This distinction generates an anthropic observation selection effect, which has been employed in response to the fine-tuning argument for the design hypothesis. This chapter argues that fine-tuning is a genuine phenomenon that cries out for explanation; that in one-world approaches to quantum theory a chancy determination of cosmological parameters would render the one universe we are in preposterously lucky; that no preposterous luck is required from the perspective of quantum modal realism; and that the correct interpretation of quantum mechanics turns out to have a significant evidential bearing on the design question.

"I could have been someone
Well so could anyone."

Finer & MacGowan (1988)

## 6.1 Introduction

Quantum modal realism is a theory of what really can happen. Yet not everything that can happen can be observed to happen. Some of the worlds in the Everett multiverse, of course, do involve observers observing reality to be some way; our own Everett world is one such world. Other worlds in the Everett multiverse contain no observers (whether because conditions in them are inhospitable to life, or because by chance life never occurs in them) but these worlds exist nonetheless. This disparity between Everett worlds that host observers and those that do not has epistemic consequences: it gives rise to an *observation selection effect*. In short, we ought not be surprised that we do not observe any course of events which cannot be observed. This simple point makes a profound difference to how we evaluate the evidential import of the fact that we observe conditions in the actual Everett world to be hospitable to life.

In this chapter my goal is to explore the scope and limits of *anthropic reasoning* in the context of quantum modal realism. Anthropic reasoning seeks to factor observation selection effects into the evaluation of the epistemic consequences of our observing the kind of world that we see around us. In particular, anthropic reasoning provides a powerful response to the well-known *fine-tuning argument* which uses the apparent extreme fragility of life with respect to variations in large-scale features of the cosmos to support the conclusion that the cosmos was intentionally designed to permit the evolution of life. I shall argue that quantum modal realism provides a new potential way to vindicate anthropic reasoning and undercut the fine-tuning argument. This particular vindication of anthropic reasoning is unavailable in the context of any approach to quantum theory other than EQM, and hence it highlights a surprising way in which the choice of interpretation of quantum mechanics bears evidentially on the question of whether physical reality was designed.

The viability of the overall quantum modal realist picture does not depend on any of the arguments in this chapter. Still, it is instructive to see how the quantum modal realist reconceiving of the nature of contingency has broader ramifications not just for the foundations of metaphysics but for epistemology and the philosophy of religion. In section 6.2 I reprise the standard dialectic of the fine-tuning argument, and sketch the debate over whether multiverse hypotheses can underwrite an anthropic explanation of fine-tuning as an alternative to design. Section 6.3 explains a role for multiverse hypotheses that differs from that standardly considered: multiverse hypotheses that have some independent support from physics may serve as *undercutting defeaters* with respect to the fine-tuning reasoning. Section 6.4 explores different types of multiverse and assesses the extent to which they are capable of undercutting fine-tuning, and section 6.5 focuses specifically on a potential route to undercutting fine-tuning in the context of EQM which is unavailable in any one-world approach to quantum physics. Section 6.6 concludes that, surprisingly enough, interpretation of quantum physics is evidentially relevant to the question of whether physical reality was designed.

## 6.2 The Fine-tuning Argument

One of the most striking features of contemporary cosmology is that our best theories include a number of parameters that are fine-tuned with respect to life. This term has various uses; here I shall use it to mean any physical variable such that i) the value of the variable is not explained within our best theories and ii) moderate variations in that variable give rise to cosmological models where complex life is not physically possible. Such variables are sometimes called constants; in this chapter I will refer to them as parameters, since whether they are in fact constant is part of what is disputed.

A number of apparently fine-tuned parameters feature in modern cosmology. Martin Rees (2000) identifies six dimensionless parameters: the dimensionality of space (D=3), the ratio of the strengths of the gravitational and electromagnetic force (N≈1036), the nuclear efficiency of fusion from hydrogen to helium (ε≈0.007), the density parameter characterizing the mass distribution in the universe (Ω≈1), the cosmological constant ($\lambda \approx 10^{-122}$) and the ratio of the gravitational potential energy of a galaxy cluster to the mass-energy of that cluster ($Q \approx 10^{-5}$). For a detailed review of the associated physics, see Barnes (forthcoming). While some of these parameters appear to be more fine-tuned than others, and future theories may yet explain the values of some of them, when taken together the fact that the combination of values of all of these parameters appears so delicately poised to permit life is very striking, and it at least motivates the search for some underlying explanation.

