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The Fine-Tuning Argument for God's Existence

Does the multiverse objection undermine the fine-tuning argument for God's existence?

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AVH5010: Master's Thesis in Systematic Theology, 60 ECTS, 2020-21

Word count: 45 000

Acknowledgements

To write this thesis has been a big part of my life the last years and I owe my sincerest thanks to people both in the academic community and outside in my personal life.

I want to give warm thanks to my supervisor Atle Ottesen Søvik for suggesting the topic of the thesis, with helpful comments on earlier drafts and stimulating conversations along the way. I am grateful that you have given my curiosity a structured direction in the process of writing this thesis.

I am also grateful for all the scholars who have bothered to answer my emails with questions, including Luke Barnes, Robin Collins, Simon Friederich, Jeffrey Zweerink and David Sloan. I am especially grateful to Jeffrey Zweerink for allowing me to cite some of our correspondence in the thesis. I am humbled for the time you all have offered; this has given me encouragement to keep up the work in this field of research.

I will also give a warm thanks to family and friends for asking how the thesis-writing is going and encouraging me to keep working. I am grateful to Vibeche for proof-reading the thesis and to Gregory for helpful comments on an earlier draft of this thesis. All the remaining errors are solely my own.

Thanks to my university and to the MF library for extending my loan periods throughout the year and for sending books and articles. This project would be expensive without you.

Last, but not least, I want to thank my beloved wife for her support, endless encouragement and patience, without her I would never have been able to complete this thesis.

Abstract

In the late 1950s, astrophysicists discovered that the universe seemed fine-tuned for life, a discovery that has resurrected the design argument for God's existence. The leading objection to this design argument for God's existence is the multiverse objection – causing the current consensus that fine-tuning is either explained by a multiverse or design. This thesis will contribute to the discussion by assessing the research question: Does the multiverse objection undermine the fine-tuning argument for God's existence? To evaluate this research question, tools valued by analytic philosophy of religion will be utilized. The thesis is carried out through (1) formulating fine-tuning arguments, (2) presenting the multiverse objection, and (3) considering objections to the multiverse by first addressing two preliminary arguments against any multiverse model and later dividing the multiverse into two models: the unrestricted and the restricted. I argue that the unrestricted multiverse is the least parsimonious hypothesis possible and it faces three forceful critiques. First, it postulates the existence of an actual infinite, leading to the possibility of certain counter-intuitive scenarios. Second, it leads to skepticism because it undermines the value of simplicity, known as Ockham's razor, and removes the only possible response to the Humean skeptic of induction. Third, I provide a novel self-formulated argument that the fine-tuning evidence itself provides a reason for rejecting the unrestricted multiverse. Against the restricted multiverse, I argue that it seems to need fine-tuning of its fundamental laws of nature. In addition, it leads to two wrong predictions: first, that we live in a simulation, and second, that we should be a Boltzmann Brain – a minimal observer. Because of these problems with the multiverse theories, I conclude that the multiverse objection does not undermine the fine-tuning argument for God's existence.

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List of Abbreviations

BB = Boltzmann brain

ECA = Embodied conscious agent

GUT = Grand unified theory

LPU = Life permitting universe

L1M = Level 1 multiverse

L2M = Level 2 multiverse

MM = Mathematical multiverse

MR = Modal realism

NSU = Naturalistic single universe

OO = Ordinary observer

RTE = The requirement of the total evidence

SSA = Self-sampling assumption

T = Theistic hypothesis

UM = Unrestricted multiverse

1. Introduction

1.1 Background

When it comes to the discussion of God's existence, few arguments have had stronger appeal throughout the millenniums than the design argument. Many people, when they marvel at the world around them, can't help but suspect that there must be a designer or a plan behind it all. How could something as beautiful and seemingly perfect as the world around us not have an intending mind behind it? Of course, many people do not share this perception. They might see the beauty and grandeur of the natural world but feel that the cruel aspects of life counterbalance any reason for thinking the world was designed.

Throughout the history of Western civilization, arguments have been put forward based on incumbent facts about the world to the conclusion that there has to be a designer. These arguments have sought to show that the perception of design is not just a subjective one. From Aristotle in Ancient Greece, Thomas Aquinas in the Medieval Period, to William Paley's watchmaker analogy in the late 18th century, the design argument is steeped in rich history. However, with the publication of Darwin's book *On the Origin of Species* (1859), the design argument hit a snag.[1] For some time, it was generally assumed in Academia that Darwin had demolished the design argument.[2] However, recent discoveries in the field of physics have again tabled the question of design. These discoveries have puzzled the physics community,

[1] That an argument is undermined does not necessarily mean that the thing argued for is undermined. As philosopher Peter Van Inwagen (2003) says, "It is often said, both by Darwinians and anti-Darwinians, that Darwin's account of evolution is incompatible with the thesis that living organisms are products of intelligent design. This thesis must be carefully distinguished from the following thesis: Darwin's account of evolution refutes the argument from design" (s. 348). Although there may be arguments for the former, I will assume that only the latter is true and hence I shall consider Darwinian evolution as irrelevant to the fine-tuning argument.
[2] In addition to the Darwinian theory of evolution the project of natural theology had faced forceful critiques from philosophers David Hume (1711-1776) and Immanuel Kant (1724-1804) which also contributed to the decline in discussions of arguments for God's existence. For a defense of natural theology in light of these critiques see Charles Taliaferro (2012) and Sennett and Groothuis (2005).

and if Darwin's book removed the need for design, the book *The Anthropic Cosmological Principle* (1986), published by the two eminent cosmologists John Barrow and Frank Tipler, put design back on the table. Their study laid out in great detail the surprising discoveries in physics. These findings show that small changes in either the laws of nature, the constants of nature, or the universe's initial conditions would render life impossible throughout the universe. Some examples of this fine-tuning will be discussed in section 2.1.

Since the publishing of this book, a lot of ink has been spilled on the discoveries of our finely tuned universe and what implications this might have. Most people familiar with these discoveries think that these findings are too extraordinary to not have an explanation. Many theologians, philosophers, and cosmologists have looked at this evidence and felt this gives reasonable grounds for resurrecting the design argument. Design arguments based on fine-tuning have been much discussed in recent years, and these arguments are what this master's thesis will take a closer look at.

1.2 Research question

An argument with such a controversial conclusion that there should exist a cosmic designer has, of course, not been accepted without detractors raising several objections. Some of these objections are the renormalization problem (McGrew, McGrew, & Vestrup, 2001), the problem of old evidence (Monton, 2006), and the "who designed God" objection (Dawkins, 2006, pp. 157-158).[3] These objections are still controversial, but it will be too big a task to address them all in this thesis. I will instead focus more narrowly on what has been recognized as the number one objection to the fine-tuning argument, namely the so-called multiverse objection. The philosopher Klaas J. Kray (2015) says about fine-tuning arguments for design that: "The most

[3] For responses see Luke Barnes (2018) and Robin Collins (2012, pp. 272-274).

important criticism holds that they are undermined by multiverse theories" (p. 3). Scholars like Alex Vilenkin (2006), Max Tegmark (2014), and Sean Carroll (2017) have argued that the fine-tuning evidence is best explained by, or at least undermined by, multiple universes, and therefore, design is not needed.

In this thesis, I want to consider this multiverse objection and assess whether this objection does undermine the fine-tuning argument for design. The strength of the fine-tuning argument will depend on the plausibility of this multiverse alternative. In many ways, this parallels the design argument relating to biological organisms. Before Darwin, there was no viable alternative explanation to the apparent design of biological organisms, and the design inference was plausible. However, after the rise of the evolutionary paradigm in biology, this argument based on biology has lost its force. The evolutionary paradigm provided a plausible naturalistic story for how the apparent design arose and made it possible, in the words of the famous atheist Richard Dawkins (1986), to be "an intellectually fulfilled atheist" (p. 6). We do not yet have an equally viable explanation in physics. The only suggestion widely given is the multiverse. If the multiverse is a convincing scientific theory, the design argument loses its force as an argument, but if, however, there are reasons to doubt the multiverse explanation, then the design argument, based on physics, will have force. Thus, my research question is: Does the multiverse objection undermine the fine-tuning argument for God's existence?

1.3 Definition of central concepts

God. I will follow the definition of God spelled out by Oxford philosopher Richard Swinburne (2004) in his book *The Existence of God*: "There exists necessarily a person without a body (i.e., a spirit) who necessarily is eternal, perfectly free, omnipotent, omniscient, perfectly good, and the creator of all things" (p. 7). This definition will be consistent with the three prominent monotheistic religions Islam, Judaism, Christianity, and in addition deism. This will be a broad definition to give the paper a broad relevance. Throughout the thesis, I will use “the design hypothesis”, “theistic hypothesis”, and “the God hypothesis” as synonyms.

Design. By design, I mean that something was made intentionally by a personal agent to serve some purpose.

Multiverse. The multiverse theory is actually a number of different theories that postulate that our universe is just one among a potentially infinite number of universes casually isolated from one another. The term “the universe” usually refers to everything physical that exists. In that sense, the whole multiverse would be “the universe”. However, in multiverse theories, “the universe” refers to one causally isolated patch of space where the physics are constant. Our observable universe that originated in the Big Bang 13.8 billion years ago is an example of one such universe in the multiverse theory. What we consider constants and laws of nature are according to some multiverse theories only local bylaws, applicable only to our region of space. Different multiverse theories will have different models for how this is realized. A description of different types of multiverse models will be discussed in chapter 3.2.

Fine-tuning. Fine-tuning is a technical term used in physics. Something is fine-tuned if only a small subset of the whole set of possible ways the laws of nature, initial conditions, and constants could be will allow for a specific outcome. Fine-tuning is a metaphor in physics, and it brings an old radio to mind. Only if the radio were fine-tuned would it play music. The outcome, in this case, would be music. When physicists talk about the universe being fine-tuned for life, they mean that out of all possible ways the laws of nature, initial conditions and constants could have been, only a very tiny minority would allow life to exist.

Some common misconceptions of fine-tuning should be addressed. Firstly, fine-tuning should not be mistaken for the claim that the universe is optimal for life. A radio would be fine-tuned for music, even if a different channel would play the music better. Whether the universe is optimal for life is a different question from whether the universe is fine-tuned for life. Second, fine-tuning should not be equated with design. Fine-tuning is a neutral term used by physicists. Design, on the contrary, implies a designer.

Naturalism. By naturalism, I mean the worldview that holds that the natural world is all there is. Several different strands of naturalism exist, but common to them all is the claim that there is no creator or designer of the universe.

1.4 Method

My thesis will be under the sub-discipline of systematic theology called philosophy of religion, and more specifically it will be analytic philosophy of religion. Among the topics analytic philosophy of religion is interested in is what arguments can be given for and against God's existence. Historically, cosmological arguments, teleological arguments, moral arguments and ontological arguments have been given to support the conclusion that God exists. In recent times, new original arguments have also been put forth, shown by the publication of books like *Two dozen (or so) arguments for God* (Walls & Dougherty, 2018) and *Contemporary Arguments in Natural Theology* (Ruloff & Horban, 2021). The fine-tuning argument can be categorized under the heading of teleological arguments and will hence be a traditional argument but based on new data.

As mentioned, I will in my thesis, use the analytic philosophy as method to probe my research question. This method values precise definitions, valid and sound argumentation and coherence. These elements will also be valued in my thesis.

Arguments for and against

The basic method of my thesis will be to evaluate arguments for and against the multiverse. I will review the literature written on the subject and choose the most compelling and discussed arguments. Because the fine-tuning evidence is largely considered to be explained by either design or the multiverse, any argument against the multiverse will be an argument for design and *vice versa*. I will, however, limit my thesis to probing arguments for and against the multiverse hypothesis. This is necessary as evaluating arguments against design will consist of evaluating the coherence of theism which is a major area of research and will be too comprehensive a task to undertake in this thesis. I will, however, comment on certain points where there is an issue with the design and multiverse hypothesis that overlaps. Because of this limitation, I cannot conclude on the larger question of whether design is the best explanation of the fine-tuning evidence. I will limit myself to the research question stated above.

Method for evaluating the arguments

In philosophy, there is no universally agreed method for evaluating arguments (Walls & Dougherty, 2018, p. 4). The area of philosophy dealing with this question is epistemology, and more specifically theories of justification in epistemology. One historically influential theory of justification is classical foundationalism. Classical foundationalism argues that our knowledge is either basic or inferred. We can visualize this model of knowledge as an upside-down pyramid with the basic knowledge at the bottom and all the inferred knowledge on top of this foundation. The basic knowledge in classical foundationalism should be incorrigible, self-evident or necessary knowledge. The paradigm example of a classical foundationalist is René Descartes, who tried to doubt everything he possibly could doubt. This led to his famous statement "*cogito ergo sum*" that is, "I think, therefore I am" (Hatfield, 2008). This was the one certainty he could not doubt, namely his own existence. However, classical foundationalism collapsed in the 1950s; it was realized that classical foundationalism led to philosophical skepticism because it did not let us have knowledge of the external world outside us. In addition, classical foundationalism suffered from the problem of self-referential incoherence. The classical foundationalist thesis was neither inferred nor incorrigible or necessarily true. Hence, we are not justified in accepting classical foundationalism on the classical foundationalist account of justification.

In the aftermath of the collapse of classical foundationalism, there has been offered many alternative models for justification, and a survey of the different models would be too comprehensive. Hence, I will only state my preferred model.

I do believe that some sort of foundationalism is the correct view of justification. The problems of classical foundationalism can largely be fixed by changing what is allowed as a basic belief. Instead of incorrigible, self-evident, or necessary truths, I suggest we take common sense and intuition as our basic beliefs. These basic beliefs will not be certain and may be revised. However, I think we are *prima facie* justified in thinking something is how it seems, until some evidence against this seeming is provided.[4] The logical possibility that, for example, the external world outside us is not real should not stop us from knowing that there is an external world outside us. This will be a weak form of foundationalism.

[4] This view in epistemology is called *Phenomenal Conservatism*.

The main difference between this method and Descartes method is that we do not obtain certainty using the method I suggest. However, if certainty is required for knowledge, we shall know very little. I think we are stuck with uncertainty and must learn to live with it. This view, that knowledge does not require certainty, is called fallibilism and has become almost universally accepted in epistemology (Dougherty & Rysiew, 2009, p. 1).

Common sense criteria

Some commonsense criteria, for evaluating the arguments, that I will use are coherence, rational intuition, and epistemic virtues like explanatory powers and simplicity. Let us look at each in turn.

Coherence

There are two different forms of coherence as a criterion for truth. Strong coherence suggests that coherence is the only criterion to determine truth, while weak coherence suggests that coherence is one of several criteria for truth (Craig & Moreland, 2017, p. 111). I will use the weak form of coherence as one criterion for truth in my thesis.

The coherence criteria assume that the truth is one and will therefore be coherent. For something to be true, it has to be coherent. Coherence will therefore be a guide to evaluate whether something corresponds to reality. The most important aspect of coherence, in my view, is that something is consistent. That is to say, that things do not contradict each other. Something true cannot be contradicting. If an argument shows that a consequence of a given multiverse theory contradicts known experience, then that will be a good argument against that theory.

Rational intuitions

Philosophers, when evaluating arguments, often appeal to intuition, but what is this intuition? An intuition can be thought of as a seeming one gets regarding a proposition. When some proposition is stated we either find it plausibly true or plausibly untrue. All intuitions are not created equal, and some intuitions will be stronger than others. The reason we find the laws of logic convincing is because of such an intuition. No one can argue that the laws of logic are true, as that would require the person to use logic to justify logic, which would be reasoning in a circle. Rather, when we hear the proposition that "nothing can be true and false in the same way at the same time" we get a seeming that it is true. The intuitions of the laws of logic are incredibly strong, and almost everybody have this intuition. However, there will be many intuitions that seem right to some people but wrong to others. In my view, these intuitions will provide some evidence for the people having them. However, intuition is not incorrigible and should be updated based on other intuitions and pieces of evidence one has.

Some may worry that these intuitions are too subjective to count as evidence; however, I am convinced that we cannot do philosophy without our intuitions, so we are stuck with them.

Theoretical virtues

There is no universal agreement for what makes an explanation better than another when assessing two competing explanations. However, many accept that there are certain theoretical virtues that an explanation can have. I will mention two that will be relevant to my thesis, namely explanatory power and simplicity. Let us look at each in turn.

Explanatory power

Explanatory power will be the degree of explanation a given hypothesis will give to certain evidence. If a theory lacks explanatory power to explain some phenomenon, it will not be a good explanation of that phenomenon. A theory that will fully explain a phenomenon X will be preferred to a theory partially explaining X.

Simplicity

Simplicity is widely considered a theoretical virtue by scientists and philosophers alike (Baker, 2016). Exactly why this is the case and how one should evaluate simplicity is, however, controversial. According to Richard Swinburne (1997), simplicity is *a priori* evidence of truth. If this means we assume the world is simple *a priori*, then I do not see the justification for that. However, I think, at least one of the reasons for the virtue of simplicity is captured by philosopher Joshua Rasmussen (2019), when he states: "A theory that posits unnecessary complexity […] has more 'opportunities' to be false" (p. 63). Rasmussen suggests that a simple theory is more likely true than a complex theory because by minimizing the assumptions of the theory, there are fewer ways the theory could be wrong. If this is true, simplicity is based on the number of assumptions one need to make for the theory to be true. When comparing two theories, the theory postulating fewer assumptions will more likely be true. An important additional consideration regarding simplicity is that this criterion has a *ceteris paribus* clause; that is to say, when all things are equal, the simpler hypothesis is preferred. If two hypotheses explain a phenomenon equally well, then the simpler hypothesis is more likely true. However, if there is a difference in explanatory power or coherence, this criterion will not apply.

God as an explanation

What makes God a good explanation of some phenomena? This is a difficult methodological question that will be relevant to address before evaluating the fine-tuning argument for God's existence. Some object that there is something wrong with using God as a hypothesis to explain a phenomenon. I will address two common concerns about using God as an explanation.

First, some worry that the God hypothesis is not an empirical explanation and hence cannot be a good explanation for anything. The root of this worry can be traced back to the old school of logical positivism at the beginning of the 20th century. The logical positivists argued for a verification principle of meaning. This verification principle stated that if some informative sentence cannot be empirically verified, it is meaningless. This principle excluded taking God as an explanation for anything, since the informative sentence “God explains X” is not possible to verify empirically. The logical positivist did not argue that God did not exist; rather, they considered any non-verifiable sentence as meaningless, which is neither true nor false. This principle underwent several revisions, including the falsification principle of Karl Popper. Popper argued that science could never be verified; rather, we could only falsify the wrong theories. The logical positivists had great influence in the beginning of the 20th century but the school of logical positivism collapsed in the second half of the 20th century because of two great difficulties (Craig & Moreland, 2017, p. 142). First, the verification principle of meaning was self-referentially incoherent. That is to say that the principle would exclude us from believing the verification principle itself. Consider the statement: “Only sentences that can be verified by the five senses are meaningful”. Is this statement verifiable through the five senses? Sadly, for the positivists, it clearly is not. A second difficulty was that the verification principle was too restrictive. The logical positivists tried to exalt science as the only reliable way to knowledge, but the verification principle rendered many scientific statements meaningless as well. Hence the verification principle by trying to exalt science undercut the very science they wanted to exalt. These two criticisms of logical positivism led to its demise.

Secondly, there is the common critique that using God to explain any phenomenon is "God of the gaps" reasoning. The idea behind this concern is that God can become a kind of gap-filler for our ignorance. Whenever we find something inexplicable, we can say that "God did it!". For example, in Norse mythology, they thought that the thunder-god Thor was responsible for lighting and thunder. As we have increased our knowledge of the world, we now explain lightning and thunder naturally, and the place once held by a god is now replaced by science, or at least so the story goes. In the same way that other inexplicable phenomena in the past were explained by the progress of science, it is presumed that any gap in our current knowledge will eventually be explained in purely naturalistic terms. What can one say to such a way of reasoning?

The first thing to consider is that the "God of the gaps" concern cannot be thought to exclude God from filling gaps altogether, as that would rule out God ever being an explanation. However, this cannot be true as we can certainly imagine vivid scenarios where we should conclude that God was the best explanation to that phenomenon. Consider, for example, what cosmologist Luke Barnes (2019) calls the awesome theological argument. He invites us to imagine that on the night sky all across the earth, the stars rearranged themselves in such a way that it spelled out the first fourteen verses of the gospel of John in every language. In a case like this, it is clear that we should not exclude God from explaining that phenomenon. If someone objected to postulating God because future science would explain this and postulating God is just "God of the gaps" reasoning, that would probably strike us as wrong-headed. I take this to be a clear counterexample to the consideration that we should never use God to explain some phenomena. However, the more difficult question is what distinguishes using God to explain thunder and using God to explain the message on the night sky.

I suggest that we should not exclude using God to explain gaps in our knowledge, as all explanations fill gaps. I think rather that the "God of the gaps" worry is really a worry about arguing from ignorance. The problem is not really that God can explain some gaps in our knowledge, but rather that we infer God as a placeholder of our ignorance. The problem is when the argument has the following form: We do not know what explains X, therefore God explains X. This is an argument based on ignorance and is a logical fallacy. The fine-tuning argument, fortunately, does not commit this fallacy. Instead of having this form, the fine-tuning argument can be better captured like this: We have good scientific evidence of X, where X is the fine-tuning evidence, and then one concludes that God is the best explanation of X. This shows that what is problematic, it is not using God as an explanation, but rather arguing from ignorance. Arguing from ignorance is fallacious and should be avoided.

God as a good explanation

But if there are no in-principle objections to using God as an explanatory hypothesis, we can ask what makes God a good explanation of something? There will be some difficulties when using God as a hypothesis. Since the fine-tuning of the universe is a one-time event, we cannot check how often a universe turns out fine-tuned. This is not solely a problem with using God as a hypothesis. The same problem arises in some areas of science too, especially in the historical sciences. One example is the continental drift theory which is the scientific theory that the continents have moved over time. We can perform no empirical experiment to check whether the continents have indeed moved over time. In cases like these, we use epistemic probabilities to see the plausibility of such a hypothesis (Collins, 2012, p. 227). Epistemic probabilities are what a rational person would expect to be the case, given a particular hypothesis. Evidence of the continental drift theory is mainly based on discoveries that animal life and plant life are similar on the parts of continents that would have been connected if the continental drift theory is correct. To evaluate this theory, we ask what the probability is that the animal and plant life should be the same on the hypothesis that they were never connected compared to the hypothesis that they were connected. It is clear that the hypothesis that the continents once were connected has better epistemic probability and therefore has better explanatory power. The same strategy is employed when considering the God hypothesis. Using epistemic probability will be how we test the God hypothesis; we will see whether some phenomena are more expected given the existence of God or given naturalism.

Summary

In the end, I think there is no in-principle objection to using God as an explanation of some phenomena. Logical positivism is self-referentially incoherent and too restrictive to function as a criterion of meaning, and the "God of the gaps" issue is just the problem of committing the fallacy of arguing from ignorance. Without any in-principle objection, we are free to postulate God as an explanation of some phenomena. Whether such an explanation is a good explanation will be a further question. One way of evaluating God as an explanation is to use epistemic probabilities. That is to ask ourselves what we would expect to be the case given the hypothesis that God exists contra naturalism. If God better explains one phenomenon, then that phenomenon will be, at least some, evidence for God's existence.

1.5 Material

The fine-tuning argument has received the most attention from the Anglo-American scholars, and hence my discussion will be with the Anglo-American literature. There are both cosmologists and philosophers writing on fine-tuning, and I will draw insights from both fields of expertise in my thesis. My thesis will focus on arguments and not authors. Hence, I will seek insight from as many experts as possible on the different arguments given for and against the multiverse.

However, some scholars will be more important than others. Let me mention some important contributors on both sides. On the design side Craig (2003), Swinburne (2004), Collins (2012), and Barnes (2019) are broadly considered important contributors. On the multiverse side there are Vilenkin (2006), Tegmark (2014), and Carroll (2017), who are prominent defenders of the multiverse as the more plausible alternative.