According to the notorious fine-tuning argument, the evidence of cosmological fine-tuning provides confirmation for the proposition that there is a designer. The basic thought is that fine-tuning evidence would be much less surprising if there is a designer than this evidence would be if there is no designer. Fine-tuned universes fit the design hypothesis better than they fit the no-design hypothesis, and accordingly a discovery of fine-tuned parameters characterizing our universe tends to provide evidential support for design.

Anthropic reasoning has sometimes been deployed to block the fine-tuning argument, by enabling us to resist the thought that fine-tuning evidence would be surprising if there was no designer, and hence to deny that there is a disparity in surprisingness. But the anthropic response to the fine-tuning argument has been influentially criticized. In John Leslie's vivid analogy (Leslie 1989), you ought to be surprised to find yourself alive after a reliable firing squad has attempted to shoot you (and you may reasonably infer some unknown cause of their all missing) even if you wouldn't have been around to be unsurprised if they had successfully carried out their task. A reliable firing squad all missing is just (we may say, without yet committing to any particular analysis of this notion) intrinsically unlikely. The problem with the anthropic response is that the occurrence of fine-tuned parameters seems likewise to be highly intrinsically unlikely—even though it is not at all unexpected given that such parameters are observed. Do not highly intrinsically unlikely events call out for explanation, of the kind offered by the design hypothesis? While this reasoning still needs to be made precise in various ways, the outline of the fine-tuning argument is clear enough, and it deserves to be taken seriously.

One way of resisting any probability boost to the design hypothesis is to maintain that the occurrence of fine-tuned parameters is not an intrinsically unlikely outcome. This is where multiverses have often entered the story. Positing the right kind of multiverse, one which includes a universe for every possible combination of constant values, seems to achieve the required result: it is not intrinsically unlikely that somewhere in that multiverse there is a universe with a life-permitting combination of constant values.

For those disinclined towards design explanations, it has been tempting to reach for a multiverse in response to fine-tuning, and regard fine-tuning itself as the evidence for the multiverse. However, a well-known objection to the appeal to a multiverse, put forward by Hacking (1987) and White (2000), is that it still seems unlikely that this very universe—the one we in fact inhabit—has fine-tuned constant values. After all, most universes in the multiverse do not. As responsible epistemic agents, we know to take into account the whole of our evidence—and our evidence tells us that this universe is fine-tuned, not merely that some universe is fine-tuned. This logically stronger evidence seems no less unlikely given a multiverse cosmology than it is given a single universe cosmology.

This particular universe, we are tempted to reason, had only a minute chance of ending up with the right parameters—so you and I had only a minute chance of existing. At least on the assumption that the universes are causally isolated, the existence or non-existence of lots of other universes doesn't seem to make any difference to the probability that this universe is fine-tuned. Then the existence of a multiverse doesn't make the fine-tuning of our universe more probable, and the evidence that our universe is fine-tuned does not support the multiverse hypothesis over the single-universe hypothesis. This argument has I think been influential in undermining the credibility of 'multiverse responses' to the fine-tuning argument within recent epistemology.

There is currently no consensus on these matters; authors including Bostrom (2002), Bradley (2012) have offered a variety of responses to White and Hacking, and Hawthorne & Isaacs (2018) respond to a number of other criticisms of the fine-tuning argument. Where multiverses have entered the picture, the focus of the debate has tended to be on whether someone not committed to the existence of a multiverse should regard fine-tuning evidence as supporting the hypothesis of a multiverse. In the next section I want to focus on a different question: if we take ourselves to have evidence for some multiverse theory on independent physical grounds, then how should we think about the epistemic import of fine-tuning evidence?

## 6.3 Multiverse Hypotheses as Undercutting Defeaters

As far as I know, the question of how fine-tuning reasoning is affected by the supposition that a multiverse exists has not been much explored. One exception is Roger White who writes, apparently as something of an afterthought to his defence of the objection referenced above:

> "the Multiple Universe hypothesis screens off the probabilistic link between the Design hypothesis and the fine-tuning data. Hence if we happened to know, on independent grounds, that there are many universes, the fine-tuning facts would give us little reason to question whether the big bang was an accident, and hence

> our knowledge of the existence of many universes would render the fine-tuning of our universe unsurprising."
>
> White (2000, p.273-274)

To put White's point another way: independent evidence for a suitable multiverse is an undercutting defeater for the design hypothesis. Such evidence does not weigh directly against the existence of a designer, as a rebutting defeater would (perhaps the problem of evil is a candidate rebutting defeater for the fine-tuning argument, given some extra premises about the likely nature of a designer?); rather, evidence from physics in favour of an appropriate multiverse is *ipso facto* higher-order evidence that fine-tuning evidence does not support the existence of a designer.