1.6 Outline

The outline of this thesis will be the following: In chapter 2, I will present the design argument from fine-tuning. I will provide some examples of fine-tuning from the literature 2.1 before I will discuss how this evidence can be used to formulate an argument for God's existence 2.2. I will discuss abductive and Bayesian versions of the fine-tuning argument. These versions of the fine-tuning argument will give a framework for understanding and evaluating the multiverse objection. In chapter 3, I will introduce and discuss the multiverse objection. In 3.1, I will present the logic of the multiverse objection; how multiple universes would undermine the fine-tuning argument. 3.2 will discuss different multiverse theories offered in the literature. Many have been offered, but I will focus on Tegmark's four-level hierarchy of multiverse theories in addition to David Lewis's modal realism. I will discuss the evidence pointing to the different multiverse models and then restrict the discussion to two different types of multiverse theories; unrestricted and restricted theories. Chapter 4 will discuss two preliminary worries for the multiverse objection. First in 4.1, I discuss the worries that the multiverse is based on a fallacy, known as the inverse gambler's fallacy. The second preliminary worry is that the multiverse leads to a bloated ontology, and that it violates, the theoretical virtue, Ockham's razor. This will be discussed in 4.2, and as we shall see, this objection will be model-dependent. In chapter 5, I will discuss three objections to the unrestricted multiverse. 5.1 will discuss whether philosophical arguments against the actual infinite counts against the unrestricted multiverse. 5.2 will discuss the most worrisome feature of the unrestricted multiverse, namely that it leads to skepticism. Arguments from Peter Forrest and Alexander Pruss will be discussed as to whether the unrestricted multiverse leads to skepticism, and as we shall see, this is a big problem for the unrestricted multiverse. Lastly, in 5.3, I will provide my own argument based on the fine-tuning evidence itself that the unrestricted multiverse is highly unlikely. I argue that either the unrestricted multiverse is liable to the objection of 5.2 or the fine-tuning evidence strongly undermines the unrestricted multiverse. In 5.4, I will give an assessment of the plausibility of the unrestricted multiverse. In chapter 6, I proceed to discuss the restricted multiverse. This multiverse is in my assessment, the greatest challenge to the fine-tuning argument for design. I will begin by assessing the scientific status of this multiverse in 6.1. I will then look at common objections levelled against this multiverse. Beginning in 6.2 by considering whether the multiverse itself needs fine-tuning and what consequences follows if it does. In 6.3, I discuss how one could make predictions if we live in a restricted multiverse. Based on the discussion of 6.3, I end chapter 6 with two potential predictions of the restricted multiverse. Firstly, in 6.4, I consider whether the restricted multiverse predicts that we should live in a simulation. Secondly, in 6.5, I discuss the most formidable challenge to the restricted multiverse, namely that we should expect to be Boltzmann Brains if a restricted multiverse exists. Finally, in chapter 7, I will come to some conclusions based on the previous discussion of the multiverse objection.

1.7 Goal

My overall goal in this thesis is to contribute to the discussion of the fine-tuning argument for design by doing a thorough analysis of the multiverse objection. I hope to plow the ground for further study to properly evaluate which alternative of the multiverse or design is most plausible. My contribution will be to look at the plausibility of a multiverse.

1.8 Relevance

The debate over the implications of fine-tuning has come to somewhat of a draw between design and the multiverse. Therefore, I think it will be relevant to consider the two hypotheses to try to tip the debate in favor of one of the two hypotheses. Regarding the multiverse, there is still much unclarity, and an exploration of the multiverse is needed. Different authors have discussed different aspects of this objection, but after surveying the literature, I found no one discussing the multiverse objection as thoroughly as I will do in this thesis; therefore, I want to contribute with such a discussion. I will do this by considering different types of multiverse theories and discuss the most important objections raised against them, in addition to providing my own arguments.

In a wider context, I think a thorough analysis of the multiverse objection will be relevant because if this objection of the fine-tuning argument for design is not a good one, then I think the natural theologian will have a good argument in its arsenal for trying to establish God's existence apart from special revelation.

2. The fine-tuning argument for God's existence

In this chapter I will present the fine-tuning argument for God's existence. The chapter is divided into two parts; first, I will present the fine-tuning evidence. This will consist of looking at some of the cases discovered by astrophysicists that the universe is fine-tuned. These cases will let the reader get a picture of what needs explaining. Then I will look at how one can use this evidence to formulate an argument for the existence of God. I will discuss different versions of the fine-tuning argument without committing myself to any specific argument. This will give a framework for understanding the multiverse objection and whether it is a good objection to fine-tuning arguments in general.

2.1 Fine tuning evidence

Since the 1950s, astrophysicists have discovered several different properties of the universe that have been very surprising. The surprising part is that had these properties been changed slightly, life could not have arisen anywhere in the cosmos. The discoveries can be classified under three headings; the laws of nature, constants of nature, and the initial conditions of the universe. The laws of nature in our universe, like, for example, the law of gravity, do not seem arbitrary but seem necessary for complex objects to exist and, more specifically, for life to evolve anywhere in the universe. Moreover, certain constants of nature have been discovered as part of the fundamental structure of the universe. A constant of nature is a number that appears in the fundamental structure of nature. These numbers can either determine the strength of some force or describe the mass of a fundamental particle. These numbers are sometimes called free parameters, and the reason for this is that they could, in principle, take any number. There is no way to derive the constants from the laws of nature. We have to go and look at what they are by measuring them. The constants are, in other words, not invented but discovered by astrophysicists. Some of these constants are fine-tuned. That is to say, they have a very minuscule life-permitting range in the values they can take, and the numbers they take fall neatly within this life-permitting range. In addition, some initial conditions put into the universe from the beginning in the Big Bang about 13.8 billion years ago, like the early low entropy of the universe, is also fine-tuned for life.

These discoveries led the famous atheist physicist, Sir Fred Hoyle, to write that: "A common sense interpretation of the facts suggests that a super intellect has monkeyed with physics" (1982). Whether this is evidence for design will not be a scientific question but a philosophical question.

In the following I will be giving brief examples of fine-tuning in each of the three categories of fine-tuning.[5] There are several different examples of fine-tuning, and some are more controversial than others. I will be focusing on the most established examples of fine-tuning. My discussion will not be an exhaustive look at the fine-tuning data, but I will provide a few examples to help the reader understand what needs explaining.

Laws of nature

The first group of fine-tuning are the laws of nature themselves. Certain laws of nature seem to be necessary for life to evolve in the universe. Philosopher of science Robin Collins (2012) mentions five laws that are necessary for life (pp. 211-213). I want to look at three of these that are necessary for complex life to emerge: 1) A universal attraction force like gravity 2) A force like the strong nuclear force that binds protons and neutrons in the nucleus 3) A force like the electromagnetic force.

[5] For a more thorough discussion see Barnes and Lewis (2016) and Collins (2003).

Let us first consider gravity. If a force like gravity did not exist, there would not be stars because star formation is dependent on something to pull the stars together. Since planets emerge as a result of gravity pulling stuff together, there would not be any planets without gravity. If there were no planets, there would be no place for life to evolve. Moreover, even if there were planets existing from eternity, the living organisms could not move on the planets without falling off the planets. Secondly, without the strong nuclear force, protons and neutrons would not stick together. Elements with an atomic number higher than hydrogen would not exist. The universe would, in this case, just contain hydrogen. Chemistry and life would not be possible. In addition, this law needs a short attraction range such that it will not attract all protons and neutrons together. If the strong nuclear force had the same range as gravity and electromagnetism, the consequences would be devastating. The universe would be one gigantic black hole. Thirdly, the electromagnetic force is necessary for chemistry of any form. The reason is that without the electromagnetic force the electrons would not be kept in orbit, which is vital for chemistry.

While there is no way of knowing all the possible laws that could govern a universe, it is nevertheless a big question why our universe has just the right laws for complex chemistry suitable for life.

Constants of nature

Let us now consider some of the constants of nature. I will give three examples: Firstly, the constant of gravity which is the constant that determines the strength of gravity. Secondly, the cosmological constant as this is the most discussed example in the literature, and lastly, the mass of the fundamental building pieces of nature.

The constant of gravity

One of the laws of nature that we are most familiar with is the law of gravity. If Newton's formulation of the law of gravity is shown in a mathematical formula, it looks like this: $F = Gm1m2/r^2$. F equals the gravitational force between the masses m_1 and m_2 separated with a distance r. G is the constant of gravity. Whatever the masses and length between the objects are the value of G remains the same, it is constant.

If we were to decrease the constant of gravity it would result in stars becoming white dwarfs made of pure helium. Barnes and Lewis (2016) comment, "The universe would remain a rather uninteresting sea of hydrogen and helium, dotted with only mildly more interesting dead and dying stars" (p. 108). This sea of hydrogen and helium gives us no reason to suppose that life like we know it would evolve anywhere in the universe.

If we instead decided to increase the constant of gravity, then stars would no longer be stable. The strong gravitational force would increase the burning in the stars' nucleus, and the stars would die in a supernova. A change of one part in 10^{35} would not give room for stable stars (Barnes & Lewis, 2016, p. 109). This assumes that the other fundamental forces, like the electromagnetic, the weak, and strong nuclear force, stays the same. For those not familiar with numbers like these, this number is 1 followed by 35 zeros.[6] To put that number in perspective, the number of seconds passed in the universe is approximately 10^{21} since the Big Bang 13.8 billion years ago. The precision is, in other words, unimaginably precise.

[6] Written out it looks like this: 1 part of 100 000 000 000 000 000 000 000 000 000 000 000.

The cosmological constant

The cosmological constant is one of the most discussed fine-tuning examples and is regarded as one of the biggest problems in physics and cosmology. One reason for this is that this fine-tuning problem comes from "our best theory of nature, quantum field theory" (Susskind, 2006, p. 66).

The cosmological constant, Λ, is used in Einstein's general theory of relativity and is the reason for the expansion of the universe when it is positive and if it is negative, the universe contracts (Collins, 2012, p. 215). What makes this a difficult problem in cosmology is that every field, like the Higgs field, electromagnetic field, and even the hypothesized inflaton field, contributes to the energy density in the universe and hence affects the effective cosmological constant. There are several unconnected contributors to this constant, and when physicists try to calculate the effective cosmological constant, they get the wrong answer. Extremely wrong. Typically, the calculations suggest that the cosmological constant should be about 10^{120} larger than the observed value. Carroll (2010) calls this result "a complete fiasco" (p. 67).

Physicists had long hoped that the cosmological constant would turn out to be 0. If that were the case, one could plausibly hope for a physical principle that would cancel out the field energies. However, this fine-tuning problem got even worse in 1998, when we discovered that our universe has a small but non-zero positive cosmological constant. This discovery rules out explaining the value of the cosmological constant by a physical principle as it does not seem likely that a physical principle would almost cancel out all the field energies.

The problem is not only that physicists get the wrong answer but that if the cosmological constant were of the value suggested by calculating the field contribution, life would be impossible. Barnes and Lewis (2016) write: “Make the cosmological constant just a few orders of magnitude larger and the universe will be a thin, uniform hydrogen and helium soup, a diffuse gas where the occasional particle collision is all that ever happens” (p. 164). A few orders smaller would lead the universe to collapse before stars would be able to form. The cosmological constant could be 10^{120} times larger than the observed value. Something would have to cancel the field energies out to one part in 10^{120}. This leaves us with a fine-tuning of about 10^{120}.[7] Only an extremely small range would allow complexity and life. In addition to the difficulty of explaining this by a physical principle, the extreme precision makes most physicists eager to find an explanation for the cosmological constant’s small observed value.

The fundamental building blocks

All the atomic elements in the periodic table are built from just three pieces: the up-quark, the down-quark, and the electron. As far as we know, these are fundamental building blocks for life and everything we see around us. We can build atoms, proteins, plants, humans, and everything physical on earth from these three particles. Physicists have discovered that small changes in the mass of these fundamental building blocks would ruin the universe. Small changes in either one of the fundamental particles would lead to a boring universe without chemistry. Let us look at the electron as an example case. If we were to increase the mass of the electron by a factor of 2.5, we would be in a universe with “no atoms, no chemical reactions. Just endless featureless space filled with inert, boring neutrons” (Barnes & Lewis, 2016, p. 51). Similar, although not identical, consequences would occur if the mass of the up and down quark were changed as well. We do not need to vary one dial at a time either, the fine-tuning remains

[7] Because the life-permitting region allows more than one specific value the real fine-tuning is not exactly 10^{120} but somewhere between 10^{53} and 10^{123}. In the literature the number 10^{120} is often used because of the uncertainties of the real number. Whether it is 10^{53} or 10^{123} would not make a significant difference as 10^{53} is a huge number as well.

even if one varies more than one parameter. Why do the fundamental particles take just the right value of their masses for life to exist?[8]

Initial conditions

In addition to the laws of nature and the constants, some initial conditions of the universe seem fine-tuned for life's existence. Initial conditions are the conditions at the beginning of the universe. That does not mean that initial conditions imply a beginning. Even if the universe is eternal, we can talk of the initial conditions as something that exists from eternity past. Initial conditions are the conditions that the laws of nature operate on. Among the examples of fine-tuned initial conditions, I want to look at the fine-tuning of the low initial entropy of our universe, as this is the most extreme form of fine-tuning discussed in the literature.

Entropy

One of the most impressive examples of fine-tuning is the initial low entropy in the early universe. Entropy is a way of measuring order and useable energy in a closed system. The higher entropy there are, the less useable energy and the more chaos there are. We know this principle from everyday experience. It is easier to create chaos than order, this is shown in the fact that we need to make an effort to clean our rooms, while mess comes naturally.

To get a closer understanding of entropy, we can imagine a bathtub filled with water. If the water has been in the bathtub for a while, the water is most likely the same temperature throughout the system. We call this state equilibrium which is the highest entropy state. The energy is evenly distributed in the closed system, i.e., the bathtub. If we would pour some additional hot water in the bathtub, we know from experience that the hot water would spread

[8] To visualize the narrow box in parameter space, see Barnes and Lewis (2016, pp. 255-263).

out. We would not have cold spots and hot spots in the water. The reason is that the second law of thermodynamic states that entropy always increases in a closed system. It will be more ways for the hot water to spread out rather than to remain orderly. There are more available high entropy states in the system of the bathtub rather than low entropy states.

The universe as a whole is, according to naturalism, thought to be a closed system. Given that we live in a universe that is not in equilibrium yet but still contains useful energy, our universe's earlier stages would have to contain even more usable energy. According to the Nobel prize-winning physicist Sir Roger Penrose (1989), one of our times leading theoretical physicists, “In order to produce a universe resembling the one in which we live, the Creator would have to aim for an absurdly tiny volume of the phase space of possible universes” (p. 343). Penrose has calculated that the precision would be in the region of 10 to the power of 10^{123}. This number is impossible to comprehend for the human mind. Collins (2012) comments, “Thus, this precision is much, much greater than the precision that would be required to hit an individual proton if the entire visible universe were a dartboard!” (p. 220). This precision is needed not only for human life but for stars to form, and life in any form would be very unlikely. According to theoretical physicist Sean Carroll (2010), a high entropy universe would be a “vast and quiet empty space” (p. 380). Why is our universe not this vast, quiet, empty space when that would be overwhelmingly more probable if the initial conditions were chosen randomly? This is the fine-tuning problem of entropy.

Summary

These are just some examples of fine-tuning required for life to exist in the universe. Further examples exist in the literature.[9] The scientific data is widely accepted. One notable exception

[9] See Barnes and Lewis (2016) for a more thorough discussion of the fine-tuning evidence.

is physicist Victor Stenger who wrote *The Fallacy of Fine-Tuning: Why the Universe Is Not Designed for Us* (2011); in his work, he argues that the fine-tuning evidence is mistaken and not only the conclusion of design. This, however, prompted Barnes to write a response article, "The Fine-Tuning of the Universe for Intelligent Life" (2012), where he defended the fine-tuning evidence against Stenger's claims. In his response article, Barnes gives a list of scientists who accept fine-tuning, he says:

> There are a great many scientists, of varying religious persuasions, who accept that the universe is fine-tuned for life, e.g. Barrow, Carr, Carter, Davies, Dawkins, Deutsch, Ellis, Greene, Guth, Harrison, Hawking, Linde, Page, Penrose, Polkinghorne, Rees, Sandage, Smolin, Susskind, Tegmark, Tipler, Vilenkin, Weinberg, Wheeler, Wilczek. (Barnes, 2012)

This list is impressive, and this shows that the large majority of scientists publishing in the area of fine-tuning accept that our universe is fine-tuned for life. The claim that our universe is fine-tuned for life should therefore be relatively uncontroversial.

2.2 Formulating the fine-tuning argument for God

Most people writing on fine-tuning see the fine-tuning data as too remarkable to not have an explanation.[10] Many have argued that this somehow points to the existence of a designer of the universe that has set the universe up for the existence of life. Several different formulations have been given for exactly how the fine-tuning evidence leads to a designer. In this section, I want to discuss how these discoveries can be used as data in a philosophical argument leading to a cosmic designer.

[10] Some philosophers have argued that no explanation is needed but physicists are more reluctant to go that route.

The logic of design arguments

Design is easier to perceive than to argue for. In the quotation above, Hoyle said that a commonsense interpretation suggested a super-intellect had monkeyed with physics. However, how does one make this intuition into an argument?

Usually, fine-tuning arguments are formalized as inductive arguments. Inductive arguments lead to weaker conclusions than deductive arguments. A deductive argument with true premises leads with necessity to a true conclusion. An inductive argument can have true premises but still lead to an uncertain conclusion. The uncertainty of inductive arguments is nevertheless not a big problem as few things in life are certain. We use induction all the time in our everyday lives, in science, and in law. As long as we are careful in formulating our inductive arguments, they can be very powerful. There are mainly two ways to draw a conclusion from the fine-tuning evidence: By abduction or Bayesian inference, let us look at each approach in turn.

The abductive approach

The first approach we will consider is abductive reasoning. Abductive reasoning is an inference to the best explanation. Philosopher Jason Waller sums up this approach thus: "Begin with a certain set of background assumptions and identify the phenomenon that requires explanation. Generate a list of possible explanations and then choose the best one" (Waller, 2020, p. 56). Regarding the fine-tuning argument, the phenomenon will be the fine-tuning evidence, and then one generates a list of possible explanations.

One person adopting this approach is the philosopher and theologian William Lane Craig. He has developed a fine-tuning argument and formalizes it like this:

"1) The fine-tuning of the universe is due to either physical necessity, chance, or design.

2) It is not due to physical necessity or chance.

3)Therefore, it is due to design" (Craig, 2008, p. 161). [11]

The first premise simply lists the alternatives available as explanations in the literature.[12] One worry with these types of arguments is that there is always the possibility that everybody writing on this subject has overlooked an alternative. Maybe in addition to chance, necessity and design, there should be a fourth option, but that should hardly stop us from using the evidence we have and arrive at a conclusion. If one insists that we should have certainty, then consistency demands that we have the same standard in every inference, which would be unlivable. To name but one consequence of this standard, no criminal could ever be convicted based on evidence since there would always be the possibility that the police had overlooked a hypothesis that would explain the evidence without the convicted person being guilty. This suffices to show that the bar for judging whether arguments for God's existence are good should not be certainty. If the premises are probably true, then the argument shows that God probably exists. If this can be shown, I think it should be regarded as a successful argument and a valuable tool for the natural theologian.

Arguing for the second premise will consist of eliminating chance and physical necessity as likely explanations of the fine-tuning evidence. Doing this will consist of giving arguments that physical necessity and chance are not good explanations. If there are not comparable good arguments against design, the argument will lead to the conclusion that design is the best explanation of the fine-tuning evidence.

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[11] Notice that Craig formulates this as a deductive argument, however, this can also be seen as an inference to the best explanation. The first premise lists possible explanations and the second premise eliminates two of the three explanations and the last option is the best explanation.

[12] The multiverse is considered under the chance hypothesis by Craig.

The Bayesian approaches

Another approach is the Bayesian approach. This approach is more widely used and is based on Bayes' theorem. In Bayesian probability theory, evidence E is evidence of a hypothesis H, given that E makes H more probable. Symbolized we can state it thus: P (H|E & K) > P (H|K – E). That is to say that the evidence E makes the hypothesis H more likely on the background information K given the evidence rather than on the background information alone without the evidence. This approach will compare hypotheses and see which hypothesis the evidence favors. I will look at the arguments of Swinburne, Collins, and Barnes as representative of this approach.

Swinburne's formulation

Richard Swinburne has pioneered the use of Bayesian probability in philosophy of religion. In *The Existence of God* he differentiates between what he calls P-inductive arguments and C-inductive arguments. He distinguishes these arguments like this:

> Let us call an argument in which the premises make the conclusion probable a correct P-inductive argument. Let us call an argument in which the premises add to the probability of the conclusion (that is, make the conclusion more likely or more probable than it would otherwise be) a correct C-inductive argument. (Swinburne, 2004, p. 6)

A P-inductive argument will make the conclusion more probably true on its own. In contrast a C-inductive argument only serves to make the conclusion more probable than it would have been without the evidence in consideration. In other words, a C-inductive argument on its own will not establish that the conclusion is probably true, only that the evidence under consideration will increase the probability of the conclusion being true.

Swinburne argues that the probabilities of there being human bodies[13] if there is no God are very improbable. If there is a God, the probabilities are not comparably improbable, and hence the argument is a good C-inductive argument. Swinburne uses the fine-tuning argument as one piece in a cumulative case for the existence of God.

Collins's fine-tuning argument

Robin Collins is probably the foremost expert on the fine-tuning argument for design. His article in "The Blackwell Companion to Natural Theology" (Collins, 2012) is the longest and most rigorous presentation of the argument in the literature. His formulation of the argument goes like this:

> 1) Given the fine-tuning evidence, LPU (Life permitting Universe - E) is very, very epistemically unlikely under NSU(Naturalistic single Universe): that is, P (LPU/NSU & k') << 1, where k' represents much less than (thus making P (LPU/NSU & k') close to zero).
>
> 2) Given the fine-tuning evidence, LPU is not unlikely under T [the theistic hypothesis]: that is, -P(LPU/T&k') <<
>
> 3) T was advocated prior to the fine-tuning evidence (and has independent motivation).
>
> 4) Therefore, by the restricted version of the Likelihood Principle, LPU strongly supports T over NSU. (Collins, 2012, p. 207)

The method for evaluating whether the evidence E confirms a hypothesis is to use the likelihood principle, which we will look closer at below. Collins uses epistemic probability, which is the probability we would expect on a given hypothesis, to establish that LPU is very, very unlikely under NSU and not very unlikely under T and hence confirms T over NSU.

[13] Swinburne uses *human* bodies as a broad term for beings similar to humans.

Barnes's Reasonable Little Question

Luke Barnes, a cosmologist at Western Sydney University and one of the leading experts on the fine-tuning evidence, has in a recent article called "A Reasonable Little Question: A Formulation of the Fine-Tuning Argument" (2019), formulated the fine-tuning argument in a new way. This formulation has some interesting consequences for the multiverse objection, as we will discuss in section 6.2.

Barnes formulates what he considers a Reasonable Little Question. The idea behind this formulation is that we would like to know the answer to what he calls the Big Question, which he formulates like this: "of all the possible ways that a physical universe could have been, is our universe what we should expect on naturalism?" (Barnes, 2019, p. 1226). However, this, he argues, is too big a question for us to answer. We simply have no way of knowing all the possible ways a universe could have been. Instead of giving up on the project, he suggests a way forward. He says the way forward is: "we find a smaller, answerable question that *reflects* the Big Question [emphasis in original]" (Barnes, 2019, p. 1227). This question, he argues, is the question of what happens when we vary the constants and initial conditions of the standard models of particle physics and cosmology. He calls this the Little Question and formulates it like this: "of all possible ways that the fundamental constants of the standard models could have been, is our universe what we would expect on naturalism?" (Barnes, 2019, p. 1229). The Little Question is, in effect, what the fine-tuning argument tries to do. We take the best physics we have and asks the question of whether this universe is in any way unusual. This formulation argues that the best way to evaluate the Big Question is to consider the Little Question.

Likelihood principle

All the Bayesian formulations rely on the likelihood principle. The likelihood principle is a normal principle in confirmation theory. The principle can be stated like this: If evidence E is more probable on hypothesis h1 than on hypothesis h2 then E favors h1 over h2. For the Bayesian formulation to work, we need to make probability judgments on naturalism and theism. This is what we will discuss next.

Likelihood of life-permitting universe on naturalism

Naturalism has no preference for one universe over another universe. Therefore, we can think of the probabilities of a life-permitting universe based on naturalism as the probabilities of a life-permitting universe existing at all. The reason for this is that naturalism is a non-informative theory.

We can illustrate this by thinking of a fair lottery with 1000 lottery tickets and one winning number. On the hypothesis that the lottery is fair, the probability of winning will be 1 out of 1000. This is because a fair lottery will have no preference for who the winner should be. In a similar vein, the naturalist hypothesis has no preference for what universe should exist. The probabilities of a life-permitting universe will just be 1 out of all the possibilities. Barnes has calculated, using conservative numbers, the combined odds of a life-permitting universe to be less than 10^{-136} on naturalism (2019, p. 1239). [14] The probability that a life-permitting universe should exist on naturalism is less than one part out of 10^{136}. It is difficult to exaggerate how unlikely this is.

Likelihood of a life-permitting universe given theism

For the God hypothesis to be any better at explaining the fine-tuning evidence, the evidence will have to be more likely given the God hypothesis than the naturalistic hypothesis. If there is nothing special about our universe compared to the other possible lifeless universes, then there is no reason why God would create this world, and hence the God hypothesis would be in

[14] Note that this is without considering the fine-tuning of entropy.

the same boat as naturalism. So, we need to give some reason for thinking that our universe is more likely on theism than on naturalism. Specifying the aim of the design will provide this reason. However, what is important to have in mind, is that we do not need to know *the reason* why the universe was designed, rather we just need to give *a reason*. The designer could have all sorts of reasons for creating the universe that we simply cannot comprehend. If we can show that there is at least some reason for the designer to create a life-permitting universe, for our purposes, this is sufficient to show that the theistic hypothesis will be better off than the naturalistic hypothesis when it comes to the fact that a life-permitting universe exist.

The aim of design

Traditionally the design argument has been formulated with humans as the aim of the designer. Detractors of the argument have critiqued this as being too anthropocentric. The famous 20th century atheist philosopher Bertrand Russel (1961) made this point well:

> Is there not something a trifle absurd in the spectacle of human beings holding a mirror before themselves, and thinking what they behold so excellent as to prove that a Cosmic Purpose must have been aiming at it all along? Why, in any case, this glorification of Man? How about lions and tigers? They destroy fewer animal or human lives than we do, and they are much more beautiful than we are […] Would not a world of nightingales and larks and deer be better than our human world of cruelty and injustice and war? (p. 221)

To argue that the purpose of the cosmos was humans seemed like the height of arrogance for Russel. What can justify such a lofty view of humans as to make it the aim of a cosmic designer? Russel's point is well taken, but if it is not humans the design is aimed at, then what is it?

In answering what the designer might have wanted to design, it will be helpful to consider what is worthy as an action of God. As Swinburne (2004) has argued: “Nothing would count as an action of God unless God in some way saw the doing of it as a good thing” (p. 101). For something to be counted as worthy of God bringing it about, it needs to be good. That is to say; it needs to contribute positively to the value of what exists. This seems like a reasonable condition. We can continue with this as a sufficient condition for being the aim of the designer. Whatever the aim is, it has to have inherent value and contribute positively to what exists. What matches this criterion?

Because of the enormous consequences of a universe that is not fine-tuned, the list of possible things that the design proponent can argue have inherent value, ranges from everything living to even non-living things like chemistry. Few, however, would see something inherently valuable about chemistry. It does not seem to matter very much if there only existed hydrogen and helium or if there, in addition, existed iron as well. Iron or any other atom in the periodic table does not seem to contribute to the overall value in themselves.[15]What then could be the aim of the designer?

Collins argues that the aim of the designer is embodied moral agents. To be embodied is to be made out of stuff and hence be dependent on chemical complexity. To be a moral agent is to have the ability to make significantly free choices with a moral character. Humans will be considered embodied moral agents. This formulation, however, takes some of the sting out of Russel’s worry because it is not humans specifically, but something similar. The critical part, for Collins, is the ability to make morally significant choices (2012, p. 203).

[15] However, they may be indirectly valuable in as much as they make useful tools.

While it can be challenging to make a sharp distinction between what is worthy of design and not, I think it is relatively uncontroversial to argue, like Collins, that there is some value in embodied moral agents.[16] That there is some value in embodied moral agents seems like a self-evident truth. In the same way that we have five senses to experience the external physical world it seems like humans have a moral sense as well. This moral sense strongly suggests that embodied moral agents have some value in themselves. The person that disagrees that there is some value in embodied moral agents will struggle to live consistently with that view. Every time we meet another person, our actions will show whether we think that person has any value. I contend that no mentally healthy person can live as if other humans have no value.[17] If we cannot but live as if humans have value, I think that should give us a good reason for thinking that they, in fact, do have, at least some, value. Therefore, I think it should be uncontroversial that there is at least some value in embodied moral agents.

If someone thinks this is too restricted and thinks that there is inherent value in other things as well, like animals and plants, they are free to include this in the designer's reasons for designing the universe. As stated above, we only need *a* reason, not *the* reason.

Objection to the above argument

An objection raised by many detractors of fine-tuning is that there simply is no way of calculating how likely it would be for God to create a life-permitting universe. Graham Oppy, a philosopher at the University of Monash, has raised this issue with the fine-tuning argument for design. He says:

[16] In fact, Joshua Rasmussen and Andrew M. Bailey (2020) have argued that persons have infinite value in their article "How valuable could a person be?"
[17] That is not to say that it is not possible to hold this as a philosophical view. Rather it is to say that the philosopher holding this view will struggle to live consistent with her view.

> Given only the hypothesis that there is an intelligent designer of a universe – and given no further assumptions about the preferences of that designer – it is not clear to me that there is very much that one can conclude about the kind of universe that the designer is likely to produce. (Oppy, 2006, p. 207)

Another similar worry is uttered by philosopher of science Simon Friederich. He stresses the need for clarity in what specific concept of God one has in mind. Different design hypotheses will give different probabilities. His most interesting considerations for our purposes are his discussion of the concept of God, as thought of in traditional theism, put forth by Swinburne. He argues that:

> In order to be convincing, the fine-tuning argument for a designer should not be combined with a highly abstract and intellectualized conception of that designer: it will otherwise be impossible to motivate how the designer *would* act if she/he existed [emphasis in original]. (Friederich, 2021, p. 46)

The objection leveled against the God hypothesis is that there simply is no way of knowing what the God of the philosophers would do. They argue that the reasoning above is based on an anthropomorphic understanding of God. That is to say, we think of God in human terms. We think of God as a powerful human being when we argue, as I have done above. However, the traditional philosophical God is wholly different from our experience, and hence we have no idea what such a being would prefer.

Response

I am, however, not convinced that we have to think of God as wholly different and that we anthropomorphize God if we appeal to embodied moral agents as valuable and hence something a good God could create. The concept of God formulated by Swinburne includes God being good. I do not see any reason for thinking that our understanding of what is good should be significantly different from what God thinks is good. Of course, our cognitive limitations should make us humble in trying to understand the motives of an all-knowing God. However, why think that this should lead us to conclude that we have no reason for thinking that God would prefer a universe with life over a universe without life?[18]

Anyhow, we can grant this premise to the skeptic for the sake of argument. Let us proceed on the assumption that we do not know of any reason God would have for preferring a life-permitting universe. Could we still make a fine-tuning argument for God's existence work?

Barnes argues that this could be done; he says that although the God hypothesis may be at worst non-informative regarding the reasons for designing, it is not non-informative at all (2019, p. 1240). While God could favor a specific subset of universes for some reasons, the naturalistic hypothesis is non-informative to what universe would be created at all. Because of this we are not justified in treating the God hypothesis as on the same footing as the naturalistic hypothesis. In the words of Barnes this is because: "there are not, in fact, - 10^{136} possible reasons for God to create that have comparable plausibility to that of a life-permitting universe" (2019, p. 1241).

Even if we do not know the reason why God would create, to say that the odds that God would prefer a life-permitting universe is not as low as -10^{136} seems reasonable. It is important to keep in mind that for the argument to work, one does not need to make it likely that God would prefer a life-permitting universe. One only needs to argue that it would not be as unlikely as under naturalism. After providing a possible reason, namely that God sees some value in embodied moral agents, the burden of proof seems to be on the naturalist to give a reason for why the probability that God would create a life-permitting universe is as unlikely as on naturalism.

[18] See Swinburne (2004, pp. 110-123) for a defense of this view.

Barnes's discussion shows, I think, that mere skepticism is not enough. The burden of proof is on the naturalist's shoulders.

One possible response the naturalist can give is that the problem of evil serves as such a reason. However, given the implausibility of a life-permitting universe on naturalism it would probably need to be a logical version[19] as the naturalist would virtually have to be certain that God could not have justified reasons for the evil in the world. Anyways, I cannot discuss the problem of evil any further because of the limited space and scope of this thesis. It suffices to say that without a good version of the problem of evil the theist can plausibly justify that the likelihood principle favors theism over naturalism.

Conclusion

The design argument has come back in full force with the discovery of our finely tuned universe. There are several ways to formulate an argument for design based on the evidence of fine-tuning. The abductive and the Bayesian approach is both discussed in philosophical journals, with the Bayesian the most advocated. This approach is based on the likelihood principle. I have argued that the probability of a life-permitting universe on naturalism is incredibly low, I followed Barnes in giving it -10^{136} in probability. Then I have argued that a life-permitting universe on the God hypothesis is not equally low. I think that a plausible aim of the designer is embodied moral agents, as suggested by Collins. As we have seen, detractors of design have argued against this notion and contend that we have no idea what a God of traditional theism would prefer. However, I think Barnes has shown that even if one treats the God hypothesis as non-informative regarding the reasons for the design, it is nevertheless not

[19] Philosophers have distinguished between a logical version of the problem of evil and an evidential version. The logical version seeks to show some contradiction between God and evil, while the evidential version only seeks to show that evil decreases the probability of God's existence.

as unlikely as the naturalistic hypothesis. The naturalistic hypothesis is non-informative, while the theistic is at most non-informative regarding the reasons for creating. The burden of proof is on the naturalist to provide some reason for why it is equally unlikely that God would have some reasons for creating a life-permitting universe. Mere skepticism is not justified. Without good objections to this argument, the theist has a good argument for a central part of his belief in God, namely that a cosmic designer designed the universe for some purpose. In the next chapter of this paper, I will identify such an objection, and the rest of this thesis will evaluate whether this objection undermines the fine-tuning argument.

2.3 Chapter summary

In this chapter, I have focused on presenting different forms of the fine-tuning argument that is presented in the literature. I have not defended a specific version of the fine-tuning argument and that will not be necessary for the purposes of this thesis. My focus will rather be on evaluating the multiverse objection raised against the fine-tuning argument in general. Therefore, I will evaluate this objection without a specific fine-tuning argument in mind. However, I will comment at certain points if a given formulation makes a relevant difference to the multiverse objection. As we shall see, in section 6.2, Barnes's formulation makes some difference for how we should think about the multiverse objection.

3. Multiverse Objection

As mentioned, there have been many objections leveled against the fine-tuning argument for God's existence. The most widely used response by detractors of the argument is the multiverse objection, and this objection will be the focus of the rest of this thesis. In the following chapter, I will introduce the multiverse objection. First, I will explain the logic of the multiverse objection then I will discuss different models for how our universe could be part of a multiverse. In discussing the different models, I will evaluate whether the model is relevant as an explanation of the fine-tuning evidence. As we shall see, many of the multiverse models are of no relevance, but a few deserve further attention.

3.1 The logic of the multiverse objection

The multiverse objection rests on two premises. First, that there exists a relevant multiverse, and second, on what is called the observer selection effect. Let us first understand how the observer selection effect works.

Observer selection effect

Observer selection effects can make data biased based on how the data was collected. If we are shown cute pictures of our friends' dog, we could conclude that the dog is very photogenic, or we can consider that there is probable that our friends have taken many pictures of the dog and only show the good pictures. This last consideration is an observer selection effect. Our observance of the pictures is biased because of our friend's desire to show good pictures. To use another example, imagine we are out fishing with a hook and keep getting medium-sized fish. Should we conclude that there are no tiny fish in the sea? Probably not, because our hook places a certain bias on what kind of fish we are able to get. If the fish is too small to bite on the hook, we will not catch fish of that size. These are examples where our observation of some phenomenon is biased because of the process of how we came to know them.

In a similar vein, the observance of our existence relies on a similar biased process which is shown by *the anthropic principle*. The anthropic principle is a much-discussed family of principles that goes back to the Australian theoretical physicist Brandan Carter. He presents it in two versions. The weak anthropic principle he formulates like this: “We must be prepared to take account of the fact that our location in the universe is *necessarily* privileged to the extent of being compatible with our existence as observers [emphasis in original]” (Carter, 1974, p. 293). What he meant by this is that the *location* we find ourselves in in the universe will be a life-permitting location. Life could not evolve in places where the conditions were not right for life. In addition to this, he formulated what he calls the strong anthropic principle, which he states like this: “The Universe (and hence the fundamental parameters on which it depends) must be as to admit the creation of observers within it at some stage” (Carter, 1974, p. 294). As discussed by Barnes and Lewis (2016, pp. 15-21), the word *"must"* in Carter’s principle has been the root of much confusion. Some have taken him to say that there must be observers in a universe or that the observers somehow caused the universe.[20] However, that is not what Carter meant. He meant that we could not examine the universe and find out that the fundamental constants are not life-permitting. The word *"must"* is a consequential must; as a consequence of our existence, the constants must be life-permitting. These principles are not some mystical, metaphysical principle that says that observers are necessary or anything like that. Instead, it is the evident truth that one can only observe facts of reality compatible with one’s own existence.

[20] See Barrow and Tipler (1986). What Barrow and Tipler call the weak anthropic principle is both the Weak and the Strong anthropic principle of Carter taken together. The strong anthropic principle of Barrow and Tipler (1986) is: “The Universe must have those properties which allow life to develop within it at some stage in its history” (p. 21). This is a much stronger principle which takes the “must” to be a metaphysical “must”, the universe must develop life.

This is rather self-evident given that if the conditions were not compatible with one's own existence, one could not observe anything. Some have tried to argue that this alone should make the fine-tuning data unsurprising.[21] If we could not ask why the universe is life-permitting without the universe being life-permitting, how can we be surprised by that fact?

A famous illustration from Leslie (1989, pp. 13-14) based on a firing squad show what goes wrong with this line of reasoning. Leslie imagines a firing squad with the task of executing your life. The marksmen get ready to fire, 3, 2, 1 fire! However, after the loud sound of the guns firing, you observe that you are still alive. What should you conclude? That this was not surprising given that if they had not missed, you would not be there to observe it? Obviously not! What follows is that we should not be surprised that we do not observe that we are dead because if we were dead, then we could not observe that fact. Nevertheless, it does not follow that we should not be surprised that we are alive. As is evident from Leslie's analogy.

When does the anthropic principle work as an explanation?

It is largely accepted that Leslie's analogy shows that the anthropic principle does not work as an explanation on its own. However, when does it work? It seems like the anthropic principle serves as an observer selection effect when there is a large number of outcomes. This can be illustrated by how our planet's specialness is explained by the uncountable number of planets in the universe. Even though it is improbable that the earth is just the right distance from the sun and has a large planet like Jupiter to catch unwanted asteroids and so forth. Given that there are a huge number of different planets, there is no reason to be surprised that we find ourselves on a planet that can support life; we could not live on the planets without life-permitting

[21] See Sober (2003).

conditions. Given a large number of possible places for life to evolve and the observer selection effect of the anthropic principle, we do not have any apparent reason for being surprised by our planet's specialness. The question would be how likely it is to have a life-permitting planet among all the planets in the universe and given a large number of possibilities, it does not seem unlikely that at least one planet could support life. Moreover, on that planet, observers would evolve, wondering why their planet was special.

In the same way, our universe's special initial conditions, laws, and constants would not be surprising if our universe turned out to be one member of an ensemble of an infinite number of universes randomly ordered in their initial conditions, laws, and constants. There would plausibly be life somewhere in the ensemble, and the universes with life-permitting conditions would evolve observers wondering why their universe was special.

One important role of this observer selection effect is to make a life-permitting universe unsurprising while still allowing other unusual events to remain surprising. Although a multiverse would make all improbable events likely to exist somewhere in the ensemble, it nevertheless would not make it likely for us to observe them without a comparable observer selection principle to the anthropic principle. This is very important as this allows for normal probability claims to hold even in a large multiverse. In other words, this observer selection effect allows the multiverse proponent to explain the highly improbable fine-tuning of our universe without explaining everything.

In summary, if a multiverse exists, it would explain why we find ourselves in a life-permitting universe despite the odds against it by combining it with the observer selection effect. However, then the question arises: do we have good reasons for thinking that a multiverse, in fact, exists?

3.2 Do we have reasons to believe a multiverse exist?

There have been suggested many different versions of possible multiverse models. Some have motivation from physics, and others are motivated from philosophical considerations. Among the multiverse theories motivated by physics, we have the cyclic multiverse of John Wheeler, Lee Smolin's black hole spawning multiverse, Steinhardt and Turok's Ekpyrotic model, and Penrose Conformal Cyclical Cosmology model. However, these are either not relevant to the fine-tuning evidence or not widely advocated, and hence I will not focus on these models any further in this thesis.

In addition to these models Max Tegmark, an MIT cosmologist, has championed a hierarchy of multiverses consisting of four levels. The first three levels are multiverse models motivated by physics and advocated by a number of physicists; for this reason, I want to discuss these models further. The fourth level is Tegmark's multiverse theory motivated by philosophical considerations. The level 4 model is not widely advocated, but it is relevantly different from the other models as it is based on philosophy; therefore, I will consider this model as well. In addition to Tegmark's hierarchy, I want to discuss a multiverse model suggested by philosopher David Lewis as his model is the most widely discussed multiverse suggested by philosophical considerations. As we will see, Tegmark's Level 4 multiverse and Lewis model are very similar.

Because Level 1 to 3 multiverse in Tegmark's hierarchy is based on physics, we will explain the relevant physics and the motivation for the physical theories. The better reasons there are for the physical theories, the better reasons there are for thinking the multiverse exists. The Level 1 multiverse (L1M) is based on a theory of the early universe known as eternal inflation. The

Level 2 multiverse (L2M) is based on both eternal inflation and string theory, and the Level 3 is based on quantum mechanics. We will now look at each of them in turn.

Level 1 multiverse – Eternal inflation

Inflationary models of the universe have been proposed since the early 1980ies. The pioneers of the theory are Alexei Starobinski, Alan Guth, and Andrei Linde. Cosmic inflation refers to the theory that the universe rapidly expanded just after the Big Bang. Barns and Lewis (2016) comments,

> Beginning roughly 10^{-35} seconds after the initial birth of the Universe, inflation lasts until 10^{-34} seconds. In that time, the Universe doubles in scale at least 80 times (about a trillion trillion times!). Think of inflating a grain of sand to the size of our galaxy more than 100,000 light years across. (pp. 171-172)

The expansion would be ginormous, from a grain of sand to our galaxy in a blink of an eye.

The motivation for inflation

Inflation was originally postulated to solve three fine-tuning problems in standard Big Bang cosmology: the monopole problem, horizon problem, and the flatness problem.

1. Monopole problem

The original problem the theory sought to solve was the monopole problem. As physicists worked on providing a grand unified theory (GUT), that is to say a theory to unite the four fundamental laws of physics: gravity, the weak and strong force, and electromagnetism, they were puzzled that the theory predicted a large number of monopoles. These monopoles are magnets with only one polarity instead of both north and south, like ordinary magnets. Guth (2001) formulates the problem like this:

> If one assumes a conventional cosmology with typical grand unified theories, one concludes that the mass density of magnetic monopoles would dominate all other contributions by an absurdly large factor of about 10^{12}. Observationally, however, we don't see any sign of these monopoles. (p. 8)

These GUT's had a tremendous problem, and inflation has a solution.

2. Horizon problem

The second problem is the horizon problem. This problem consists of explaining how the cosmic microwave background is uniformed to at least one part in 10^5 in different directions. We can illustrate this by thinking of the cosmic microwave background as a pool of water. Throughout the pool, the temperature is almost the same to a precision of 10^5. Usually, this would be explained by communication of some sort. Physicist Brian Greene (2011) uses the example of shaking the hand of another person. If the other person's hand is cold, it is uncomfortable, but soon enough, the temperature will even out (p. 49). When things are in contact, thermalization causes the temperature to even out. However, this explanation fails in the Big Bang theory. The reason it fails is because there has been no causal contact between our horizons. Our horizon to the left and our horizon to the right could not have had contact. Light has just reached us and will have an enormous distance to cover before reaching the other horizon. How can they be uniform without ever having contact? If we think again of the illustration of the water pool, it would be like many different causally isolated pools would have the same temperature to a precise measure. If we observed this, it would be rather strange, and we would expect to find some causal link. Penrose (2004) summarizes the problem like this: "The impossibility of the causal communication that would be required for thermalization, in the standard model, is referred to as the *horizon problem* [emphasis in original]*"* (p. 747). What explains the uniformity of the cosmic microwave background if there were no causal contact?

3. Flatness problem

The last problem for the standard Big Bang model is the flatness problem. Physicists have measured our universe to be flat to a very high accuracy. The reason this is a problem is that it is a highly unstable position. Tegmark (2014) illustrates this by imagining a stopped bike remaining upright (p. 99). In the same way, the bike is unstable in that position; our universe is unstable in a flat geometry. Tegmark (2014) says that the probability of a universe remaining almost flat for 14 billion years happening by chance alone is less than the probability of a randomly fired dart from Mars hitting a bulls-eye on a dartboard on Earth (pp. 99-100). This is the famous flatness problem.

Inflation to the rescue

In one swoop, the inflationary theory solves all three problems. The universe, by undergoing inflation, could be in casual contact and could reach the same temperature through a thermalization process before inflation expanded into the universe we observe. The flatness problem also vanishes because it is only driven away from the flatness when the expansion is slowing down. In the case of inflation, it is driven towards critical density and thus toward flatness (Vilenkin, 2006, p. 53). The magnetic monopole problem is also solved in the words of astrophysicist Jeffrey Zweerink (2008) this is: “since inflation occurs around the same time as the separation of the strong and electroweak forces, it also dilutes the magnetic monopole concentration to a level below astronomers’ measured limit” (p. 10). This explanatory power of the theory has been the reason for the incredible amount of literature written about it in physics.

Eternal inflation

What makes the inflationary paradigm turn our universe into a multiverse is the scenario of eternal inflation. In eternal inflation scenarios, one imagines a false vacuum at the beginning that continues to grow. As this space grows, the stuff that causes the expansion will begin to decay. This will lead to some regions decaying closer to the ground state. This region will grow in size and experience reheating. Reheating is when the vacuum energy is converted to matter and radiation. Because the false vacuum grows at such a high speed the expansion will be faster than the decay of the stuff causing the expansion. Therefore, there will always be expansion somewhere and this process would continue to form new universes endlessly.[22]

In this scenario there would be infinitely many pocket universes with different initial conditions. The universes with different initial conditions would form in the false vacuum. This process is often illustrated by a bathtub with lots of bubbles. Maybe our universe is just a bubble in a much larger reality, each bubble will have different initial conditions. In this scenario, there would form endlessly many pocket-universes like bubbles form in a bathtub. Inflation makes the space between the regions stretch faster than light, so we could never interact with these other space-time continuums. Each bubble would be far away from the next bubble because of this expansion. These other universes with different initial conditions would be causally unconnected from us, and we could never directly observe them.