We may use the familiar analogy of misleading lighting. An object looks red to us (a fine-tuned universe looks designed) so we conclude that it is red (so we conclude there is a designer); but, once we are informed that the object is being illuminated with red light (once we are informed that there is a multiverse), we recognize that we now ought to revert to our prior expectations about the object's colour (we now ought to revert to our prior expectation about whether there is a designer). Higher-order evidence about the misleading lighting screens off the evidential relevance of our perceptual experience to the object's colour. (Information about the existence of the multiverse screens off the evidential relevance of the fine-tuning evidence to the existence of a designer.)

There are numerous interesting open questions about exactly how undercutting defeat works, raised in recent work by Lasonen-Aarnio, Sturgeon and others. Does it work by providing reasons for positive higher-order beliefs about causal or other explanatory relationships between the posited phenomenon and our possession of the evidence that seems to count in favour of that phenomenon? Or does it work purely by pruning away features of our epistemic states, without itself providing us with any positive reason for belief in any proposition? On the former model, the independent evidence that there is a multiverse provides new positive reason to believe the higher-order thesis: that the evidence that this universe is fine-tuned fails to support the thesis that there is a designer. On the latter model, the independent evidence that there is a multiverse merely cuts away some structure within our epistemic states, eliminating the link between fine-tuning and divine design. There is also an active debate about how undercutting defeat can and should be rendered in a Bayesian framework (see e.g. Weisberg 2015). We need not pursue these questions here. What concerns us is which sorts of multiverses are capable of acting as undercutting defeaters and why; we can set aside the nature of undercutting defeat, and its proper representation within formal epistemology.

Before we look in more detail at the kinds of multiverses for which there might be independent evidence, and assess whether they really do act as undercutting defeaters for the evidence from fine-tuning, it is worth observing that the posit of a multiverse for reasons independent of fine-tuning reasons does not eliminate the evidential import of fine-tuning altogether. Even if evidence of fine-tuning does not support the multiverse hypothesis, and even if the multiverse hypothesis screens off the support provided by the fine-tuning evidence for the existence of a designer, the evidence of fine-tuning may still support other surprising conclusions. By analogy, your having an experience as of a red object may support some potentially surprising conclusions even if it does not support the misleading-lighting hypothesis, and even if the misleading-lighting hypothesis screens off its support for the red-object hypothesis. For example, it may support the hypothesis that the inhabitant of the room likes the colour red, or it may support the hypothesis that you can see in colour.

So: what should multiverse proponents regard as the evidential import of fine-tuning evidence? It goes without saying that the answer depends on which kind of multiverse is posited. Physicists do not multiply universes first and ask questions about what those universes are like later, even if this impression might be gained from certain philosophical work on the topic. Rather, they posit certain kinematical structures and dynamical laws in order to explain observed physical phenomena, and then ask questions about whether these physical posits give rise to multiplicities of universes. There is no general argument to be found in physics for the existence of a multiverse of some kind or other; there are only arguments for multiverses that are realized in certain physically specific ways.

## 6.4 Which multiverses can undercut fine-tuning?

Max Tegmark's classification of multiverses into levels (Tegmark 2003) is coarse-grained, but it provides a useful starting point:

- Level 1: Multiplicity of regions of a single spacetime, spatio-temporally distant from one another. All regions share the same physical parameters.
- Level 2: Multiplicity of regions of a single spacetime, spatio-temporally distant from one another. Regions differ in their physical parameters.
- Level 3: Multiplicity of quantum-mechanical worlds, as in EQM.
- Level 4: Multiplicity of complete possible physical realities, as in Lewisian modal realism.

Level 1 multiverses are spatially infinite universes which are ergodic in the sense that everything happens somewhere: all physically possible dynamical processes are to be found somewhere within such a universe. If you were to travel far enough within a Level 1 multiverse, you would eventually come across another region of space with indiscernible contents to our own region—for any arbitrarily large region of space around us that one may want to consider. For the limiting case of an Hubble volume indiscernible from our own, Tegmark estimates one would expect to travel $10^{10^{115}}$ metres before finding one. Still, if we live in a Level 1 multiverse, duplicates of our Hubble volume are certainly out there somewhere. Various theories of cosmic inflation seem to predict a Level 1 multiverse; but the details will not matter for our purposes. This is because knowledge of the existence of a Level 1 multiverse would not, after all, screen off the evidential relevance of a fine-tuned universe to the existence of a designer.