However, this L1M has been critiqued as not really being a multiverse since the same laws and constants govern the whole space. There would just be one very big universe with many pockets of space in it. This would, in other words, not explain all the fine-tuning, like the constants of

[22] See Alan Guth (2001) for description of this scenario.

nature and the laws of nature, but it would explain the fine-tuning of the initial conditions in our pocket-universe.

Level 2 multiverse – Inflationary string theory multiverse.

The most discussed and defended multiverse theory that could explain fine-tuning is, without a doubt, what Tegmark calls the Level 2 multiverse. The reason is that it is the only multiverse that could explain the fine-tuning that is not "mere speculation" (Collins, 2012, p. 262). The L2M combines two speculative theories in physics: eternal inflation and string theory. We saw the motivations behind eternal inflation in the L1M, but as we noted, the L1M could not explain the fine-tuning of the constants and laws of physics. To explain this, it would need, in addition to this universe creating mechanism (eternal inflation), some kind of mechanism that would alter the constants of the universe in each pocket-universe in this ensemble of universes. This is where the superstring theory does the work. To alter the constants, the inflationary multiverse scenario needs some form of GUT. Among the available options, string theory is largely considered the best hope of one.

String theory

String theory is the leading theory in particle physics for unifying the standard model of particle physics with Einstein's general theory of relativity. The theory postulates one-dimensional strings and higher dimensional branes as the fundamental stuff in the universe. Originally string theorists tried to find one specific way the universe had to be. However, recent trends have seen the theory go from predicting one specific outcome to allowing 10^{500} different vacuum states corresponding to different universes. These different types of universes represent a possible landscape of universes that string theory allows. String theory in itself does not predict that each universe should be realized. Only when we combine this cosmic landscape of possibilities with eternal inflation will it be filled with actual universes with different initial conditions and constants of nature. Eternal inflation combined with string theory would give a multiverse that would increase the chances of getting a life-permitting universe. Among the 10^{500} different universes, there would likely be at least one fine-tuned for life. A multiverse consisting of 10^{500} different universes with different constants and initial conditions would be sufficient to explain away the fine-tuning as an environmental happenstance.

The eternal inflation combined with string-theory is the most widely advocated multiverse theory, and it has the potential of explaining the fine-tuning evidence. Because of these reasons, this multiverse will be a major focus of this thesis.

Level 3 multiverse – Many worlds interpretation of quantum mechanics

The Level 3 multiverse theory in Tegmark's hierarchy is based on quantum mechanics. Quantum mechanics is a physical theory that describes the smallest parts of nature, like atoms and subatomic particles. This theory is well established but very difficult to understand. The mathematics is well understood and well tested, but the interpretation is highly disputed. There exist multiple different interpretations of quantum mechanics that all can account for the same empirical data. One of the interpretations states that what quantum mechanics shows us is that our world splits into different worlds. This is called the many-worlds interpretation of quantum mechanics and has been gaining popularity in recent years.[23]

The double-slit experiment

To understand why there are so many interpretations of quantum mechanics, it will be helpful to consider a famous experiment called the "Double-Slit Experiment". This experiment consists of firing photons of light at a barrier with a thin slit in it. On the other side of the barrier, there

[23] See (Wallace, 2014) and (Carroll S. , 2019).

is a screen to observe the photons. When there is only one slit open, the pattern of the photons is the expected one, namely a single line behind the slit. However, when there exist two slits, the pattern changes unexpectantly to a classic interference pattern. An interference pattern is a pattern we would expect if waves were hitting the slits. This experiment shows that when there was one slit, the photons acted like particles, but then when the two slits were opened, they changed from particle-like behavior to behaving like waves.

The really interesting thing happens when we add a measuring device to detect if photons have passed through the slit. When this is done, the interference pattern vanishes, and we have two lines behind the slit. The photons, strangely, start to act like particles when we measure them. Waller (2020) writes:

> This extremely strange phenomenon has been observed countless times, but it is very hard to develop a coherent picture of what the photons could actually be doing down there for us to perceive this weird collection of observations. It seems as though when the photon leaves the gun, it starts moving *as if it were a wave* until it is measured and then it suddenly starts acting *as if it were a particle* [emphasis in original]. (p. 205)

This experiment leads us to ask what the photon is doing before measurement. A normal way to think of this is that the photon is in a superposition or quantum state before measurement. The idea is that the photon is in all possible states at the same time prior to measurement. But how should one interpret this?

Many worlds interpretation

This is where the many-worlds interpretation of quantum mechanics comes in. This interpretation says that whenever something enters a superposition, the universe branches off and becomes different parallel worlds or universes. All the possible states are realized in different parallel universes. This process will continue, and there will be countless worlds that keep branching off. Some have argued that this makes the fine-tuning evidence less remarkable. The reason is that there exist countless universes and that increases the probability of a life-permitting universe occurring. However, there have been some questions if this is the right kind of multiverse. In fact, the late philosopher of science Ernan McMullin (1993) argues that this is the wrong kind of multiverse for explaining fine-tuning, he says: “Everett’s branching worlds do not provide the range of alternative initial cosmic conditions or alternative physical laws that this version of an anthropic explanation of the initial parameter constraint would require” (p. 380). The problem for the many-worlds multiverse is that nothing in that theory would alter the constants of nature or the initial conditions. Given the initial conditions and the constants of nature, the many worlds would predict that all possible worlds originating from the same initial state would be actual. However, without additional assumptions of how the initial conditions and constants would be altered, it would not give us a relevant multiverse to explain the fine-tuning. For this reason, the many-worlds hypothesis does not give us an explanation of the fine-tuning evidence, even if it is the correct interpretation of quantum mechanics.

In addition to being just one of many potential interpretations of quantum mechanics, the many-worlds multiverse, even if true, would not give us a multiverse that is relevant for explaining the fine-tuning. Therefore, I will not consider this multiverse anymore in my thesis.

Level 4 multiverse – Tegmark’s mathematical multiverse

The Level 4 multiverse in Tegmark’s multiverse hierarchy is his mathematical multiverse (MM). Tegmark suggests that all mathematically possible universes exist. The universe is a mathematical structure in his view. His motivations for postulating this multiverse are because of Leibnizian considerations. Gottfried Leibniz was a famous 17th-century philosopher, among other things, known for asking why there is something rather than nothing. In a similar way, Tegmark worries that even if the multiverse explains the fine-tuning, there would still remain the question of why this mathematical structure of the multiverse exists and not a different one. Tegmark (2007) suggests: "as a way out of this philosophical conundrum, I have suggested that complete mathematical democracy holds – that mathematical existence and physical existence are equivalent, so that *all* mathematical structures exist physically as well [emphasis in original]" (p. 118). Every possible mathematical structure exists, and in every possible structure, there is an infinite number of copies of universes.

This is postulated as a solution to a philosophical problem, and physical considerations are not important to this model. It seems to me that the main reason for considering this model is to explain the philosophical conundrum of why this mathematical universe exists rather than another.

Lewis's modal realism

David Lewis, one of the most important philosophers of the 20th century, has another similar model. Lewis's model is based not on mathematics but on modal claims. Modal claims are claims of how things could have been. A helpful way of talking about how things could have been is in the semantics of possible worlds. We can say that Hillary Clinton could have been the first female president of the United States in a possible world. Now, of course, in the actual world, she lost the election, and Trump became president, but it seems to have been possible for her to win. Possible worlds are a way of talking about things that could happen. A possible world is a world with no logical contradiction. We can imagine a world where Hillary became president, but we cannot imagine a world where 2+2 is not 4 or a world containing a square circle. These last worlds seem necessarily false. The semantics of possible worlds gives us a tool to distinguish between broadly possible worlds and impossible worlds.

David Lewis argues that what best explains our modal intuitions is that they are based on the reality of the different possible worlds. Every possible world is an existing world, in Lewis's view. These different worlds are the grounding of our modal claims. The reason we can speak meaningfully about what would have happened given some alternative reality is that there in fact exist a world where that occurred.

In differentiating between what is actual and what is possible, Lewis defines the actual world as a casually connected world. To say that something is actual in our world is to say that it exists in our causally connected world. By defining the actual world as a causally connected reality, we will be able to distinguish between what is possible and actual in our world. However, all the other worlds exist as well in a real sense, but he defines them as unactual for us (Lewis, 1986, pp. 92-96). This view of reality he calls modal realism (MR) because he takes the possible worlds as existing in reality. So, we can imagine a world where the tigers are green, the sky is pink, and in Lewis's MR, there are worlds where these are actually existing things. Lewis was not thinking about our finely tuned universe when he suggested his view. His justification is based on grounding modal claims. This view is in a similar vein to Tegmark's view based on philosophical considerations and not physics.

Is Tegmark and Lewis's view the same view?

Although Tegmark and Lewis have different routes for arriving at their views, their views are very similar. Both suggest an actually infinite number of casually isolated worlds that we will never, in principle, observe. Tegmark suggests that all possible mathematical universes exist, while Lewis argues that all possible worlds exist. I will argue that this is, in effect, the same view. The reason for this is that Tegmark equates existence with mathematical existence. If one grants Tegmark this assumption (without commenting on whether this is logically coherent) the two models become pretty much identical. If all possible worlds consist of more worlds than all mathematical worlds, then Tegmark would not answer his philosophical conundrum after all. Instead of asking why this mathematical universe rather than another, we could ask why all mathematical universe exists and not non-mathematical universes? If it were possible for non-mathematical universes to exist, then it would seem *ad hoc* why it would only be mathematical universes that existed and no other types of universe. To this, I suppose Tegmark would argue that there is no such thing as a non-mathematical universe. After all, if one equates existence with mathematical existence, then how could there be any other universe than the mathematical ones? Moreover, if there is no non-mathematical universe in Tegmark's view, then he affirms that all possible worlds exist, which is exactly what Lewis affirms. In the end, I think that the views of Tegmark and Lewis are very similar and hence will be liable to much of the same critiques. The only difference between the views is that Tegmark equates existence with mathematical existence while Lewis does not commit himself to such a view.

Because of their striking similarities, I will consider them both, following Collins (2012), under the heading of the unrestricted multiverse (UM) (p. 258). I will consider these multiverse theories in addition to the L2M because they are significantly different from the L2M in two respects. Firstly, because they are postulated as metaphysical multiverse theories based on philosophy, and secondly, they postulate an actually infinite number of universes, where the L2M can be argued to postulate only a potentially infinite number of universes. As we will see, these differences make criticism of the UM not necessarily a critique of the restricted multiverse.

3.3 Chapter summary

In summary, we have seen that the multiverse objection rests on two things. Firstly, the existence of a multiverse, and secondly, an observer selection effect. The anthropic principle is a much-discussed principle that serves as an observer selection effect when combined with a multiverse. In considering whether a multiverse exists, we have looked at a family of multiverse theories with very different structures and mechanisms. We can broadly categorize the multiverse theories as restricted theories and unrestricted theories. The restricted multiverse theories are typically motivated by some physical considerations, while the unrestricted have philosophical considerations as their basis. Among the restricted multiverse theories, the L2M multiverse is the most discussed theory. It is based on theories that have theoretical support from physical considerations. The other restricted theories are either irrelevant to explain the fine-tuning data or are not widely advocated. Because of these reasons, I consider the L2M as the most plausible among the restricted theories and will be the only restricted theory I will consider in this thesis. Among the unrestricted theories, there are two dominant views; either Tegmark's all mathematical structures or Lewis's all possible worlds. As I have argued, these theories are very similar and will therefore be liable to many of the same critiques. The unrestricted theories are less advocated than the L2M, but they are relevantly dissimilar such that some critiques will not apply to both kinds. Before looking at critiques specifically aimed at either the unrestricted or the restricted multiverse, I will in the next section look at some preliminary worries that apply to multiverse theories of both kinds. These preliminary worries will be important to discuss before we can look at the model-specific critiques.

4. Preliminary worries for the multiverse objection

In this chapter I want to look at two preliminary worries for any multiverse inferred from the fine-tuning evidence. The first worry is that postulating a multiverse based on the fine-tuning evidence commits a logical fallacy known as the inverse gambler's fallacy. It is important to discuss this objection because, if it is sound, it would make the whole multiverse objection a logical fallacy. Secondly, many have objected that the multiverse theory leads to a bloated ontology and hence violates the principle of parsimony called Ockham's razor. These objections can be leveled against any multiverse theory, and hence I will look at these worries before looking at model-specific objections in chapter 5 and 6.

4.1 The inverse gambler's fallacy

A worry for the multiverse proponents is that several philosophers have questioned whether the fine-tuning of the universe gives any support for the multiverse.[24] The objection revolves around the question of whether the multiverse hypothesis commits the inverse gambler's fallacy. This fallacy involves doing the inverse of the classic gambler's fallacy. The gambler's fallacy is a fallacy of reasoning that leads people to think that the probabilities of a given thing, for example, getting a red pocket in roulette, will increase if the roulette has hit the black pocket several times in a row. This feeling that the probability increases when a given outcome has not occurred several times in a row is simply a fallacy of reasoning known as the gambler's fallacy.

Some have argued that the inference to a multiverse from the fine-tuning evidence is the reverse fallacy of the gambler's fallacy; therefore, it is called the inverse gambler's fallacy. On the gambler's fallacy, one thinks that a specific outcome will increase in probability because it has

[24] See Hacking (1987) and White (2003).

not happened in a while. The inverse gambler's fallacy is to look at some improbable outcome, let us say the roulette wheel landing on 0 three times in a row, and conclude that it has probably been many previous spins of the wheel. This objection to the inference to the multiverse was first formulated by philosopher of science Ian Hacking, who interestingly only attributes this fallacy to multiverses that are sequentially ordered and not spatially disconnected multiverses. The inverse gambler's fallacy is acknowledged by both sides of the debate to be a fallacy. The question of debate is whether the multiverse inference commits this fallacy.

MIT philosopher Roger White has written the most rigorous defense of Hacking's thesis, but, *pace* Hacking, White argues that this applies to all types of multiverses, sequentially ordered and spatially ordered alike. He uses Bayesian statistics to argue why he thinks the multiverse inference commits this fallacy. As mentioned above, in Bayesian statistics, evidence E for hypothesis H, is only evidence if $P(H|E \& K) > P(H|K)$. That is to say that the evidence E on the background knowledge K renders the hypotheses more likely given E than on the background knowledge K alone without E. He then argues that if the evidence E is "our universe is life-permitting," then the evidence does nothing to the probabilities of the multiverse. It would be like seeing someone roll a double six and conclude that the dice probably had been rolled many times. Concluding this would be fallacious since the dice roll is independent of other rolls of the dice. The only way to make the multiple rolls inference work is to imagine that you do not see the dice roll but hear that some dice have been rolled double six. In this case, the multiple rolls inference is legit. In the first case, one observes a specific dice roll, while in the other case, one hears that some roll has been double six. White argues that the evidence we have is closer to the first case rather than the second case. If the Big Bang's initial conditions are split into different possible outcomes, we can call them T1x, and our life-permitting universe is, a, we have evidence of T1a and not the weaker claim T1x. That is to say that we have evidence of a specific universe being life-permitting and not the weaker claim that some universe is life-permitting (White, 2003, pp. 229-232).

Finding the right question by analogy

Much of the literature on the inverse gambler's fallacy considers different analogies for what situation we find ourselves in concerning the fine-tuning evidence. Therefore, finding the right analogy will be crucial to whether the inference to a multiverse commits the fallacy.

Let us begin by considering the illustration given by Ian Hacking in the original paper on the inverse gambler's fallacy. Hacking says (1987):

> Think of a gambler coming into a room, walking to the fair device, and seeing it roll double six. A Kibitzer asks, 'Do you think this is the first roll of the evening? Or have there been many rolls?' The gambler reasons that since double six occurs seldom, there have probably been many rolls. (p. 333)

This is to commit the inverse gambler's fallacy.

The supporters of the multiverse inference agree that the example of the gambler above commits the inverse gambler's fallacy. However, they disagree that this is the right analogy of our life-permitting universe. Some argue that the analogy lacks an observer selection effect. The philosopher P.J. McGrath (1988) has argued that a more apt analogy is an observer being woken up when double six is rolled. Suppose the observer is awoken and told that he would be awoken when double six is rolled, the inference that there probably where many rolls are in this case rational. However, against this line of reasoning White (2003) have argued that: "it is not as though we were disembodied spirits, waiting for some big bang to produce a universe that could accommodate us” (p. 238). Only if we were waiting as disembodied spirits for a life-permitting universe will our fine-tuned universe support the many universes inference.

Another way of disagreeing with Hacking’s analogy has been put forth by philosophy professor Cory Juhl (2005). He argues that the fine-tuning argument for multiple universes is more analogous with learning that some spin on a roulette wheel landed on 3. On this evidence, the hypothesis of many spins will be the favored hypothesis. If the roulette wheel has spun 37 times, it is more probable that the wheel has landed on 3 than if it has spun only one time. In this analogy, the multiple universe inference does not commit the inverse gambler’s fallacy.

White has responded to this way of thinking by arguing that we know that our specific universe exists. To not use our more specific evidence of the universe and change it for a weaker claim that is entailed by the more specific evidence, is according to White fallacious. It violates a principle he calls the requirement of the total evidence (RTE).

According to White, the principle of RTE is that we should use the most specific evidence available to us. To show how violation of this principle leads to absurd conclusions, we can consider an example given by Waller (2020):

> Suppose I walk over to my neighbor’s house and notice that they have a pet fish. I then reason as follows: “Since I know they have a pet fish, I also know that they have *some pet or other*. But the most common pets in the United States are dogs. Thus, because I know that the neighbors have a pet, I can infer that they likely have a dog [emphasis in original]. (p. 180)

Obviously, we cannot infer that our neighbor has a dog because we know he has a fish. This shows what can go wrong if RTE is violated.

However, philosopher Peter Epstein has shown that the RTE principle is problematic. Epstein gives an example of fishing in a lake. Suppose you want to know if there are more large fish or more small fish in the lake. You use your net and catch a large fish. This seems to confirm that there is more large fish in the lake. However, suppose you give that fish the name Asha. If you now characterize the evidence as you are catching Asha and not a large fish. This changes things because were:

> you more likely to catch Asha if there were mostly large fish rather than mostly small fish? It seems clear that you were equally likely to catch Asha on either hypothesis […] Asha was swimming along and happened to be in the wrong place at the wrong time. (Epstein, 2017, p. 643)

It seems as if catching Asha does not make it more likely that there are more large fish in the lake. This serves as an example that RTE does not always work. In inductive reasoning, the RTE should not be used, argues Epstein. In the case of the pet fish, he accounts for the problem differently. He says that we should "characterize both the hypotheses we are evaluating and the outcomes observed in a way that was salient prior to actually observing the outcome" (Epstein, 2017, p. 639). He names this the predesignation requirement. In the example of Asha, what goes wrong is that we take a feature of the fish that were irrelevant prior to the experiment and rethink the experiment in light of this new fact. This makes the new hypothesis *ad hoc*. The same applies to the pet fish example. We learn that our neighbor has a fish pet, then we recharacterize the data as "some pet".

The critical thing for Epstein is not that we should make the hypotheses before we have the evidence. That would make postulating a hypothesis to explain the fine-tuning evidence impossible since we had the evidence of a life-permitting universe long before we knew the universe was fine-tuned. Instead, what is essential is to characterize the hypothesis in such a way that it was salient prior to actually observing the outcome. However, the question remains whether our evidence is "someone observes some universe" or "someone observes a particular universe."

Our special planet analogy

Simon Friederich has argued that the casino analogies given above are inadequate. He gives three other analogies he thinks are better. Those are: “the problem of our fine-tuned planet, the problem of our fine-tuned ancestors, and the problem of our lucky civilization” (Friederich, 2021, p. 59). I want to consider only one of the analogies he suggests, and that is our fine-tuned planet, because this analogy is the best, in my opinion. As mentioned in the previous section, one of the intuitive supports of the multiverse inference is its analogousness with the objection to our special planet. That is to say that the plentitude of planets explains our special planet in addition to an observer selection effect. However, if the multiverse inference commits the inverse gambler’s fallacy, so do the many planets respond to our special planet. Intuitively this seems wrong. The "many planets" explanation of our special planet, in the words of Friederich (2021) “seems prima facie adequate” (p. 59). Few think that our special planet needs any explanation beyond many planets and an observer selection effect. Is there a difference between the special planet and the special universe?

Friederich argues that there is a significant difference between the special universe and the special planet. He says that the reason we do not ask what we can infer from our special planet: “may well simply be a consequence of the fact that we have independent empirical evidence for other planets” (Friederich, 2021, p. 69). The difference is in the empirical evidence. Because of this consideration[25], Friederich concludes that there is no clear answer to whether the multiverse commits the inverse gambler's fallacy or not. However, it seems to me that if our planets' specialness does not need an explanation, in light of the empirical evidence of other planets, we could postulate many universes that would explain the fine-tuning evidence. If empirical support of something will explain away some phenomenon, then it seems that postulating those entities without empirical evidence will have the same effect. This would give the multiverse explanatory power and therefore increase the probability of its truth and hence avoid the inverse gambler's fallacy. Of course, the many planets hypothesis is much more certain given that we have empirical evidence of them. However, the many universe hypotheses are more probable given the fine-tuning evidence than it would have been without it. Hence, the fine-tuning evidence gives some evidence for a multiverse.

The salient question

To shed some light on what the most salient question is out of: "why is some universe life-permitting?" or "why is this universe life-permitting?" I think we can use the analogy of our special planet. By using our special planet as an analogy, I think we can see what the right question is.

Let us first consider the evidence. We have evidence that there is life on earth, and if we were to obey White's principle of RTE, we would not have an explanation for our special planet in "the many planets" response. The question would be, why is there life on earth, our specific planet? To this question, "the many planets" response would do nothing to explain why there is life on earth. All the other planets would do nothing to render life on earth unsurprising. In addition to this, Epstein's critique gives us reason to seek a different solution than White's

[25] And other considerations.

principle. I suggest a different solution can be given if we ask what needs explanation instead of asking what evidence we have.

To see what is in need of explanation, I think it will be useful to consider an illustration from John D. Barrow formulated by Craig (2008, p. 164). Barrow tells us to imagine a sheet of paper. Place a blue dot on the sheet where the constants and initial conditions allow for life and a red dot when it would be life prohibiting. This would lead to a sheet of paper covered with red dots with just a few blue dots. The question we are trying to answer is why a blue dot exists rather than a red dot. We are not trying to answer why a specific dot exists. If that is what needs explanation, we will not find an interesting answer. This is because all the dots are equally improbable, and if one asks why a specific dot exists, there will probably be no good answer. Even the design inference will not answer this question since there would be no clear answer to why the designer would choose this universe rather than some other life-permitting universe.[26]

If this illustration shows what needs explanation, and I think it does, then the right question to ask is why there is some universe with life and some planet with life. The question is not why a specific dot exists but rather why it was blue rather than red. Why is our planet life-permitting rather than life-prohibiting, given the unlikeliness of life-permitting planets? To this, the "many planets" response in addition to an observer selection effect will answer the question. Even though a life-permitting planet is very unlikely, the special planet will be explained by the fact that there are extremely many planets. Observers will only be able to ask the question in places where life is permitted. By chance, some planets would have the right conditions for life, and on those planets, observers evolve and ask why their planet is special. The same response can

[26] Although the design hypothesis could limit the puzzle to why this life-permitting universe rather than another life-permitting universe.

be given to the question of the universe. Why does a life-permitting universe rather than a life-prohibiting universe exist? Because there are many universes and only in universes where observers can evolve will they ask the question. When the multiverse inference is formulated as a response to why there exists a life-permitting universe rather than a life-prohibiting universe, it avoids the inverse gambler's fallacy, and the multiverse hypothesis has explanatory power.

Conclusion

The inverse gambler's fallacy objection to the multiverse is an interesting objection that raises many interesting questions. All sides of the debate agree that the inverse gambler's fallacy is a fallacy, but they disagree about whether it applies to the multiverse inference. Both sides of the debate agree that the crucial question is whether we should ask why this universe exists or why some universe exists. White has argued that a principle of RTE shows that the right question to ask is why this universe exists. Epstein has given counterexamples of White's principle and argues that the right question is why some life-permitting universe exists. By considering White's principle on the analogy of our special planet, I think we should reject this principle. Instead of using the most specific evidence we have, as suggested by White, we could instead ask in what sense the fine-tuning evidence needs an explanation. Barrow's illustration of a sheet of paper filled with red dots representing life-prohibiting universes and only a few blue dots representing life-permitting universes shows what needs explanation. It is why our universe is life-permitting and not life-prohibiting that is surprising and cries out for an explanation. This leads to the conclusion that the right question is why some life-permitting universe exists rather than not. For this reason, I think the multiverse inference, in the end, does not commit the inverse gambler's fallacy. So, if the design proponent wants to tip the debate in favor of design, it will have to be on other grounds than the multiverse committing the inverse gambler's fallacy.

4.2 Simplicity

If we can, based on the previous discussion, agree that either a multiverse or a designer would explain the fine-tuning evidence, then we can ask if one of the hypotheses is more plausible *a priori* than the other. Many have argued that on theoretical virtues alone, the multiverse hypotheses are less plausible than design. The reason that is often given is that it violates the theoretical virtue of simplicity. This theoretical virtue is known as Ockham's razor, named after the 14th-century theologian and logician William of Ockham, and the principle states that one should not postulate entities beyond necessity. Why postulate an enormous multiverse rather than just one designer? I will, in this section, examine whether the multiverse hypothesis violates this principle. I will discuss the two different versions of the multiverse, and I will argue that the answer will depend on which version one has in mind.

The simplicity concern for the multiverse

Simplicity in the context of Bayesian terminology is often associated with the prior probability of a theory. The prior probabilities are the likelihood of a given theory being true based on our background information alone. If a theory equally well accounts for the evidence, then the theory with higher prior probabilities is favored. Simplicity is a theoretical virtue often used to assess the priors and see whether a theory is likely on the background information alone. If all else is equal, then the simpler theory is favored.

Richard Swinburne argues forcefully that the multiverse hypothesis is much more complex than the theistic hypothesis. He argues that:

> it is the height of irrationality to postulate an infinite number of universes never causally connected with each other, merely to avoid the hypothesis of theism. Given that simplicity makes for prior probability, and a theory is simpler the fewer entities it postulates, it is far simpler to postulate one God than an infinite number of universes,

> each differing from each other in accord with a regular formula, uncaused by anything else. (Swinburne, 2004, p. 185)

Many have shared his perspective.[27]Let us look at how this consideration affects the prior probabilities of the unrestricted and the restricted multiverse.

Unrestricted multiverse

The UM seems to be the least parsimonious theory of the hypotheses under consideration. Neither Tegmark's nor Lewis's multiverse theory would probably impress William of Ockham. They both postulate an infinite number of entities in their theories and hence are the least simple theory one could postulate. However, this critique has not gone unchallenged. In response to the critique that it is the number of entities in the theory that makes its prior probability low, Lewis (1973). says "I subscribe to the general view that qualitative parsimony is good in a philosophical or empirical hypothesis, but I recognize no presumption whatever in favor of quantitative parsimony" (p. 87). Lewis argues that what matters with regard to simplicity is not the quantity, that is to say, the *number* of things, but qualitative, that is to say, different *kinds* of things that the theory postulates. To Lewis, it is far simpler to suggest an infinity of other universes, as they are of the same kind of things, rather than God, which would be a different kind of entity.

Swinburne has a different view of what counts as simplicity. He argues that what counts as simplicity is:

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[27] For example Craig (2003): "it is simpler to postulate one Cosmic Designer to explain our universe than to postulate the infinitely bloated and contrived ontology of the Many-Worlds Hypothesis" (p. 171) and Koons (1997): "This hypothesis postulates an infinity of entities for which there is absolutely no positive evidence, simply in order to avoid the necessity of explaining the anthropic coincidences we have observed. This is the height of metaphysical irresponsibility, far worse than the most extravagant speculations of medieval angelology" (p. 208).

> a matter of it postulating few (logically independent) entities, few properties of entities, few kinds of entities, few kinds of properties, properties more readily observable, few separate laws with few terms relating few variables, the simplest formulation of each law being mathematical simple. (Swinburne, 2004, p. 53)

There is, in other words, a difference in what they consider simpler theories. Swinburne argues that it is fewer things and kinds, while Lewis argues that kinds are the only relevant category. Who has the right view of simplicity?

It is difficult to tell, but on reflection, it seems that Lewis is correct to say that to postulate a new kind of entity is at least a higher cost of a theory than a larger number of the same things. Consider an illustration inspired by Waller (2020, p. 190): if I were confronted with a large crop circle with a message saying "attack here" or something of the kind, I would think that there would be a far simpler explanation that humans made this as a prank rather than aliens. This would still be the case even if the crop circle were of such a size that there would have to be many people doing it. The illustration reveals that postulating a new kind of thing is a higher cost than postulating more of the same kind of thing.

Does that make the multiverse hypothesis simpler than the design hypothesis since the multiverse only postulates a larger number of things while the design hypothesis postulates a new kind of thing? I do not think so. I will argue that the multiverse of Lewis and Tegmark is less parsimonious than the design hypothesis. Both of them argue for an infinity of separate universes, which will be an additional assumption in their hypothesis. However, in addition to the extravagant number of individually postulated things, there is also an extravagant number of new kinds. Why is this?

Lewis's multiverse includes universes consisting of only a unicorn existing unexplained and a universe consisting of elves and all sorts of different kinds of things. By postulating that all possible worlds exist, he commits himself to worlds consisting of all kinds of things because these worlds seem possible. The same criticism can be leveled against Tegmark's multiverse since he equates mathematical formulation with existence. As Pruss (2006) notices in a different context: "There are perfectly coherent mathematical models describing possible worlds in which the only thing that exists is a brick" (p. 32). There is nothing special about bricks in Pruss's example. Anything imaginable could replace the brick. This will lead to there being a universe where a dragon, or anything imaginable, is the only mathematical description. If this is correct, then Tegmark's theory postulates that new kinds of things exist, like a dragon. Indeed, both Lewis and Tegmark seem to postulate an infinite number of different things and an infinite number of different kinds of things. Each universe in their theories will be an additional assumption since there is nothing unifying the different universes. It seems difficult to be more extravagant than these multiverse theories, and if simplicity is a theoretical virtue, their theories will the lowest possible prior probability of being true. Therefore, I think the design hypothesis is simpler and should have a higher prior probability of being true than Tegmark's and Lewis's multiverse. The design hypothesis postulates one new kind of entity, but the UM postulates an infinite number of new entities.

In summary, I think that regarding the UM, Swinburne's critique is wholly justified. Based on simplicity considerations alone the design hypothesis should have a higher prior probability of being true.

Restricted multiverse

If my discussion above is correct, the UM is less likely than design *a priori*, but what about the restricted multiverse represented by L2M?

The problem with the UM theories is that they postulate unconnected universes. If there were one thing connecting all the universes, then the universes would not be extra assumptions but instead would be implications of the theory. I will argue that the L2M is much simpler than the UM because it postulates only one universe generating mechanism. This connects all the universes to one original cause. This cause is a primordial false vacuum that expands while creating new universes. In this scenario, there is only one thing postulated, namely, a false vacuum. In this respect, the L2M seems to be on the exact same footing as the design hypothesis.

One could argue that the L2M entails a multitude of universes containing the same different kinds of things as the UM, but this is however, to miss the point of Ockham's razor. Ockham's razor states that one should not postulate entities beyond necessity; those entities' implications are not an essential consideration. The important thing are how many entities is postulated as assumptions in the theory, and the restricted multiverse postulates only one new entity.

On the other hand, one could argue that the inflationary multiverse is simpler than the design hypothesis. The design hypothesis postulates a supernatural being, while the multiverse hypothesis only postulates a natural thing. Could simplicity favor the inflationary multiverse over design?

This consideration is interesting, but I think that it ultimately is without merit. What distinguishes something from being natural or supernatural? Whatever one argues distinguishes natural and supernatural, I would argue that the universe generator and God would probably be of the same kind. If what distinguishes it is that it is beyond our universe, then the false vacuum will also be characterized as supernatural. If something is considered supernatural if it can produce effects that no other known thing can, then the two hypotheses are also on a similar footing. There is no known universe creating mechanism besides the hypothesized false vacuum.

However, maybe the difference could be that the restricted multiverse uses physical principles that one knows works and extrapolates them to a domain outside our universe while the design hypothesis postulates something wholly unfamiliar. Again, I think this does not work as the design hypothesis could be characterized as an extrapolation from intelligence causing design to a cosmic intelligence causing design. This seems like the same kind of extrapolation that the L2M makes. Both extrapolates something from a known domain to an unknown domain. The only relevant difference between God and the universe generator, it seems to me, is that God is personal. However, we cannot say that something is supernatural because it is personal as that would make humans supernatural, and humans are not supernatural.

In summary, I think Swinburne’s criticism that a multiverse is less simple than a designer does not apply to the L2M. It postulates a common origin of the multitude of universes and hence postulated only one extra entity. Indeed, the L2M and the design hypothesis seem to be on the same footing when it comes to simplicity considerations. I think other considerations are needed to edge the debate in favor of one of the two hypotheses.

4.3 Chapter summary

This chapter has considered two preliminary worries, which were important to discuss before delving into the model-dependent objections. First, we considered whether the multiverse commits the inverse gambler's fallacy, as has been suggested by a number of philosophers. I concluded that we want to explain why a life-permitting universe exists rather than a life-prohibiting universe and not why this specific universe exists rather than another. This, I argued, shows why the multiverse inference does not commit the inverse gambler's fallacy. Secondly, we considered the simplicity of the multiverse. I argued that while the UM is less simple than a designer, the restricted multiverse seems to be on par. I argued that the important part is not what the theory implies but rather the assumptions the theory makes. With these preliminary worries dealt with, I will now continue by considering some objections leveled at the concrete multiverse models.

5. Critique of the unrestricted multiverse

In the following chapter, I will discuss arguments against the UM theories of Tegmark and Lewis. Both of these multiverse theories face several challenging critiques, some of which I will discuss in this chapter. I will restrict my discussion to critiques that will apply to both theories and hence can be seen as objections to the UM.

When people hear of the UM, many find it inconceivable and hard to believe. This becomes especially clear when one considers the implications of both these theories, namely that all possible worlds exist. All things we consider imaginary will exist somewhere in this ensemble, like dragons or elves. No wonder these theories are met with an incredulous stare by most people (Lewis, 1986, pp. 133-135). However, finding something strange is not a good reason for rejecting a theory, although it can give some *prima facie* evidence against it. As discussed in section 3.2, the main reason for accepting these theories, without fine-tuning consideration, will be to answer why something exists or account for modal statements. To evaluate whether this is a plausible response to the fine-tuning evidence, I will consider some objections raised against an UM and evaluate whether these give us a reason for rejecting the UM. First, I will consider whether there is something problematic in postulating an actually infinite number of things 5.1. Then I will look at the most discussed objection to the UM, namely that it leads to skepticism 5.2. Finally, in 5.3 I will present my own argument against the UM based on the fine-tuning evidence itself.

5.1 The problem of the actual infinite

The first worry for the UM that I will discuss is the problem of an actual infinite existing in reality. This argument is associated with another argument for God's existence, namely the

Kalam cosmological argument. The person responsible for a revival of this medieval argument is philosopher and theologian William Lane Craig.

The Kalam argument goes like this:

“1) Whatever begins to exist has a cause.

2) The universe began to exist.

3) Therefore, the universe has a cause” (Craig, 2008, p. 111).

In support of premise 2 he gives four arguments, two philosophical and two based on physics. Among the philosophical arguments given for premise 2 is the argument that an actual infinite is impossible. This argument is formulated like this in the Kalam argument:

“1.1 An actual infinite cannot exist.

1.2 An infinite temporal regress of events is an actual infinite.

1.3 Therefore, an infinite temporal regress of events cannot exist” (Craig, 2018, p. 154).

Now for our purposes, premises 1.2 and 1.3 are not relevant. We can reformulate this argument, reusing 1.1 in the following way to make it relevant for our purposes:

1.1 An actual infinite cannot exist.

2.2 The UM imply an actual infinite.

2.3 Therefore, the UM cannot exist.

Preliminary terminology

Before we assess this newly formulated argument against the UM, we need to understand some terminology. The most crucial terminological distinction is between what is called the actual infinite and the potentially infinite. An actual infinite collection of things will have an infinite number in it, while the potential infinite can be thought of as a number growing toward infinity as a limit but never actually reaching it. The L2M, if it had a beginning, would be of the second sort. It would start at t = 0 and form new universes indefinitely but would never reach infinity. Because of this, some versions of the L2M are not liable to this objection and can avoid it. Hence, whether the L2M is liable to the same critique will be model-dependent.[28] However, as we shall see, the UM plausibly implies that an actually infinite number of things exist.

Defending premise 2.2

Let us start with the justification for premise 2.2 since I believe this to be the least controversial premise.

Both Lewis's and Tegmark's models seem to be best understood to have an actual infinite in their ontology. If they were to cut off at any point how many worlds that existed in their views, that cut-off would seem arbitrary. If the number of worlds were 1 trillion, then it would be rather odd why it could not be 1 trillion plus one. Wherever one tries to cut off the number of worlds, the cut-off would seem arbitrary in these models. In addition, we can imagine worlds containing an infinite number of any random thing like tulips or lions, and as long as that is logically possible, there is one world containing this on the UM. Therefore, I think it is plausible that these models contain an actually infinite number of worlds. Without any natural cut-off of worlds, choosing an arbitrary limit makes the theories look *ad hoc*, especially if the limits are just postulated to get out of this objection.

[28] Many of the L2M theories postulate infinite space which would lead to this objection being applicable. However, the L2M does not necessarily lead to this consequence and hence I think this is best seen as a critique against the UM.

Defending premise 1.1

The more controversial premise will be 1.1. To evaluate the plausibility of this premise I want to look at how this premise has been defended and challenged in the debate over the Kalam argument.

In defense of this premise, Craig (1979) has only one consideration, he says that “while the actual infinite may be a fruitful and consistent concept in the mathematical realm, it cannot be translated from the mathematical world into the real world, for this would involve counter-intuitive absurdities” (p. 157). These counter-intuitive absurdities are shown when we consider certain thought experiments. There are many examples of these, but I will, because of limited space, only consider one of these thought experiments and discuss whether this gives us good grounds to accept 1.1. The thought experiment I want to consider is one of the most discussed, namely, Hilbert’s hotel.

Hilbert’s Hotel

Hilbert’s Hotel is the brainchild of the German mathematician David Hilbert. I will give a shortened presentation of this thought experiment based on the presentation given in Craig and Sinclair’s chapter in *The Blackwell Companion to Natural Theology* (2012, pp. 108-110). Hilbert invites us to imagine a hotel with infinitely many rooms and infinitely many guests occupying those rooms. This is, in other words, a fully booked hotel with no available rooms. Now imagine that a new guest arrives and asks the hotel owner whether there are any rooms left. The hotel owner thinks to himself and says, "Yes, there is, just one moment." He proceeds to tell the person in room 1 to move to room 2 and room 2 to room 3 and continues this process *ad infinitum*. He then turns to the new guest and says that room 1 is available. Now, this is a rather odd situation. The hotel was full, but it was still possible to make room for one more guest by rearranging the rooms. Also, the hotel would have an equal number of guests after the new guest arrived as before the last guest checked in, namely an infinite number.

This gets stranger when one considers what would happen if an infinity of new guests appeared and wanted a room. By rearranging the guests in the even-numbered rooms to the odd-numbered rooms, the hotel owner could make room for an infinity of new guests. All the odd-numbered rooms would be occupied by the existing guests, and all the even-numbered rooms would be available for the new guests. Even though all the rooms were occupied before the new guests arrived, it was still possible to rearrange them to accommodate the new guests. And again, this would leave the hotel with as many guests as before. This despite making room for an infinite number of new guests. Hilbert's Hotel certainly seems very strange!

We could even make this hotel stranger by checking out every odd-numbered room. This would lead to an infinite number of guests leaving, and the hotel would still have the same number of guests as before they left. Craig finishes his considerations of Hilbert's Hotel with a rhetorical question:

> Can anyone believe that such a hotel could exist in reality? Hilbert's Hotel is absurd. But if an actual infinite were metaphysically possible, then such a hotel would be metaphysically possible, it follows that the real existence of an actual infinite is not metaphysically possible. (2012, pp. 109-110)

This intuition that Hilbert's Hotel is absurd is the main justification for 1.1.

Responses to the absurdities of Hilbert's Hotel

I want now to consider some responses that have been given to this argument for 1.1. The first response I will consider is the response given by philosopher Graham Oppy. Oppy has suggested a strategy for the friends of infinities; that strategy is to outsmart those who present these cases. He defines what to outsmart is in a footnote: "Outsmart, v. To embrace the conclusion of one's opponent's *reduction ad absurdum* argument [emphasis on original]" (Oppy, 2006, p. 48). That is to say; one just accepts that this is what would happen in an actual infinite hotel. After all, there is no logical contradiction in the thought experiment. In fact, Craig agrees that there is no logical contradiction; these examples do not lead to logical contradictions, so one could say they are metaphysically possible without contradiction. However, Craig's response to Oppy is this:

> Because these involve, not strict logical inconsistencies, but, as I put it, "counter-intuitive absurdities," whether one finds them troubling enough to embrace (1.1) will be to a considerable degree subjective. I find them sufficiently troubling, and I hope my readers will, too; indeed, I think they should, although I do not aspire to prove this. (2018, p. 158)

This leaves us with a clash of intuitions. Many people find puzzles like Hilbert's Hotel counter-intuitive and absurd, giving them a reason to accept 1.1.

The second response I will consider is given by philosopher Wes Morriston (2018). He argues that puzzles like Hilbert's Hotel only show that some kinds of actual infinities cannot exist. He argues that these puzzles do not show that no kinds of actual infinites could exist; that is, they cannot be generalized. He argues that the puzzles only give grounds for thinking that coexistent objects whose physical relationship can be changed are relevant. Remember, these objections are originally presented against the Kalam argument, and in that case, none of these types of infinities is relevant to the infinities discussed. However, in the case of the UM, it does have an infinite number of coexisting objects. Whether the infinities need to have a physical relationship to be problematic would still remain a question because, in MR and MM, the coexisting universes are not causally connected.

However, in response to Moriston's worry, why think that the paradoxes involving infinities arise because some aspect of the specific cases rather than the actual infinities? As Craig says in regard to cases like Hilbert's Hotel: "The difficulty here is two-fold: (i) nothing in the various situations seems to be metaphysically impossible apart from the assumption of an actual infinite, and (ii) the absurdities are not tied to the particular kinds of objects involved" (2018, p. 158). Regarding Craig's first point, there is nothing strange or metaphysically impossible about moving guests from room to room. The absurdities only arise when there is an actual infinity involved. The ability to move the parts does not seem essential to the absurdities; it seems more plausible to say that the problem is the existence of an actual infinite. The second point of Craig that there is nothing special about a hotel or rooms is evident because the same problems would arise if there were an actual infinite of books, horses, or universes. Suppose there is nothing special about moving guests and there is nothing special about a hotel. In that case, it seems that what makes this thought experiment troubling is indeed the existence of an actual infinite.

A diffrent proposal have recently been suggested by philosopher and mathematician Alexander Pruss. He considers many paradoxes of infinities in his book *Infinity, Causation & Paradox*, looks for a unified explanation, and concludes, "Causal finitism provides such a unified explanation by denying the possibility of an infinite causal history for a single item" (Pruss, 2018, p. 193). However, if Pruss is correct in his conclusion and the paradoxes containing the actual infinite only show that an infinite casual history is impossible, then again Hilbert's Hotel would be possible since it does not involve an infinite causal history. This, however, turns out to be the same move as previously suggested by Oppy, namely, accepting the strange paradoxes of Hilbert's Hotel as metaphysically possible. The plausiblity of an actual infinite seems to stand or fall on this intuition.

Is God an actual infinite?

One *ad hominem* consideration is worth raising, and that is that the friends of infinities can argue that God is infinite. If God is infinite, then this argument would rule out God as well, and this is an unwelcome conclusion for the proponent of the Kalam or the fine-tuning argument for design. It is important to notice that this is an *ad hominem* consideration because it does not target any premise in the argument, it only shows that the defender of design has the same problem. It is, however, relevant because if God is liable to the same objection as the multiverse, then this objection should not be very weighty.

However, does God present an actual infinite? Some models of God certainly do just that; if, for example, God has existed in time from eternity and have a changing mental life, then he has experienced an actual infinite number of events. However, not every model of God is committed to actual infinites. If God is timeless[29], then he has not experienced an infinite number of events. Normally when theologians talk of God as infinite, they are thinking in quality and not quantitively. God can be infinite in power and knowledge without requiring that he create an actual infinite number of things or that he knows an actual infinite number of future

[29] Craig argues that God is timeless sans creation but in time after creation. For a defense of his view see Craig (2001).

events. Therefore, while some models of God are liable to this objection, there are other models available that are not, and hence I do not think that God is liable to the same objection. Nothing in the definition of God presented at the beginning of this paper commits one to there being a quantitatively actual infinite in God.

Conclusion

Discussion of whether an actually infinite number of things can exist has been a lively debate regarding the Kalam cosmological argument. I have in this section showed how this discussion is relevant to the UM. I focused on the thought experiment of David Hilbert; Hilbert's Hotel. This is one of many examples of thought experiments regarding actual infinities that lead to strange if not absurd conclusions. I discussed two ways out for the friends of infinities. The first is outsmarting the opponent by accepting the absurdities. The second is to deny that these examples can be generalized. In response to the second possibility, I discussed two responses from Craig. First, the absurdities seem to be tied to an actual infinite and not to causal considerations. Second, nothing hinges on the kinds of objects used. This, I think, plausibly leaves the actual infinite as the problem. Regarding the first option of outsmarting the opponent by accepting the absurdities, this seems to be a clash of intuitions. I find Hilbert's Hotel troubling and would feel uncomfortable accepting it as a metaphysical possibility. Others may not share that intuition. This argument will then have different degrees of force depending on your intuition regarding Hilbert's Hotel. In addition, even if one finds Hilbert's Hotel troubling, one would still need to compare this to other reasons for accepting MR or MM. If one's reason for accepting MR or MM is sufficiently strong, they could overpower the intuition that an actual infinite cannot exist in reality. However, overall, I think this argument has the potential, depending on intuition, to be one piece of a cumulative case against the UM.

5.2 The worry of skepticism on the unrestricted multiverse

The second objection to UM that I want to discuss is the most discussed objection, namely that the UM leads to skepticism. Australian philosopher Peter Forrest first formulated this objection as an objection to Lewis's MR, but the objection works just as well against Tegmark's MM. Alexander Pruss, inspired by Forrest, has further developed an argument against the justification of induction on MR. We will, in this section, look at both of these arguments against UM and discuss whether these give us a reason for rejecting UM.

Undermining Ockham's razor

Let us look at the first objection given by Forrest (1982), who argued that MR would lead to skepticism about Ockham's razor, which in turn would lead to skepticism in general. The reason for this worry is that on MR, there is no difference between what possibly exist and what, in fact, exists. If everything exists, then Ockham's razor cannot be applied, as reality is ultimately not simple. This would remove a valuable reason for rejecting certain skeptical worries, for instance, Descartes's deceitful demon. This skeptical worry asks how we can know that our perceptions are not the result of a demon deceiving us. Everything we think we know may just be one big deception. Forrest argues that we usually use Ockham's razor to prefer the simplest theory, and hence the worry of Descartes's demon is removed. However, if there are possible worlds where a demon is deceiving people, then there does not seem to be any simplicity advantage to prefer the hypothesis without the demon. After all, there exist plenty of worlds where this is happening. Simplicity considerations would not make sense, as all things exist. We could only argue that *our* world would be simpler. On the whole, reality would not be simple. If what ultimately exists is not simple, then what reason do we have to expect that our part of reality should be simple?