Why not? Because all regions in a Level 1 multiverse have the same values of the parameters that are at issue in the fine-tuning argument. Either all regions have parameter values congenial to life (even though not all of them will actually contain life, of course) or no regions do. Evidently, since we exist, if we do live in a Level 1 multiverse then we live in one in which all of the worlds have suitable parameter values for life. The existence of such a Level 1 multiverse would then seem to call out for explanation in just the same way that a single fine-tuned Hubble volume would; even if a fine-tuned multiverse is no less likely than a fine-tuned universe, it certainly does not seem any more likely. So the fine-tuning evidence remains highly surprising even on the supposition that we live in a Level 1 multiverse, and the existence of such a multiverse is not an undercutting defeater for the fine-tuning argument for a designer.

Level 2 multiverses are a different story. While they are like Level 1 multiverses in that they consist in single infinite spacetimes with different phenomena in different regions, Level 2 multiverses have different values of the parameters in different regions—and typically they are also assumed to be ergodic in our rough sense: all physically possible states of affairs—including all physically possible combinations of parameters—occur somewhere in some region of the multiverse. Hence Level 2 multiverses are capable of acting as undercutting defeaters for the support that fine-tuning evidence provides for a designer. If there is a Level 2 multiverse, then there are certain to be infinitely many different regions of spacetime that have appropriate parameter values for life, and—given that we ourselves are alive—it is no surprise that we observe a region of that kind. Whether Bradley or White is right in their assessment of the nature of the maximal relevant evidence—that this universe is suitable for life, or that we inhabit a universe suitable for life—in a Level 2 multiverse there is guaranteed to be a universe that is indiscernible from this one, so our maximal relevant evidence is guaranteed to be received somewhere. That we receive such evidence is accordingly neither unsurprising nor unlikely given that there exists a Level 2 multiverse.

By construction, Level 1 multiverses do not undercut the fine-tuning argument and Level 2 multiverses do. It is part of what it is to be a Level 1 multiverse that parameters do not vary across regions, and part of what it is to be a Level 2 multiverses that parameters do so vary. The non-trivial question that remains is whether we have any reason to think we live in a Level 2 multiverse, and hence any reason to think that the fine-tuning argument really is undercut. While the theories of cosmic inflation that lead to a Level 1 multiverse are relatively mainstream, the theories that generate Level 2 multiverses are much more speculative. A variety of mechanisms for generating such multiverses have been considered—for example, Linde's chaotic inflation model (Linde 1986), also known as eternal inflation, and Smolin's cosmological natural selection model

(Smolin 1997) but each proposed mechanism, goes well beyond the orthodox Λ-CDM cosmology that is currently favoured by most cosmologists.

It is safe to say that is an open theoretical question whether there is a Level 2 multiverse. Our situation is thus like that someone who has seen an object that looks red, but who has also been warned that misleading lighting is a live possibility. On the supposition that there is misleading lighting, the evidential support of the red appearances for the thesis that the object is red is undercut; on the supposition that there is not misleading lighting, that evidential support is not undercut. In such a circumstance it is presumably rational to reduce one's confidence that the object is in fact red below the level of confidence usually associated with red appearances when no suspicions have been raised, but to maintain that confidence above one's base-line expectation that the object is red prior to any observation of it whatever. Likewise, the evidence of fine-tuning ought to raise our confidence that there is a designer above the baseline, but this confidence ought to stay below the level that the fine-tuning evidence would establish in the absence of any suspicions of a multiverse. The more confidence we have in a Level 2 multiverse, the more confident we should be that the fine-tuning evidence is undercut and the closer our confidence in a designer should be to its baseline level.

## 6.5 Everett Multiverses as Undercutting Defeaters

I now want to turn to the main target of my discussion: the consequences of the existence of a Level 3 multiverse for the evidential force of fine-tuning evidence. The Level 3 multiverse is the multiverse of EQM, and it contains an Everett world for every physically possible course of events. Unlike Level 1 and Level 2 multiverses, the universes of the Everettian multiverse are not different regions within a single infinite spacetime. If there is at least one Level 2 multiverse and in addition EQM is correct, then there is a huge plurality of Level 2 multiverses: each Everett world contains its own Level 2 multiverse.