In addition to this problem, Forrest argues that we actually have a reason for thinking that there is an infinite number of worlds where a demon deceives us and only one where it does not. Forrest (1982) states, "for each possible world without the redundant entity there are infinitely many, with it, corresponding to the infinitely many different properties the redundant entity could have" (p. 458). The argument seems to be that for every normal world without deceit, there will be infinitely many where a demon deceives us. This is the case because the demon can be thought of in infinitely many ways, while the regularity of a normal world will only have one possibility. There is, according to Forrest, infinitely more likely that we are in a deceptive world based on Lewis's modal realism.

In response to Forrest, Lewis argues that the MR proponent is in the exact same position as the non-modal realist. He counters Forrest's argument by arguing that there is "a different way of dividing the relevant worlds into classes, such that in each class there are infinitely many clean worlds, and only one rubbishy one!" (Lewis, 1986, p. 120). The reasoning behind this response is that infinities are of equal size. There will be an infinite number of both worlds in an UM, so there is no reason to think that one world is more likely than another.

This leaves the modal realist in a position that there are infinitely many worlds that are regular and infinitely many worlds that are the product of a deceitful demon. However, this response from Lewis is not sufficient to avoid Forrest's argument. It is not enough to say that there is an infinity of both kinds, as Friederich (2021) argues, "Unless Lewis provides reasons to believe that, if modal realism is true, those pathological observers are, in some relevant sense, a tiny minority, believing in modal realism is impossible" (p. 172). If there is a 50% chance that all our perceptions are the result of an evil demon deceiving us, then I do not think that we can say that we know anything. To know something surely needs more than 50% confidence. Hence, the burden of proof is on the proponent of MR to show why we should not be skeptics. The Modal Realist needs to give an argument to show why we should think that the deceptive worlds are a tiny minority of all the possible worlds. Without such a reason, MR leads to skepticism.

Humean skeptical worry

Alexander Pruss has expressed another similar worry in his work *Actuality, Possibility, and Worlds* (2011, pp. 110-119). He argues for the same conclusion, namely that MR leads to induction being unjustified and hence to skepticism. Pruss's argument is inspired by Forrest, and it leads to a similar skeptical conclusion. However, Pruss argues differently and not based on Ockham's razor. Instead, he argues that the only reasonable response to the Humean skeptic about induction is not available to the modal realist.

He argues that if every possible world exists, then there are infinitely many worlds where gravity has been regular up to this moment and stops being regular after this moment. There is both an infinity of worlds where it continues and where it breaks down after t0 (t0 is the present moment). How would we know whether we are in a world where gravity holds after t0 or if it breaks down? This is the Humean worry.

David Lewis has responded to this challenge by arguing that the same problem persists within any theory of possible worlds. Whatever theory of possible worlds one adopts, the Humean problem of induction will apply, and MR is in no worse state than any other theory of possible worlds. In response to this suggestion, Pruss argues that while other theories of possible worlds can give a response to the Humean skeptic of induction, Lewis's MR cannot give the same response.

Let us first lay out the problem. To see why there is a Humean argument for skepticism it is helpful to consider possible worlds illustrated as a heavenly library. Each book in this library corresponds to a possible world, let us call it: w. If one imagines a world to be a book and the history of that world up until the present moment consists of 1000 pages. The book can be called, w0, and the present moment, t0. These pages have been regular up to this point, but will they remain regular? In this heavenly library, there is an infinite number of books that are regular up to the 1000th page and stay regular. However, there is also an infinite number of books that are regular up until the 1000th page and then become irregular. All we know about this world is that it corresponds to one of the books in this heavenly library. Do we have any reason for thinking that this world will continue to be regular after the 1000th page? It seems not. It is important to remember that all of this is in the logical space. We know nothing more about the books than that they are in this heavenly library as an analogy of the logical space.

Suppose we include in this argument that the book, w0, is our world, and the 1000 pages represent our past. This should not change much. Before we knew that the book was our world, we did not have any reason to think the regularities should continue; why should we think so after learning that w0 is our world? The Humean skeptic says that we should not, and that is because we have not learned anything new by finding out that the book represents our world. Any theory of possible worlds seems to face this Humean problem of induction. However, Pruss argues that a reasonable response can be given by other views of possible worlds that the proponent of MR cannot give.

One can give this response: the fallacy lies in thinking that we have not learned anything new in learning that the book represents our world. When we use induction in the actual world, the inference is based on the actual world. It does not matter what is in the logical possible space.

Pruss (2011) says, "When we have learned that w0 is actual, the problem of what will be true after t0 at w0 was transferred from a question about logical space, to a question about actual events" (p. 115). This transfer allows us to make inductive inferences like we do all the time in our everyday life.

This seems like a reasonable response against the Humean skeptic. However, Pruss argues that the MR proponent cannot give the same response. The reason for this is that the crucial move one could make regarding the Humean skeptic was to say that one had learned something new by knowing that w0 is our world. If this cannot be said by the proponent of MR then the Humean skeptical argument is sound and the justification of induction goes out the window.

Now, does the MR proponent learn something new when they learn that w0 is their world? It seems not. The only thing they learn is an indexical fact that w0 is *here*. Because in MR, the whole logical space exists. There does not seem possible to draw the same distinction between the logical and the actual space; they are the same on MR.

Pruss (2011) concludes,

> If Lewis's indexical theory of actual is correct, it follows indeed that learning that w0 is actual and t0 now does not give us any relevant information with regard to the question of whether w0 will continue to have induction holding in the near future of t0. Hence Lewis cannot make the only possible response to the skeptical argument. (p. 116)

This leaves the MR proponent with the problem of justifying induction.

While the argument given by Forrest and Pruss was aimed at Lewis's MR, it seems like the exact same argument can be given against Tegmark's MM. The reason is that MM, as in MR, blurs out the distinction between what is actual and what is possible. Every mathematical structure exists and will give rise to every possible world, and hence the same problems arise on MM.

Conclusion

In this section, we have seen two different arguments that lead to the same conclusion. Namely, if an UM exists, we will have problems with justifying rejection of certain skeptical hypotheses and arguments. Forrest argued that MR, by undermining simplicity, removed a reason for rejecting the possibility that a demon was deceiving us. Pruss argued that MR removed the only reasonable reply to the Humean skeptic, namely that we learned something new by discovering that we existed in an orderly world. Skepticism would be a big price to pay for the UM. As noted above, both of these arguments will equally apply to MM and hence will be an objection to the UM.

5.3 Stringent laws objection

In the following, I will suggest a new objection to the UM theories of Lewis and Tegmark. My argument will be based on the possibility that some possible fundamental laws do not need fine-tuning to permit life. If that is true, it is improbable that we should find ourselves in a universe where the laws need fine-tuning for life to exist. I will first argue that Tegmark and Lewis's views entail that universes with different laws that do not need fine-tuning are possible and hence exist in their view. Then I will argue that if there are universes governed by these laws of nature, we should expect to be in such a universe. I will formalize this argument and evaluate the plausibility of each premise. As we shall see, this argument will be best thought of as one horn of a dilemma; either the UM will suffer from a similar problem of skepticism as discussed above, or this objection will be sound.

Can the laws be different on the unrestricted multiverse?

Both Lewis and Tegmark's views entail that every possible world actually exists. My understanding is that this does not have to be confined to our fundamental laws of nature. They do not argue that every possible world with our laws of nature exists. If they did, then our laws of nature are left unexplained. Moreover, it seems possible that laws of nature could exist that would not require fine-tuning for life to develop; that is to say, they do not need to have precise values of their free parameters to obtain life. Instead of there being only a small range of values that would allow life, there presumably could be fundamental laws that would allow a large range of values that would allow life. Let us call these laws where the range allowing life is large for *lax laws*. An example of a universe governed by lax laws would be a universe where the value of the electron's mass did not need to be in a narrow range to allow life. Maybe 50% of the values could allow life to form, or even better, 90% allowed life. In my mind, it seems possible that the universe could be that way, and on the UM, if that could possibly be true, it is true, in some universe. By contrast we can call fundamental laws needing fine-tuning to permit life for *stringent laws.*[30]

Given that our laws of nature only allow small changes in the constants and initial conditions before life is impossible, it seems that of all possible universes with our laws, there is a relatively small number of possible life-permitting universes. However, it seems that the universes, governed by lax laws, would have significantly more life-permitting universes in its landscape of possible universes. These laws would allow large changes in its constants and initial conditions and still allow life. If this is possible, one could argue that the life-permitting universes, governed by lax laws, would exponentially outnumber the universes governed by stringent laws.

[30] Terminology adopted from Michael Rota (2021).

Let us imagine a scenario; if our universes stringent laws allowed 100 different universes and only 1 percent allowed life, then it would be one life-permitting universe governed by our laws on the UM. If another universe governed by lax laws also allowed 100 different universes, 90% of those universes allowed life; then it would be 90 universes containing life governed by lax laws. In this hypothetical scenario, it would be a ratio of 90 to 1 in favor of the universes governed by lax laws over stringent laws.

If the argumentation above is sound, it leads us to expect that ordinary observers would find themselves in a universe governed by lax laws. That is to say, a universe governed by laws of nature that allow life on a large range of possible constants and initial conditions. Now the fact that we, as ordinary observers, find ourselves in a universe with stringent laws gives us a reason for thinking that the UM is not true.

Formalizing the argument

We can formalize the argument in two steps.

First:

P1: If the UM exists, then universes governed by stringent laws exist and universes governed by lax laws exist.

P2: If universes governed by stringent laws exist and universes governed by lax laws exist, then life-permitting universes governed by lax laws vastly outnumber life-permitting universes governed by stringent laws.

P3: If life-permitting universes governed by lax laws vastly outnumber life-permitting universes governed by stringent laws, then all ordinary observers live in universes with lax laws.

Therefore,

P4: If the UM exists, then all ordinary observers live in universes with lax laws.

Second, we can reuse P4 to argue that the UM does not exist.

P4: If the UM exists, then all ordinary observers live in universes with lax laws.

P5: Some ordinary observers do not live in universes with lax laws.

Therefore

P6: The UM does not exist.

Formalizing it like this will make it easier to evaluate the argument and see if it is a good argument against the UM. I will now look at each premise and see what can be said for and against it.

Premise 1

Regarding premise 1 it would be possible to argue that this is false maybe universes governed by lax laws are logically impossible. The burden of proof to show this, however, is on the proponent of the UM. What makes this logically impossible? Without a reason for why it is logically impossible, it seems reasonable to rely on the modal intuition that says it is possible. The proposition "There exist universes governed by laws that do not require fine-tuning for life to appear in them" seems to be without contradiction and would therefore be broadly logically possible. The idea that stringent laws govern all possible universes makes stringent laws necessary. Believing that stringent laws are necessary needs a good argument in its favor; without one, I think premise 1 is plausibly true.

Premise 2

In the example given above of the two universes governed by different fundamental laws, one universe would have stringent laws where only a small portion of those laws would allow life. In contrast, the other had lax laws allowing many life-permitting universes. If these were the only universes that was possible and hence existed, it would be very likely that an ordinary observer should find herself in the universe with lax laws and not in a universe with stringent laws.

To illustrate this point, if string theory is correct in stating that there are 10^{500} different possible ways our universe could be, and the life-permitting universes are 1 part out of 10^{136}, only a small minority of universes would allow life. However, why could it not be universes governed by lax laws allowing 10^{500} universes where all were life-permitting. If this is a mathematical possibility, then it would exist on the UM. The number of life-permitting universes with lax laws would vastly outnumber any life-permitting universe governed by stringent laws. It is impossible to say how many there would be of each kind of universe, but it seems plausible that universes governed by lax laws would vastly outnumber any life-permitting universe governed by stringent laws.

However, there is an objection to P2 that makes it the least plausible premise in the argument. In an actual infinite multiverse, like the UM, there would be an infinite number of life-permitting universes governed by stringent laws and an infinite number of life-permitting universes governed by lax laws. Both types of universes would contain an infinite number of life-permitting universes, and hence we have no reason to think we should be in one type over another. If this is correct, premise 2 is false, and the argument fails. However, if this objection to premise 2 is sound, all probabilities seems to break down in the UM. For example, will my car start tomorrow? There are infinitely many universes where it will and infinitely many universes where it will not. No probabilistic reasoning would be possible on this UM theory. This would lend support to the argument above that the UM would lead to skepticism. All our probability reasoning would be fallacious. If, on the other hand, we reject that probability reasoning will collapse, then this premise will hold. In this sense, this argument against the UM can be seen as one horn of a dilemma. Either probability reasoning collapses, or this argument's weakest premise is justified.

Premise 3

Premise 3 seems to be a consequence of life-permitting universes governed by lax laws outnumbering the life-permitting universes governed by stringent laws. If there are vastly more life-permitting universes that are governed by lax laws than stringent laws, then the majority of observers in life-permitting universes observe lax laws. To be ordinary, in this context, is to be among the vast majority.

Premise 4

This premise draws an inference using hypothetical syllogism from P1-P3.

Premise 5

Premise 5 is the controversial premise left to discuss. The premise presupposes two things. First that humans live in a universe governed by stringent laws and second, that humans are ordinary. The first assumption is supported by the fine-tuning evidence presented in section 2.1 and should not be controversial in this context. However, what about this second assumption that humans are ordinary?

This assumption, similar to premise 2, seems to be either true or would lead to the collapse of probability reasoning. Let us consider an example to see why this is the case: Imagine playing poker with your friends. Suppose something remarkable happens. The dealer deals five royal flushes in a row to herself. You get suspicious and confront the dealer and accuse her of cheating. The dealer insists that she is not cheating. We live in an infinite multiverse, she argues, and somewhere in this ensemble, there will be someone dealing five royal flushes in a row to herself who is not cheating. We just happen to be in the one where that happened by chance. One could reply that it is correct that somewhere in the ensemble, that will be true, but it is very unlikely that it is true in our universe. In our universe, it is more likely that the dealer cheated. This reply assumes that you are an ordinary observer. Without this assumption, it would be impossible to argue that you are in a universe where the dealer cheats rather than in the universe where the dealer just happens to be extremely lucky. Again, this leaves us with a dilemma. Either this premise is true, or probability reasoning collapses.

Premise 6

Premise 6 logically follows from 4 and 5.

Conclusion

In this section I have provided a novel argument to the conclusion that the fine-tuning evidence itself provides a reason for rejecting the UM. This argument as we saw is best thought of as a dilemma. Either the controversial premises are true, or probability reasoning collapses and we have further justification for the claim that UM leads to skepticism.

5.4 Assessing the unrestricted multiverse

Based on the previous discussion, let us try to make some assessments of the plausibility of an UM explaining the fine-tuning data. First, we considered the simplicity of an UM and concluded that this is the least parsimonious theory possible to postulate. By postulating an infinite number of universes with an infinite number of different kinds of entities, this theory will be highly implausible based on simplicity considerations. The prior probability of such a theory will be very low. In addition to the low prior probability, it also faces some severe challenges. Firstly, it leads to the metaphysical possibility of an actual infinite, leading one to conclude that Hilbert's Hotel is metaphysically possible. Whether this gives one a reason for rejecting UM will depend on whether one finds Hilbert's Hotel absurd or not. Secondly, it leads to several skeptical worries. We cannot appeal to simplicity to reject Descartes's worry as to whether an evil demon is deceiving us, and in addition, the UM removes the one plausible response to the Humean skeptic of induction, namely that we learned something new when we learned that w0 is actual. The UM proponent is left with no satisfying response to why we should not be a skeptic of induction. Lastly, I offered my own argument that probabilistic reasoning either collapse or the fine-tuning evidence strongly suggest that we do not live in an UM. In the end, I assess that postulating the UM as a solution to the fine-tuning evidence is highly implausible.

6. Critique of the restricted multiverse

I will now turn my attention to the restricted multiverse as suggested by inflationary string cosmology. I have argued that this is a more plausible multiverse than the UM. It is simpler, and some versions do not postulate an actual infinite number of universes which will alleviate it from the objections levelled against the UM.

In the following, I will first assess the scientific status of the inflationary multiverse apart from the fine-tuning evidence. Secondly, I will discuss whether this multiverse will also need fine-tuning. Then I will discuss some difficulties regarding how to make predictions in a restricted multiverse before I look at two potential predictions of the restricted multiverse theory. The predictions I will consider are whether this multiverse leads us to expect to be a Boltzmann Brain or that we should expect to live in a computer simulation. I choose these two because of all the predictions in the literature I think these two are the most likely candidates for being plausible predictions of the L2M.

6.1 Assessing the scientific status of the Level 2 multiverse

Is the multiverse purely a metaphysical speculation, or is it established science? When it comes to the multiverse's scientific status, it can be confusing to understand whether it is a plausible physical theory or "the last resort for the desperate atheist" (Manson, 2003, p. 18).[31] It is not easy to know whom to trust when eminent scholars disagree with each other. Sir Roger Penrose (2016) calls the idea of inflation and the multiverse a fantasy, while Alex Vilenkin (2006) says that to avoid it, you would need to be "willing to clutch at [straws]" (p. 116). In this section, I will try to bring some clarity to this perplexing area. As we have seen, the L2M is built on two

[31] Notice that this is not Manson's own view but only what some people allege.

ingredients: Eternal inflation and string theory. Let us look at each to try to understand the scientific status of the two theories.

Inflation

Eternal inflation is one scenario in the general idea of inflation. I will first assess the scientific status of inflation in general and then see whether all inflation models lead to the eternal inflation scenario.

We have already seen that inflation's motivation lies in solving the horizon problem, flatness problem, and monopole problem. In addition to solving these problems, Barnes and Lewis (2020) summarizes four more features lending it support:

1. Inflation provides a mechanism that generates the initial lumps and bumps in the universe […] However, different models predict different amounts of lumpiness.
2. An inflationary model will predict the distribution of the sizes of the lumps and bumps in the universe […] This has been confirmed. However, inflation is not the only model that predicts this distribution, which was written down and studied by cosmologist in the 1970s, before inflationary models were invented.
3. Inflation predicts that, other than the distribution of sizes, the pattern is as random as possible, technically known as a *Gaussian random field.* But again, randomness is not hard to generate.
4. Inflation predicts that, at some level, there will be an extra layer of lumps and bumps due to gravitational waves. To date, this has not been observed [emphasis in original]. (ss. 192-193)

These considerations are evaluated differently by different cosmologists. Inflation remains the most popular theory of the early universe, but there is no universal agreement.[32]

The fact that inflation predicts gravitational waves has been seen for some as evidence against inflation. In 2014 there were reports that BICEP2 had detected these gravitational waves, but under scrutiny, these reports were premature and what they had detected was dust. The problem with this non-detection was how the inflation proponents could claim that detecting these gravitational waves was strong evidence for inflation. However, when it turned out to be false reports, they just continued as nothing had happened. If detecting these waves were strong evidence for inflation, would the non-detection not be evidence against inflation?

Albert Einstein professor in science at Princeton, Paul Steinhardt, a skeptic of inflation, has pressed this objection. His critique is forceful and worth quoting at length:

> The BICEP2 incident has also revealed a truth about inflationary theory. The common view is that it is a highly predictive theory. If that was the case and the detection of gravitational waves was the 'smoking gun' proof of inflation, one would think that non-detection means that the theory fails. Such is the nature of normal science, yet, some proponents of inflation who celebrated the BICEP2 announcement already insist that the theory is equally valid whether or not gravitational waves are detected. How is this possible? The answer given by proponents is alarming: the inflationary paradigm is so flexible that it is immune to experimental and observational tests. (2014, p. 9)

[32] For an overview of the case for both sides see Barnes and Lewis (2020, ss. 193-194).

Most cosmologists would not agree with Steinhardt's assessment, but neither is he alone in his judgment. Concerning the scientific status of inflation, it is divided, even though it remains the most popular theory of the early universe.

Eternal inflation

Although inflation is the most popular theory of the early universe, the L2M needs a specific scenario of inflation, namely eternal inflation. The question then becomes whether all inflationary models lead to eternal inflation. This is what we will discuss next.

Eternal inflation is a scenario in the general idea of inflation and hence is not identical to inflation. This suggests that eternal inflation should not have the same scientific status as inflation in general. However, a number of cosmologists think that practically all the plausible models of inflation lead to eternal inflation or at least a healthy fraction of them (Vilenkin, 2006, p. 117), (Carroll S. , 2010, p. 376). This leads them to assess the likelihood of eternal inflation as the likelihood of inflation in general. However, this seems to be a controversial point among the experts. In the new publication, *Fine-tuning in the Physical Universe* (Sloan, Baptista, Hicks, & Davies, 2020), Jerome Martin, one of the leading experts on inflation, argues in his chapter on inflation that inflation and eternal inflation should not be placed on an equal footing. He argues that while inflation is a good phenomenological description of the early universe, eternal inflation is "only a speculation, although definitely an interesting one" (Martin, 2020, p. 160). The reason for this, he argues, is that it relies on "what we assume about the shape of the potential at high energies, outside the observational window" (Martin, 2020, p. 166). We do not know the properties of the hypothesized inflaton field because it is hypothesized and not detected.

The controversy surrounding whether eternal inflation is on an equal footing as inflation relies on whether one finds these assumptions of the inflaton field plausible or not. It is important to take into account that experts disagree on this point. What can be said is that there is no consensus that eternal inflation is an obvious implication of the general idea of inflationary cosmology and hence should not be put on equal footing with inflationary cosmology.

String theory

As mentioned earlier, it is not enough to have eternal inflation as we need a mechanism for altering the constants of nature. This is what string theory will do if it is the correct GUT. Thus, we want to ask what its scientific status is.

Again, the physics community is divided concerning the status of string theory. While having intriguing theoretical arguments for it, it still has not made any predictions and has no experimental confirmations. String theory's main attraction comes from its elegant mathematics and that there is no other plausible GUT. Mathematician and theoretical physicist Peter Woit (2006) write that string theorists often answer this when asked why they continue with string theory despite no experimental results: "Look, it's the only game in town. Until someone comes up with something else more promising, this is where the action is" (p. 224). Among the suggestions of available GUTs, string theory is the leading candidate. Although there exist alternatives like loop quantum gravity, there is broad agreement that string theory is the leading alternative. In addition, the rich mathematical structure of string theory gives mathematicians and string theorists the feeling that there has to be something more to string theory than just mathematics. They sense that the reason for the rich structure is that it matches nature. For non-mathematicians, it might seem weird why a rich mathematical structure should prove that it matches reality, but mathematicians are often led by their aesthetic impulse. True theories often have a beautiful mathematical structure. Hence, being the leading candidate and having a rich mathematical structure provides much of the reason for the research of string theory. This has led to a debate in the scientific community of how much elegance and beauty should count as evidence of a theory.[33] However, because string theory has not made any testable empirical predictions, it will remain speculative. Whether it is plausible speculation is up for debate, but until string theory makes predictions testable by experiments, it will remain speculative.

String landscape

In addition to string theory being speculative, the multiverse needs string theory to create the string landscape, which is not certain it will. Experts in string theory disagree among themselves on whether this is a consequence of string theory (Martin, 2020, p. 165). Without a string landscape, an inflationary multiverse would do nothing to explain the fine-tuning of the fundamental constants. Even if the initial conditions could be explained away, there would still remain several examples of fine-tuning unexplained. This would give the design proponents reasonable grounds for reformulating the argument, focusing on the constants of nature, to avoid this L2M objection. This would take the sting out of the multiverse objection. Hence, we need there to be a string landscape to have a relevant multiverse.