In chapters 2 and 3 I defended a diverging version of EQM on grounds related to the interpretation of objective probability. The distinction between overlap and divergence is largely orthogonal to our present concern, however. This is because which qualitative possibilities are realized in the Everettian multiverse does not depend on how these qualitative possibilities are mereologically structured. Whether divergence or overlap is correct, there either are Everett worlds containing a variety of combinations of parameter values or there are not. If there are such worlds, then the Everettian multiverse undercuts the evidential import of fine-tuning for a designer. If there are not such worlds, then the Everettian multiverse does not undercut the fine-tuning argument.

An Everettian multiverse's ability to undercut the fine-tuning argument depends only on the existence of worlds in it with appropriate parameter values; it doesn't matter for our present purposes of assessing the fine-tuning argument how these worlds are mereologically related. What does matter for our purposes, however, is whether the worlds of a Level 3 multiverse include worlds in which there are a suitable variety of combinations of parameter values to make it unsurprising that there are life-permitting combinations. It is characteristic of Everettian multiverses that they include worlds corresponding to all physically possible outcomes of indeterministic quantum-mechanical processes. That is, if there is a non-zero quantum-mechanical chance of some outcome—no matter how small—then there is an Everett world in which that outcome occurs. Hence our question becomes: is there a quantum-mechanical chance, no matter how small, of the parameter values taking all of the combinations needed to make the existence of a world with life-permitting parameter values unsurprising? Are there indeterministic dynamical processes that assign non-zero quantum-mechanical chances both to combinations of parameter values that are life-permitting and to combinations that are not, such that the overall range of parameters permitted is of a kind that is not suggestive of divine design?

A toy example may help clarify matters. Suppose that only one parameter is involved—call it Z—and suppose that Z may take any integer value from 1 to 100. Only a Z value of 77 is compatible with life. A Z value of 77 is observed. *Prima facie*, this whole body of evidence tends in the context of a single-universe cosmology to support the hypothesis of a designer who selected 77 as the value for Z. Now suppose that EQM is correct, and that there exists a quantum-mechanically chancy process which determines the value of Z. There will then be Everett worlds with each of the physically possible values of Z. Now consider four different hypotheses about the chancy process which fixes the value of Z:

- Process A: The quantum probability of Z taking value 4 is 50%, and the quantum probability of Z taking value 77 is 50%. All other values get zero probability.

- Process B: The quantum probability of Z taking value n is 0.01% for each integer n from 1 to 100 except for n=77; the quantum probability of Z taking value 77 is 99.01%.

- Process C: The quantum probability of Z taking value n is 1% for each integer n from 1 to 100.

- Process D: The quantum probability of Z taking value n is (n/50.5)% for each integer n from 1 to 100.

Which of these processes gives rise to an Everettian multiverse capable of undercutting the toy fine-tuning argument based on the value of Z?

Process A does not give rise to a suitable multiverse. Even though it guarantees that there will be an Everett world with a life-conducive value of Z, this is not enough to undercut the support that is provided for the designer hypothesis. This is because life-conducive parameter values continue to play an unexplained and unexpected role in the theory. On the supposition that two specific values of n play an unexplained and basic role in the theory, it remains very unlikely that 77 will be one of these values, and hence that life will be possible at all in our toy multiverse; given an even prior probability distribution over which pair of Z values are physically possible, the probability of one of these values being 77 is only 2%. So there would still be a significant boost in this toy scenario for the divine design hypothesis.

Process B also does not give rise to a suitable multiverse. Although all values of Z are now rendered physically possible, so there will be an Everett world with each of the values, there is still something distinguished and special about the life-supporting value of Z: it is nearly 1000 times more likely than any other value of Z, and there is no explanation for this fact from within the theory. So there would still be a significant boost in this toy scenario for the divine design hypothesis.

Process C does give rise to a suitable multiverse. The particular Z value that is conducive to life does not play any special role in the theory; it is not distinguished in any way from the other parameter values, so there is no basis for the hypothesis that a designer had any hand in so distinguishing it. If we were informed that Process B was part of the physics of our toy multiverse, then the toy argument for a designer from the apparent fine-tuning of Z would be undercut.

Process D also does give rise to a suitable multiverse. As with Process C, the particular Z value that is conducive to life does not play any special role in the theory. The probability distribution over Z values may not be uniform, but nor is it tilted in particular towards life-conducive Z values. What makes a universe more likely to be the outcome of the initial chance process, in this scenario, is just higher Z value. It is true that the life-supporting Z value is towards the higher end of the spectrum, but—as far as I can see—this fact by itself provides no significant boost to the designer hypothesis.