Conclusion

In conclusion, I think we have seen that the L2M is not a well-established scientific theory. In my opinion, Alan Guth (2015), one of the fathers of the inflationary multiverse, is right in saying that, “Ultimately, if the multiverse does become a standard part of science, it will be on the basis that it’s the most plausible explanation of the fine-tunings that we see in nature” (para, 40). The fine-tuning will be the decisive evidence if we should accept the multiverse as standard

[33] For a defense of beauty and elegance counting as evidence see Dawid (2014). For a critique of this trend see Ellis and Silk (2014).

science. Nevertheless, the L2M is not without theoretical support. It is not just a last resort cooked up by the desperate atheist. It deserves to be taken as a serious alternative to the design hypothesis. There are some theoretical reasons for thinking that a multiverse of the relevant kind exists, or at least could exist. However, I think Vilenkin's comment that the skeptic of a multiverse is clutching at straws to avoid it is equally misleading. He probably only had the L1M in mind, that would certainly be more plausible than the L2M. In my understanding, the status of an L2M seems to be somewhere between these extremes. The L2M has some theoretical support and ideas for how it could be realized, but it remains a highly speculative theory which at the present moment can only be affirmed as an explanation of the fine-tuning data. The multiverse is based on speculation upon speculation and should not be thought of as an easy refutation of the fine-tuning evidence. The eminent cosmologist George Ellis, after considering the scientific status of a multiverse asks,

> Is the degree of faith required to believe in a multiverse more or less than that required to believe in a creator God? I argue that because of the lack of conclusive evidence in both cases, the degree of faith required to believe in either is the same. (2012, p. 141)

This is not to suggest that the only reason for considering a multiverse is faith or that the belief in God cannot be based on reason. Instead, Ellis wants to distinguish science from philosophy. The multiverse and God can be a good "empirically-based philosophical explanation" (Ellis, 2012, p. 141). Since my thesis is in philosophy and not science, we want to consider which explanation is the best. The design proponent deserves a place at the table since the design hypothesis seems no more speculative than the multiverse one. The question remains as to which is more speculative, and which has better theoretical virtues. To probe this question, I will now examine some objections to the restricted multiverse objection, with the L2M being the representative multiverse model.

6.2 The multiverse itself needs fine-tuning

An objection often given to the restricted multiverse theory explaining fine-tuning is the problem with the multiverse generator itself needing fine-tuning.[34] We have seen that the L2M would explain the initial conditions of our universe and the constants of nature. However, there remains the question of the fine-tuning of the fundamental laws of nature and the initial conditions of the multiverse itself. We will leave the question of whether the L2M need fine-tuning of its initial conditions until section 6.5 as this is one of the most formidable challenges to the L2M and deserves to be treated in a separate section. We will now address the question as to whether the L2M needs fine-tuning of its fundamental laws. Does the L2M need just the right laws?

In addition, we will look at how Barnes's formulation of the fine-tuning argument explained in section 2.2 leads to some interesting consequences regarding the question of the fine-tuning of the multiverse itself. As we will see, on his formulation, without a standard multiverse model, the multiverse objection to the fine-tuning argument becomes nothing more than a possible way the fine-tuning evidence could be misleading. However, let us first look at the fine-tuning of the fundamental laws of the L2M.

Fine-tuning of the fundamental laws of the Level 2 multiverse

For a restricted multiverse to exist, there would need to be a universe generating mechanism that produces universes, but if this generator is also finely tuned, the multiverse does not seem to be much of an explanation. It would lose its explanatory power. Collins provides a good

[34] See Barr (2003, s. 154), Collins (2012, pp. 263-265) and Meyer (2021, ss. 339-345).

example of this. He says that even something as simple as a bread machine is in need of fine-tuning, it "must have the right structure, programs, and ingredients (flour, water, yeast, and gluten) to produce decent loaves of bread" (2012, p. 263). Imagine coming home from work with a friend one day and seeing a newly baked bread on the kitchen table. Your friend asks: "who made that bread?" Your friend would probably not be very satisfied if you answered that a bread machine made it. If you explain the existence of a bread by saying that a bread machine made it, then we would be left wondering what made the bread machine. No explanatory progress has been made. If something as mundane as a bread machine needs fine-tuning, then what about a universe generator? It seems likely that it would also need fine-tuning. Let us consider the universe generator of the L2M as this is the most widely advocated universe generator. This postulation would probably need fine-tuning in the fundamental laws.

Collins (2012) points out four things that the fundamental laws would need to do:

(i) Cause the expansion of a small region of space into a very large region

(ii) Generate the very large amount of mass-energy needed for that region to contain matter instead of merely empty space

(iii) Convert the mass-energy of inflated space to the sort of mass-energy we find in our universe

(iv) Cause sufficient variations among the constants of physics to explain their fine-tuning. (p. 263)

How do we get these four ingredients? Because the fine-tuning of the laws of the multiverse is quite technical I will give a summary of the explanations given by Collins (2012, pp. 263-265). To get (i) and (ii) on the list, we need the hypothesized inflaton field and Einstein's equations of General Relativity. The inflaton field gives the vacuum positive energy density, and Einstein's equations explain the enormous expansion of inflation. The inflaton field also provides unlimited energy and this energy is needed for producing universes. Without these fundamental laws, there would not be an L2M. Suppose Newtons theory of gravity was obeyed by our universe. In that case, Collins notes that “the vacuum energy of the inflaton field would at best simply create a gravitational attraction causing space to contract, not to expand” (2012, p. 264). This would eliminate the ingredient of inflation in the L2M, and we would not have a multiverse capable of producing even one life-permitting universe.

To get (iii), we need Einstein’s theory of the identification of mass and energy, and the assumption that the inflaton field is connected to the matter fields. Finally, to get (iv), there would be a need of two things. First, the existence of a landscape, that is to say a number of different ways the universe could have been. Secondly, it would need a large enough landscape. The landscape would need to be huge to allow for enough variation to explain the fine-tuning. Superstring theory provides these two ingredients, but why does it have just the right properties to allow for a life-permitting universe among its possibilities? There does not seem to be any necessary reason for this to be the case. As Collins (2012) notes, there have recently been studies on grand unified theories “which allow for only a very limited number of variations of the parameters of physics, about a dozen or so in the case of the simplest model” (p. 264). A dozen or so variations would not suffice. A life-permitting universe would still be extremely unlikely. The variation needs to be huge as the probability of a life-permitting universe is astronomically small. To illustrate the improbabilities, the cosmological constant is said to be fine-tuned to one part in 10^{120}. To make this coincidence unremarkable, there would need to be at least around 10^{120} different universes. String theory would need a landscape of at least 10^{120} to make the cosmological constant unremarkable. Why is the landscape of string theory of the size that would allow for a life-permitting universe and not of a different size?

It seems like the landscape of string theory would need a one-sided fine-tuning; that is to say, it could not be below a certain number; let us use 10^{120} for simplicity. It could, however, be any given number above, let us say 10^{500} for simplicity. This leaves us with a one-sided fine-tuning. In addition, superstring theory also needs fine-tuning in the number of dimensions because it needs 10 or 11 dimensions. Why is it 10 or 11 dimensions and not 2 or 3 or 13? This seems like a fine-tuning problem for string theory.

More "ingredients" could be mentioned, but I think these considerations will suffice to show why several scholars have argued that even a life-permitting multiverse would need fine-tuning of its fundamental laws.

Response from the naturalist

In response to this objection against the multiverse, the naturalist can argue that the same argument can be leveled at the God hypothesis. Only a God with the right kind of parts, motives, and desires would create a life-permitting universe. So, if the multiverse needs to answer who designed it, then it would seem that the theist would have to answer who designed God. What can the theist say to this?

In response, the theist could first and foremost deny that there is a need to presuppose any concrete motives and desires of God. One would only need to presuppose that God is good, which seems like an essential property of God. If the theist needed to presuppose any concrete desires and motives, then I think it would be relevant to ask why God had those particular desires and motives rather than any other motives and desires. However, this is not needed. As the discussion in 2.2 shows, the only thing needed is that God's goodness gives us some reason for thinking that God wants a life-permitting universe. This shows that God having some reason for creating a life-permitting universe is not as unlikely as a life-permitting universe based on naturalism. In addition, as we saw in section 4.1, we do not need to answer why this specific universe exists but rather a more general question of why a life-permitting rather than a lifeless universe exist. No concrete desires and motives need to be presupposed, and hence that question disappears.

This leaves us with the question of the parts of God. This is, of course, not physical parts, as God is immaterial and has no physical parts; rather, it would be different properties like goodness, omnipotence, and omniscience. Do these properties of God need an explanation in the same way that the fundamental laws of the multiverse need an explanation?

Two potential moves

I want to offer two moves the theist can appeal to. Firstly, one could argue for something like the doctrine of divine simplicity, which states that God does not contain any parts or properties. His goodness is identical to His power which in turn is identical to His knowledge. This doctrine has been part of the traditional model of who God is in the western tradition. Such a simple God could not be asked to have a designer as God would not be composed of any physical or conceptual parts. Whether this is a good move or not will be too large a task to determine in this thesis. Many modern theologians have questioned this doctrine, and I am among those concerned about its coherence and unwanted consequences.[35] Nevertheless, it remains an option for further exploration.

If one finds the doctrine of divine simplicity unacceptable, then another move is available for the theist. This is to argue that God is a metaphysically necessary being. All his properties exist

[35] See Mullins (2013) for a critique of divine simplicity.

necessarily and are essentially linked to God's nature. Hence, they could not be any other way. That is to say that all God's properties are unified in His metaphysically necessary nature. Although the properties are different, they are unified by His nature.

However, it is not evident that this move is not available for the naturalist as well. The naturalist may be tempted to state the exact same thing of the fundamental laws of nature. She could say that the fundamental laws are necessary and need no further explanation. However, it would be challenging to find a unifying property on naturalism. It does not seem like there is any plausible unifying property that unifies the different fundamental laws of nature. The naturalist would have to postulate some unknown unifying law that connects all the fundamental laws to remove the puzzle of why a life-permitting multiverse exists rather than a life-prohibiting multiverse.

At this point, I think the crucial question for anybody evaluating this argument is to check their intuitions. Do the fundamental laws for a life-permitting multiverse being necessary give as good an explanation as God having a necessary nature? Different people will probably evaluate this differently. Without the quantifiable nature of the fine-tuning, I think we are stuck with our intuitions. Many will probably find it somewhat puzzling if just the right fundamental laws exist to allow for a life-permitting multiverse. However, others will not find it any more puzzling than a God with just the suitable properties. In the end, I think the argument that the multiverse would need fine-tuning of its fundamental laws is at best weak evidence against the L2M and functions best as one part in a cumulative argument against the multiverse.

However, then the question arises of whether it is possible to quantify the fine-tuning needed on L2M? Below, I will discuss why this is not possible, at least not yet, furthermore, why Luke

Barnes's formulation of the argument leads to the multiverse objection only stating how the fine-tuning evidence could be misleading.

No way of knowing if the multiverse needs fine-tuning without standard model

In section 2.2, I summarized some of the different formulations of fine-tuning arguments. I remarked that Barnes's formulation had some interesting consequences for the multiverse objection. To quickly repeat his formulation, he argued that we seek answers to the Big Question: Of all possible ways the universe could be, is the universe we observe what we would expect on naturalism? He argues that this is too big a question to ask. What we can ask is the Little Question: Is the values of the constants and initial conditions more expected on theism or naturalism? He then argues that theism best explains why we observe a life-permitting universe.

Insight of Barnes's formulation

One important insight Barnes brings to the table is that the question we are interested in is whether naturalism or theism is a better explanation of the fine-tuning evidence. The opposition is not really between the multiverse and theism, as the multiverse is compatible with theism.

On Barnes's formulation, the multiverse objection ends up only showing how the Little Question might misrepresent the Big Question. The multiverse objection would only state a possible way out for the naturalist; he could say: maybe our universe is just a random universe in a multiverse. However, then the question will be: of all the possible ways a multiverse could be is this multiverse what we would expect according to naturalism? There could very well be a multiverse according to theism, and if the multiverse itself needed significant fine-tuning, that would suggest that theism would best explain why just the right multiverse exists. The existence of a multiverse would, in other words, not rule out design. According to Barnes (2019), the role left for the multiverse is that the multiverse "will allow the naturalist to pose a Little Question 2.0, in hope that naturalism will win the rematch" (p. 1245). The question becomes: Can we use the multiverse to formulate a bigger question that is closer to the Big Question?

Barnes argues that the answer is no. We do not have a multiverse model that is recognized as the standard model. Barnes (2019) states that, "We instead have a menagerie of bespoke, proof-of-concept, cherry-picked toy models, which add most of the important physics by hand, have almost no record of successful predictions, and were formulated with one eye on the fine-tuning problem" (p. 1244). The reason we can quantify the fine-tuning needed for a life-permitting universe to exist is that we have standard models that we can slightly alter and see what happens. Without a standard model of the multiverse we cannot answer the question of whether the multiverse itself would need fine-tuning of its parameters. Maybe it does need fine-tuning, maybe it does not - we cannot know without a standard model. At the moment the multiverse objection, according to Barnes's formulation, only shows that it is possible that the Little Question is misleading. Possibilities are, however, cheap, and the possibility that we might be wrong should not stop us from pursuing the answer to the Big Question. If we in the future get a standard multiverse model, then we can pose the slightly bigger question and see whether the answer to that question favors naturalism over theism. Until that time the multiverse, according to Barnes's formulation, is just the hypothesis that future physics might give a different answer than current physics.

Assessment of the argument

The argument that the L2M itself would need fine-tuning is limited but has some force. The multiverse could plausibly explain the fine-tuning of our universe's constants and most of the initial conditions but would not explain the fundamental laws of the multiverse. The fine-tuning of the fundamental laws, however, are less rigorous than the fine-tuning of the constants and initial conditions because it cannot be quantified in the same way. It is difficult to say whether of all the possible ways the laws of nature could be that the laws of the multiverse are unlikely. It seems, intuitively, remarkable that several different laws would exist to make this multiverse possible. However, this intuition could be rejected without there being any rigorous argument for the intuition. In addition, the naturalist could claim that it is equally puzzling why God is composed of just the right properties. Regarding the constants and initial conditions, we can point to what would happen if these were different. This option is not as readily available for the laws of nature. We can say, for example, what would happen if Newton's laws were correct, but this does not exhaust our options. We do not have a list of potential laws of nature whereby only a few allow a life-permitting multiverse. As Barnes argues, there simply is no way to ask the Big Question rigorously. Nevertheless, as we have seen, an appeal to a multiverse will not automatically solve the fine-tuning problem as the multiverse could, in theory, need fine-tuning. Without a standard multiverse model, we cannot ask a bigger question than the question based on the Little Question. The possibility that the multiverse might need fine-tuning makes the multiverse objection lose some of its force as an objection. The different laws that need to be in place for the universe generator to produce universes give some intuitive reason for thinking that even a multiverse would need fine-tuned laws.

6.3 Predictions in a multiverse

For the L2M to be considered a scientific theory, it needs to, at least in theory, make predictions. As we shall see, some argue that it does not, and hence should be considered philosophy and not science. If the L2M cannot make any predictions, I think this would undermine the theoretical reasons supporting inflationary cosmology. We shall look at this when we are discussing the measure problem below. Therefore, if the multiverse should be considered a plausible solution to the fine-tuning evidence, then it seems that it has to make predictions. The question then becomes: How do advocates of multiverses propose to test the multiverse theory?

In Simon Friederich (2021) words, “The strategy that is widely considered the most promising […] is to treat the multiverse theory as predicting those observations that typical observers make if the theory is true” (p. 99). This strategy is based on a principle given by philosopher Nick Bostrom, who calls this the self-sampling assumption (SSA). One should reason as if one was a random sample from a chosen reference class.

To show how this is done in practice Bostrom (2010) gives the following illustration:

> The world consists of a dungeon that has one hundred cells. In each cell there is one prisoner. Ninety of the cells are painted blue on the outside and the other ten are painted red. Each prisoner is asked to guess whether he is in a blue or a red cell. (Everybody knows all this.) You find yourself in one of the cells. What color should you think it is? – Answer: Blue, with 90% probability. (p. 59)

In this thought experiment, the SSA is the only way you could reason within the situation you find yourself. The same can be said of the multiverse. We can only reason as if we were random samples in one specific reference class. Of all the universes we could have found ourselves in in the multiverse, is there something special about the universe we find ourselves? That is to ask, within the anthropically allowed region of universes, are we an ordinary universe, or is there something special about our universe? To answer this question, we have to determine our reference class and then determine what an ordinary observer would observe. Let us start with finding the reference class.

What reference class should we consider?

Finding the reference class in the example given by Bostrom above is easy. Since there are one hundred cells and one hundred prisoners and you are a prisoner, the reference class is the one hundred prisoners. In concrete examples like these, it is easy to determine the relevant reference class. However, it is not easy when we consider the multiverse; what should be our reference class in that case?

Different reference classes will yield different results, and hence it will be essential to have the correct reference class in mind when testing the multiverse. To illustrate the importance of this, one could think of one's location. If we take every human being on the earth as in our reference class, then the SSA predicts that we should live in one of the cities in the world with the biggest population. That would lead us to expect to be in cities like Shanghai, Delhi, or Tokyo, as these are the world's most populated cities. However, if I considered only Norwegians to be in my reference class, then I should expect to live in a big city in Norway, like Oslo or Bergen. The first reference class would make a wrong prediction regarding my location, but the prediction would be somewhat correct in the second reference class as I live in Bergen. This shows how different reference classes will change the predicted outcome.

Friederich (2021) has suggested a recent solution to the reference class problem. His suggestion is this: "Given background information D0, include in the observer reference class precisely those observers who you possibly *could be* in view of D0 [emphasis in original]" (p. 110). The difficulty then is to determine what the right background information is. In the case of the dungeon, the right background information would be that you are in one of 100 cells, and hence you could be in any one of those cells. In the case of the reference class of where one should expect to live, it seems plausible to take the whole world as our reference class as there is nothing in our background knowledge that would prevent us from living in any different place on earth. This, however, shows how predictions based on typicality can fail. Many people will not be typical. Therefore, for something to be counted as a good prediction on the grounds of typicality, the prediction has to make it overwhelmingly more plausible that one should have different observations if one were a typical observer. In the case of our location on earth, it is not overwhelmingly more likely that one should find oneself in Tokyo; it was only more likely.

What is the right background information to consider regarding the multiverse? I contend that the right background information is that we could be any observer able to ask why our universe is special. Among observers able to ask that question, we should be typical according to the multiverse theory. Suppose a multiverse theory predicts that we are highly typical in the reference class of those observers. In that case, I think we should regard that as a successful prediction of the multiverse. However, if the multiverse predicts that we are highly unusual, the prediction would undermine the multiverse.

Making predictions

Making predictions in a multiverse is difficult for at least two reasons. First, we do not know how many observers there will be in the different sub-universes with different values of, for example, the cosmological constant. These worries are usually countered by relying on proxies such as "'proportion of matter clustered in giant galaxies' or 'total entropy production'" (Friederich, 2021, p. 102). However, we do not know whether the chosen proxy will give the right proportion of observers.

Secondly, there is the famous measure problem. The measure problem is a problem regarding how to calculate the probabilities in the multiverse. As theoretical cosmologist Anthony Aguirre

(2007) says “multiverses come at a high price” (p. 368). Since the inflationary multiverse typically predicts an infinitely large multiverse, where everything that can happen will happen, the probability for something occurring is infinity over infinity which is hard to make sense of. Alan Guth (2015) says,

> In a single universe, cows born with two heads are rarer than cows born with one head. (But in an infinitely branching multiverse) there are an infinite number of one-headed cows and an infinite number of two-headed cows. What happens to the ratio? (para, 6)

This question is challenging to answer in a vast multiverse. It seems as if the probabilities break down.

One scholar arguing that the multiverse leads to this breakdown of probabilities is Paul Steinhardt. He argues that it is precisely the implication of the multiverse that undermines inflationary cosmology. If a multiverse exists, then everything that can happen will happen an infinite number of times. No experiment can rule out such a theory and “hence, the paradigm of inflation is unfalsifiable” (Steinhardt, 2014, p. 9). He continues to argue that not only is it not falsifiable, it is also untestable. No test can confirm the multiverse because all that can happen will happen an infinite number of times. Steinhardt ends his discussion of the measure problem on an unsympathetic and pessimistic note: “It is clear that the inflationary paradigm is fundamentally untestable, and hence scientifically meaningless” (Steinhardt, 2014, p. 9). For Steinhardt, the multiverse is not a virtue of the inflationary paradigm but rather a vice. The problem is that inflation, by implying a multiverse, removes the original reasons we had for accepting inflation, like solving the flatness problem, horizon problem, and the predictions of the distribution of the sizes of the lumps and bumps in the universe. The multiverse undermines the original reasons we had for the inflationary paradigm itself.

The reason is this: All the predictions of inflationary cosmology come from quantum processes, but quantum processes will always contain some uncertainties. Let us imagine that all the predictions of inflationary cosmology were given by an accuracy of 99,9 %. If the process of inflation produced 1000 universes, then 999 would match our universe. This is an impressive prediction of inflation. However, if inflation produces an infinite number of universes, what happens to the predictions? Because in an eternally inflating multiverse, there would be an infinite number that matched the predictions but also an infinite number of universes that do not match the predictions. Greene (2011) says it like this: "The contrarian [of a multiverse] concludes that when inflation is eternal, *the very predictions that we use to build our confidence in the theory are compromised* [emphasis in original]" (p. 213). This quandary has led a number of physicists to consider the multiverse as a problem for inflation. If inflation only happens once, then all the predictions are intact, however, if inflation leads to the multiverse, then it seems as if all our motivations for inflationary cosmology become unjustified.

If the measure problem is in principle unsolvable, then the implication of a multiverse would lead to inflation losing its empirical and theoretical support. We would be left with an unfalsifiable theory that had no support from physics. To see the problem clearly, we can imagine the thought experiment of Bostrom again. The world is a dungeon. However, this time there is an infinity of cells, each containing a person. Again, the cells are colored either blue or red, but this time there is an infinite number of blue cells and an infinite number of red cells. How should you reason in this case? It seems impossible to reason sensibly.

Although everybody recognizes the measure problem as a severe problem with no generally accepted solution, everybody does not agree with Steinhardt's assessment. Proponents of the L2M think there will be a solution to the measure problem and that is what we will discuss next.

Solutions to the measure problem

If the measure problem is an in-principle problem, then I think that the L2M proponents' hopes are dim. Never mind that we would lose all the predictive justification for accepting inflation and hence the multiverse. But, even worse, we would end up in the same epistemic situation as in the UM concerning inductive reasoning. An infinite number of universes would have been orderly up to our point and then would become unorderly. We would again have no reason for accepting induction, as discussed in section 5.2. This would be a very high price to pay for believing in the L2M.

However, many physicists do not think the measure problem is unsolvable. They think that the match between the prediction of inflation and our universe is so impressive that there must be a solution to this problem that allows normal probabilities to hold. The suggested solution is to use different measures of the multiverse to calculate the probabilities. Guth, Kaiser, and Nomura (2014), defenders of inflation, argue in a paper they co-wrote defending inflation:

> Since anything that can happen will happen an infinite number of times, the distinction between common events and extremely rare events requires a comparison of infinities, and that requires some method of regularization. We do not yet know what is the correct method of regularization, or even what physical principles might determine the correct answer. (p. 5)

Despite not knowing the answer they argue that "the different measures that have been proposed, and presumable the correct measure that we seek, obey all the standard properties of probability theory" (Nomura, Guth, & Kaiser, 2014, p. 5). They contend that there are different measures that will give normal probabilities in a multiverse.

Many measures have been suggested, such as the proper time measure, the scale-factor measure, the light cone time measure, pocket-based measure, and causal diamond measure. These different measurements lead to different predictions of the multiverse. Does it matter which one we choose? Friederich (2021) says, "The unambiguous answer to this question is "yes." (p. 123). This has been shown by recent studies by Barnes, et al. (2018). Their results showed that predicting the cosmological constant on the multiverse gave significantly different results depending on the measures they used. Some measures gave results close to the observed value while others gave predictions that were 50-60 times larger. In this case, some measures led to favorable results while others to unfavorable results.