Note that given Processes A and B, the Everettian multiverse does not fail to undercut the designer hypothesis because a designer is needed to explain why the actual world we observe has suitable parameters. Rather, Processes A and B seem to invite the hypothesis of a designer to explain why the theory itself has certain properties that are correlated with life-conduciveness. The probabilification of a designer is not based on the observed parameter values being unlikely except if there is a designer, but instead is based on the way in which these observed parameter values are selected by an underlying causal mechanism being unlikely except if there is a designer. That alters the nature of the fine-tuning argument, but it does not change the ultimate upshot: a probability boost for a designer.

So: which of these types of scenario is actual, if EQM is correct and we are in fact living in an Everettian multiverse? The somewhat deflationary provisional conclusion of this chapter is that it is simply too early to tell. We do not know enough about the physics of the very early universe to know whether there were any dynamical processes relevant to the fixing of parameter values in the early universe. However, there is potential for progress over the coming decades in quantum gravity research to shed some light on these questions.

Candidate approaches to quantum gravity do already include appropriate candidate dynamical processes. In particular, as discussed in section 4.7, the landscape model emerging from recent work on string theory provides a mechanism by which an unstable high-dimensional spacetime state evolves into one of a staggeringly large number of different compactifications, each corresponding to a lower-dimensional spacetime characterized by a different combination of parameters. This evolution is a unitary quantum process, so there is guaranteed to be an Everett world (with its attached objective chance) that corresponds to each of the possible compactifications. And in each of these minima of the string landscape, an enormous multiplicity of parallel worlds will witness all of the different physically possible processes that play out in each of the resulting compactified spacetimes. The string landscape multiverse would make our obtaining fine-tuning evidence entirely unsurprising. Likewise, in other approaches to quantum gravity, it may reasonably be expected that some cosmological parameters may have their values dynamically determined; time will tell.

Fortunately, we can draw some epistemic lessons from the preceding discussion even in the absence of a well-confirmed theory of quantum gravity. If neither the activity of a dynamical process of the Process C/Process D sort, nor the design of a designer, was responsible for the actual parameter values, then our evidence of fine-tuning looks extremely unlikely even on the assumption that EQM is correct. So on the assumption that there is an Everettian multiverse, and taking into account the fine-tuned parameter values that are actually observed, there is strong support for the disjunctive hypothesis that either a life-neutral dynamical process akin to Process C and D fixed the values of the parameters in our own (region of our) Everett world or a designer was involved in setting the distribution of parameter values across Everett worlds.

Although I have argued that Everettians ought to be very confident in the above disjunction, it remains open for other doxastic commitments to tip the balance of likelihood towards one or other of these disjuncts. For example, an Everettian with very low prior credence in the existence of a designer is likely to become strongly confident in the life-neutral-parameter-fixing-dynamical-process disjunct, while an Everettian with prior theistic commitments is likely to become more confident in the divine-designer disjunct. But this differential response remains well within the bounds of reasonable disagreement.

## 6.6 Summary

Close attention to specific fundamental cosmological hypotheses, and in particular to candidate dynamical processes that might give rise to variation in parameter value, is necessary to settle the status of the fine-tuning argument. The fine-tuning argument might be undercut by future cosmological discoveries in two main ways. Either future physics may unearth evidence of a Level 2 multiverse, or future physics may unearth evidence of life-neutral dynamical processes that operate to fix parameter values and, in conjunction with EQM, generate a Level 3 multiverse with different parameter values in different Everett worlds.

EQM, while not itself undercutting the fine-tuning argument, does nevertheless provide a cosmological framework suitable to host dynamical processes by which the fine-tuning argument might be undercut. This potential route to undercutting the fine-tuning argument is distinct from (though compatible with) to the route to undercutting the fine-tuning argument that goes via a Level 2 multiverse. A suitable dynamical parameter-fixing process need not give rise to a Level 2 multiverse in order to undercut the fine-tuning argument—though it might well give rise to one, for example if the string landscape hypothesis is combined with EQM. We may conclude that there is at least one additional route to undercutting the fine-tuning argument that is available to Everettians but not to non-Everettians. Perhaps surprisingly, then, choice between interpretations of quantum mechanics turns out to be indirectly evidentially relevant to the existence of a cosmic designer.

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