If the measure determines the predictions, then how does one choose a measure?
The usual way for the multiverse advocates to choose measures is based on the same criteria upon which they choose physical theories (Friederich, 2021, pp. 123-124). Like physicists believes there is a physical theory that describes nature there is presumably also a measure that describes nature. Measures that describe nature well are favored.

Problems with choosing measure

There is, however, a problem with choosing the measure this way. The reason is that this way of choosing a measure assumes that a multiverse exists. If we evaluate a measure to the degree that it matches reality, then we cannot obtain predictions that would falsify the L2M. If we were to find a measure that gives predictions that do not match reality, like many of the measures mentioned above do, and which we will look closer at in the next section, then these measures will be disfavored because they do not match reality. This makes the multiverse immune to false predictions. This does not seem right.

When we develop scientific theories, we have the right to disfavor the ones not matching the world because we know the world exists. But why should one disfavor measures that lead to predictions disfavoring the multiverse? After all, the question we are trying to answer is exactly whether there exists a multiverse. The reason we want predictions from the multiverse is to see whether the predictions matches the data and hence confirms the theory or if it does not match the data and hence, falsifies the theory. If one chooses measures based on the assumption that there exists a multiverse, then it seems to me that this procedure will never be able to falsify the theory. As Barnes (2019) notes "A specific multiverse model must justify its measure on its own terms, since the freedom to choose a measure is simply the freedom to choose predictions ad hoc" (p. 1244). Without the models justifying the measure, we can choose measures that fit the data, which will be *ad hoc*.

Researcher' degrees of freedom

Friederich argues that finding measures *post hoc* function as researcher' degrees of freedom. He discusses how there has been a crisis in social sciences. The problem is that it has been difficult to replicate studies in social science (Friederich, 2021, p. 126). This problem has been attributed to the researcher's degree of freedom. The process of collecting data in social sciences can be manipulated, either intentionally or unintentionally, to confirm the hypotheses that the researcher prefers. Friederichs argues that the proxies and the measures in multiverse predictions function as the researcher's degree of freedom and suffer from the same difficulties as in the social sciences. He argues,

> Choices of both [proxies and measurements] are not rigorously constrained by widely accepted criteria that have a credible claim to objectivity, yet both have an extremely large influence on the outcomes of the predictions made. Moreover, researchers openly

> admit that they make those choices with an eye on deriving predictions that are confirmed by observations. (Friederich, 2021, p. 127)

These considerations seem to be a challenging critique of how multiverse predictions have been made so far. The measure one uses to deduce predictions from the multiverse must be allowed to make predictions that do not favor a multiverse. If this is not allowed, then I think we should be very suspicious of how much value there is in the predictions.

Conclusion

Making predictions to test the L2M requires a different method than typical scientific predictions. It will be based on the SSA, namely that we should reason as if we were an ordinary observer in a given reference class. It is not easy to know how we should define the reference class in the multiverse, but I have argued that we should consider all intelligent observers in our reference class. We could be any of those observers. If the L2M predicts that we are ordinary observers in that reference class, it will be a confirmatory prediction. However, if it predicts that we are highly unusual observers in that reference class, the prediction will falsify and undermine the multiverse.

I have argued that making predictions based on these considerations is difficult to make because of two reasons. First, we have to use proxies to evaluate how many observers that would exist. Secondly, we face the measure problem. Both these considerations can be seen as the researcher's degrees of freedom. It will therefore be difficult to make objective predictions based on the L2M model. Nevertheless, in the next two sections, I will discuss two predictions that I will argue are not liable to these researcher's degrees of freedom.

6.4 The simulation objection

Nick Bostrom, an Oxford philosopher, has argued that it is a significant probability that we are living in a computer simulation. That is to say that everything you think you know, like the world around you, the threes, the sky, the sun is all an illusion in a computer simulation. This he argues from a trilemma, which he states like this:

> (1) the human species is very likely to go extinct before reaching a "posthuman" stage; (2) any posthuman civilization is extremely unlikely to run a significant number of simulations of their evolutionary history (or variations thereof); (3) we are almost certainly living in a computer simulation. (Bostrom, 2003, p. 243)

He argues that one of those propositions is true, although he does not specify which one. There is no mention of the multiverse in his paper, and hence he thinks this is a good trilemma even if there is only one single universe. I will argue that assuming the truth of the multiverse will make it more likely that we live in a simulation. The theoretical physicist Paul Davies has argued that the multiverse leads to it being likely that we live in a simulation. This, in turn, can be formulated as an objection against the multiverse hypothesis. Let us consider first whether the multiverse makes the simulation hypothesis more likely and secondly whether that is a reason to reject the multiverse.

Will consciousness be simulated?

Let us consider the first proposition of Bostrom's paper, namely that humans will never reach a post-human stage. By a posthuman stage, Bostrom means a civilization with significantly better technology than ours and that will be able to simulate consciousness. The interesting contribution of the multiverse theory in the discussion of this proposition is that if it is even possible to simulate consciousness, it will happen. This is true since, given an L2M, anything that can happen will happen.

Bostrom's original argument was based only on a single universe hypothesis, and therefore, one could argue that the human species will go extinct before reaching such an era. Hence one could say that it would, in principle, be possible for a civilization to reach this posthuman era; it is just not, in fact, the case that they have done so. This argument, supporting the first proposition, is made invalid on the multiverse hypothesis. If it is possible, it will happen. One has to argue that simulating consciousness is impossible; no posthuman civilization will ever simulate consciousness to opt for this first alternative.

This would be a very interesting result as that seems to rule out a significant theory of mind, namely the functionalist view of the mind.[36] Philosopher of mind Pete Mandik (2014). says this of functionalism "mental states can equally be had by creatures with brains and entities controlled by nonbrainy machines (especially machines that compute)" (p. 112). In other word, on the functionalist view of mind consciousness could be simulated.

This leaves us with the following argument:

S1: The L2M entails that everything that is possible will happen

S2: Consciousness is possible. (Entailed by functionalism).

S3: Consciousness will be simulated.

This conclusion would render the first proposition of Bostrom false.

The only way to opt for the first proposition of Bostrom's trilemma is to deny either the L2M or the functionalist view of the mind. If the first way is taken, then this is a good argument

[36] And any other view of the mind that allows for simulation of consciousness. I will use functionalism as representative for any view that can simulate consciousness.

against the multiverse. If the second is taken, then we have a defeater to one of the most popular views in philosophy of mind. This, in turn, could serve as a plausible premise in a different argument for God.[37] So, either way, it would be an interesting conclusion.

Is it unlikely that simulated worlds will outnumber real worlds?

Let us now consider the second proposition in Bostrom's trilemma, that post-human civilizations are very unlikely to run computer simulations of consciousness.

If we assume two things: (1) to live in an L2M and (2) that consciousness can be simulated, then we know that some civilization will simulate consciousness. The question will, however, be whether these simulated worlds will outnumber ordinary worlds. Let us consider some reasons that would make this likely. First, consider the fine-tuning evidence discussed in section 2.1; the probability of getting a life-permitting universe is minuscule. The simulated observers would have to be even more unlikely.

Two possibilities could cause the simulated observers to be outnumbered by ordinary observers. Either the posthuman civilizations with the ability to simulate consciousness is extremely rare, or the posthuman civilization has some reason for preferring not to simulate consciousness. Let us look at that first alternative. Now why think post-human civilizations would be extremely rare? Maybe simulating consciousness is extremely hard. Now that might be true, but as Bostrom (2003) notes, "Some authors argue that thus stage may be only a few decades away" (p. 245). Now, these authors may underestimate the task of simulating consciousness, but if consciousness can be simulated, then I do not think we have very good reasons for thinking

[37] Alexander Pruss notices this in his lecture: The Argument from Falsity of Skepticism (2020).

these posthuman civilizations would be very far away. To further see why we should think simulated worlds would be plentiful, consider Davies's comments,

> Fake universes are incomparably cheaper than real ones. To make a fake universe you just have to process bits of information, and although that costs some energy (computers get hot), it is far less than the energy needed to make 10^{50} tonnes of matter. Moreover, it's not necessary to make a whole universe to convince you and me that the world about us is real. (2007, p. 207)

Because simulated worlds are incomparably cheaper, we should not expect them to be extremely rare.

What about this second possibility, that the posthuman civilization would have some reason not to simulate consciousness? Bostrom considers two reasons why a posthuman civilization would prefer not to simulate consciousness. Firstly, he considers an ethical reason, and he writes, "One can speculate that advanced civilizations all develop along a trajectory that leads to the recognition of an ethical prohibition against running ancestor-simulations because of the suffering that is inflicted on the inhabitants of the simulation" (Bostrom, 2003, p. 253). This ethical consideration seems rather implausible for at least two reasons. Firstly, humans do not tend to put much weight on ethical considerations that do not have bad consequences for the ones doing the action. This at least seems implausible on a universal scale. Would every human take these ethical considerations to heart in such a way that they would not simulate consciousness? This seems very unlikely.

Another reason for thinking the ethical considerations would not stop posthumans from simulating consciousness is that it does not necessarily seem unethical to simulate consciousness. In fact, it could be a good thing, as long as one knows how to run the simulation properly. Bostrom (2003) comments: "from our present point of view, it is not clear that creating a human race is immoral. On the contrary, we tend to view the existence of our race as constituting a great ethical value" (p. 253). So, from our perspective, it seems rather odd if ethical considerations hold the posthuman civilization back from creating lots of simulations.

The second reason why a posthuman civilization would not simulate consciousness is that they lose interest in doing so. Bostrom (2003) writes, "Another possible convergence point is that almost all individual posthumans in virtually all posthuman civilizations develop in a direction where they lose their desires to run ancestor-simulations" (p. 253). Nobody would be interested in doing so. This seems very contrary to the interests of humans in our civilization. The Sims, a game simulating people, is a very popular videogame with millions of unique players. The interest in simulation games is huge in our civilization. We would have to believe that every posthuman civilization would lose this interest. This is, of course, not impossible, but it seems rather unlikely. If the interest in simulating consciousness in the future is anything like the current interest in The Sims, I think it would be plausible that ordinary observers would be outnumbered by simulated observers in the multiverse.

The simulation argument based on the multiverse theory

From our discussion above, we can reach some interesting conclusions about the simulation argument given the reality of a multiverse. Concerning the first proposition of the trilemma, that there will never be a post-human civilization, the multiverse gives us reason to either reject the proposition or reject functionalism.

Regarding the second proposition, that the post-human civilization is unlikely to run many simulations, even though the multiverse can ensure that there will be simulations, it does not say anything about the ratio between normal and simulated observers. However, as argued above, there seem to be good reasons for expecting the simulated worlds to dominate the normal worlds. I have given some reasons for thinking so, firstly, our interest in simulating games in our civilization suggests that when we can simulate consciousness there will be a similar interest in that civilization. Secondly, it is much cheaper than real universes and would therefore likely outnumber real ones. Thirdly, we see the existence of our race as something ethically good and would probably want to simulate consciousness. But how shall this be an argument against the multiverse?

Simulation as an argument against the multiverse theory

The multiverse seems to remove, in my view, the most plausible option in Bostrom's trilemma, namely that the human species is very likely to go extinct before reaching a "posthuman" stage. The L2M, therefore, gives evidence for the simulation hypothesis. However, this leaves us with some unwanted consequences, as Davies (2007) has argued, "The threat of fake universes constitutes a reduction ad absurdum of the entire multiverse theory" (p. 213). If our theory of the multiverse implies that there is more likely than not that we are just a simulated consciousness, this fact will undermine our reasoning. If we are in a simulation, then our senses cannot be trusted unless we could find a way to determine the axiological qualities of our maker. Our senses and reasoning faculties would be entirely in the hands of the creators of the simulation program.

Given that we now have good reason to be suspicious of our reasoning faculties, we would no longer have any reason to think that our conclusion that the multiverse hypothesis best explains the fine-tuning of the universe is a reasonable inference. In fact, we would not have any good reason to accept the fine-tuning data in the first place. If the multiverse hypothesis makes it more likely than not that we are in a computer simulation, I think we have a good defeater for the multiverse hypothesis. The multiverse hypothesis would be self-defeating. If it is true, our reasons for thinking it true is undermined.

A good prediction?

In light of our discussion in section 6.3 about making predictions of the multiverse theory, is this a good prediction?

In our previous discussion, we noticed that three crucial questions would need to be answered to make a good prediction from the multiverse. Firstly, we need the correct reference class, and secondly, we need a proxy to determine how many observers there would be, and thirdly, we need a solution to the measure problem. How does the simulation argument fare in light of these worries?

The simulation prediction would seem to fare well. Firstly, the reference class of who we could be would include simulated consciousness as we could have the exact same experience as we do have and still be in a simulation. Secondly, we do not need proxies in the simulation prediction because we just compare the likelihood of being a simulated observer against the likelihood of being an ordinary observer. Thirdly, our intuition about the proportions of universes containing ordinary observer's contrary to universes containing simulated observers should be the determining factor regarding the measure problem. We do not need to have the correct measure if our intuition makes us expect one type of observer to outnumber the other. Hence, if we find the reasons given that the simulated worlds would outnumber the ordinary worlds compelling, then I think that any plausible solution to the measure problem should lead to the same conclusion.

The difficulties with making predictions in a multiverse are largely avoided in the simulation prediction. The only question seems to be whether the argument for this prediction is a good one.

Conclusion

In conclusion, I think this simulation argument against the multiverse offers some evidence against the multiverse. It is not a knockdown argument as the multiverse proponents can question several of the assumptions in the argument, like the truth of functionalism or that simulated observers will outnumber ordinary observers. However, I think the most plausible assumption to question is the existence of a L2M.

6.5 The Boltzmann brain objection

One of the biggest concerns regarding the restricted multiverse is that it predicts that we should be a Boltzmann brain (BB) rather than an ordinary observer (OO). This problem has been pressed by many as the biggest problem for the restricted multiverse.[38] Therefore, I will devote some space to develop this objection and evaluate it. I will, in this section, first discuss the history of the BB objection, then I will discuss why BB is a problem. Lastly, I will discuss whether the L2M suffers from the BB problem and evaluate whether this is a good prediction in light of the problems with making predictions discussed in section 6.3.

[38] See Penrose (2016, pp. 310-323), Collins (2012, pp. 265-272), Mann (2015, s. 37) and Barnes & Lewis (2016, pp. 314-322)

The history of the objection

The BB objection to the multiverse is based on the fine-tuning of the initial conditions of the multiverse, more specifically, the entropy. That is to say that the multiverse cannot explain the low entropy in our universe if the BB objection is sound.

To get a grip of this objection, it will be helpful to understand the background of the objection. In the late 1800s, Ludwig Boltzmann, one of the fathers of statistical mechanics, worked on the second law of thermodynamics. This law states that entropy in a closed system will always increase. Boltzmann's most famous contribution was his statistical explanation of the second law of thermodynamics. Though the Second Law is statistical and not absolute, it is overwhelmingly likely to hold. Carroll (2017) gives the reason why: "there are, by construction, many more high entropy states than low-entropy ones" (p. 4). This gave Boltzmann a problem because the Second Law implied that our universe is headed toward equilibrium. Equilibrium is the highest entropy state and is characterized as a state with no available useful energy. The problem for Boltzmann was that the consensus view in his day stated that the universe was eternal. If the universe were eternal, how could we observe a universe with available energy? The entropy increases according to the second law of thermodynamics, and if it had been increasing for eternity, it should have been in thermal equilibrium by now. Why do we not observe a universe in equilibrium?

Boltzmann's multiverse

Boltzmann's radical response was to postulate, arguably, the first multiverse.[39] He argued that our universe might be in thermal equilibrium on the whole but because the Second Law is statistical and not absolute, there would occur, because of spontaneously fluctuation, small

[39] At least based on physics.

regions containing low entropy. Fluctuations like these are extremely unlikely, but given an eternal universe, we would just have to wait a while. Boltzmann's view of the multiverse was an infinite universe, on the whole in thermal equilibrium, but with pockets of order spontaneously fluctuating into existence. This scenario is allowed because of the Second Law's statistical nature. These pockets of order he would call worlds. This idea was indeed very creative, but sadly, for Boltzmann, his theory faced a big problem, namely the problem of BBs.

The Boltzmann Brain problem

Boltzmann did not notice the problem his model presented, and it was only after his death that Sir Arthur Eddington in 1931 pointed out that according to his model, there would only be a need for intelligent observers, not galaxies and solar systems (Carroll S. M., 2017, p. 6). Given that a spontaneously created pocket of order is much more likely to be of the smallest form possible, it would be incredibly more probable that this pocket would consist of a single brain that would hallucinate the external world rather than the external world actually existing. These lonely brains hallucinating the external world is what is known as a BB.[40]

One worry for the BB problem is that there is not an accepted definition of a minimum observer. This is, however, not a problem. Even if we cannot know for sure what conditions would be required for an observer, we can be very confident that whatever that condition turns out to be will be either incredibly more likely with BBs over OOs or extremely more unlikely, depending on the model (Carroll S. M., 2017, p. 9). The important consideration will be "whether BBs will fluctuate into existence at all, and whether the universe lasts for a short time or essentially forever" (Carroll S. M., 2017, p. 9).

[40] Term coined by Andreas Albrecht and Lorenzo Sorbo (2004).

If BBs fluctuate into existence and the universe lasts for a very long time, then BBs will dominate the cosmological model over OOs. This is because we obviously do not need everything in the observable universe to exist. The entire universe is just a statistical fluctuation on Boltzmann's view, but we surely do not need the entire universe for life to exist. We might need something more than just a brain. However, even if it took the whole solar system, it would be incredibly more likely that a pocket containing the solar system would fluctuate into existence rather than the whole observable universe.

To see why this is the case consider an analogy of randomly ordered letters on a scrabble board, given by Collins (2012):

> If we were to shake the scrabble board at random, we would be much more likely to get an ordered, meaningful arrangement of letters in one small region, with the arrangement on the rest of the board essentially chaotic, than for all the letters on the entire board to form meaningful patterns. (p. 267)

There would probably be plenty of little two-worded words like hi, do, in, and so forth if the letters were numerous and randomly ordered. Around these pockets of words would probably be much gibberish. The small words would vastly outnumber any meaningful sentence, and any sentence would vastly outnumber any paragraphs of meaning in the pool of randomly ordered scrabble letters. Let us make this analogous with the multiverse. If the initial conditions of our universe were chosen randomly, then it would probably be life-prohibiting in the same sense that if the scrabble letters were shaken randomly, they probably would be gibberish.

However, the multiverse has an additional explanatory mechanism, namely the observer selection effect. So, for this example to be analogous, we have to add this feature to the scrabble board illustration. Imagine that a randomly ordered scrabble board is shown to you, but in addition to being random, there is a machine that stops the scrabble letters when the first intelligible word is formed. In this case if we saw a scrabble board where *Hamlet* was written in its entirety, it would be extremely implausible on the hypothesis that the scrabble letters were just randomly shaken and shown to us at the moment an intelligible word was formed. We would expect the smallest possible words because these are overwhelmingly more likely to form randomly than the entire play of *Hamlet*.

This scrabble board analogy shows the logic of the BBs objection. If we want to use the observer selection effect to explain the low entropy in our universe by a random fluctuation, then it would be incredibly more likely to consist of just our solar system (a sentence in the analogy) rather than our galaxy (a paragraph in the analogy), and it would be incredibly more likely than the entire universe (*Hamlet* in the analogy). Even more likely than solar systems would be BBs (small words in the analogy). These considerations show that BBs are a problem even if we are unsure of a minimum observer's conditions.

Likelihood of BBs

But how more likely would a BB be than an OO? Remember from section 2.1 that Penrose calculated the probability of our observable universes' low entropy to be 1 part out of 10 to the power of 10^{123}. By comparison, Penrose considers the cost of only creating our solar system from a random collision of particles. He concludes that the probability that a region consisting of only our solar system would spontaneously occur by chance is utter chicken feed compared to the whole observable universe (Penrose R. , 2004, p. 764). Smaller patches would be even more probable. As Geraint Lewis (2016) says "you get what you need and almost certainly no more" (p. 314). Boltzmann's theory predicts us to be in the lowest order needed for observation and fails spectacularly since that does not match our observation.

The original BB problem

We have seen that the original problem of BBs is that Boltzmann's theory predicted that we should be BBs, however, we are not BBs, and hence the theory makes a false prediction. In Boltzmann's multiverse, the BBs would appear, and they would overwhelmingly dominate. This became fatal for Boltzmann's random fluctuation model and is the reason why his theory has been universally rejected (Craig, 2003, p. 172). However, the question remains if the L2M has the same problem.

Three arguments that the Level 2 multiverse lead to Boltzmann brains

In the literature, I have found three arguments that BBs will be a problem for the L2M. Firstly, we shall consider the BB problem if one adopts an eternalist view of time, then if we explain the low entropy of our universe by a random fluctuation. Lastly, we shall consider Collin's argument that BBs will exist even in non-fine-tuned universes.

1. Argument for BBs on eternalist view of time

Let us first look at why the eternalist view of time might make the BB problem more challenging to avoid.

In the literature on the philosophy of time, there exist three dominant views of the ontology of time; presentism, eternalism and the growing block. These views disagree about the ontology of time, that is to say if the past, present and the future exist. Presentism is the view that the only moment that is real is the present moment. The eternalist on the contrary argues that the past, present and future is equally real. The growing block view says that the past and the present is real.

Adopting the eternalist view of time makes a difference because it makes future events real. The problem for the eternalist is that in the future, our universe will likely produce BBs. The physicists Raphael Bousso and Ben Freivogel (2006) write,

> In a long-lived vacuum with positive cosmological constant, structure can form in two ways. Structure can form in the conventional way (through a period of inflation followed by reheating), or it can form spontaneously as a rare thermal fluctuation. Because de Sitter space is thermal, if the vacuum is sufficiently long-lived spontaneous structure formation will occur. (p. 4)

What they are saying is that our universe in the future will evolve into a de Sitter space which is the highest entropy state of a universe with a positive cosmological constant, and in this de Sitter space, BBs will form through thermal fluctuation. Max Tegmark agrees and states that, "In the standard cosmological model, this random rearranging goes on *forever*; so it will randomly produce an exact replica of you who subjectively feels exactly like you do, complete with false memories of having lived your entire life [emphasis in original]" (2014, p. 307). In other words, our universe will create BBs endlessly in the far future. He comments further: "This is deeply troubling. If our spacetime really contains these Boltzmann brains, then you're basically 100% certain to be one of them!" (Tegmark, 2014, p. 307).

One could object that this is a problem if our universe is a single inflating universe as well; the multiverse is not needed. However, it seems to be a more difficult problem for the L2M multiverse. The reason is this: If there only exists this single universe that predicts BBs in the future, then we can expect that something is wrong with our theory of this universe. Maybe it will not expand forever as suggested. Maybe something happens that prevents this, like a phase transition. These are at least options. However, in the L2M multiverse, I think it would be bizarre if no universe expanded forever and created this de Sitter space where BBs would dominate the observers.

The reason why BBs would dominate the L2M is that if a de Sitter space would occur it would last forever, and BBs would form forever. However, OOs would only form for a short period in any universe. Since there is a state of the universe where BBs will fluctuate into existence forever but no state where OOs will be produced forever, the multiverse will be overwhelmingly dominated by BBs over OOs. This is a massive problem for the multiverse advocate who holds to an eternalist view of time.

One way, for the friend of the multiverse and eternalism, to avoid the BB problem is if it is impossible for a universe to expand forever; however, this is exactly what our cosmological model predicts, so it does not seem impossible. It, therefore, seems likely that BB will dominate in the future, and If the future is just as real as the past and present, the BBs would exist statically in this block of time. If we asked what a typical observer in this block of time on the L2M multiverse would likely be, it would almost certainly be a BB. If we adopt an eternalist view of time, the L2M plausibly leads to this prediction.

A way out

This first BB consideration can be avoided by adopting the a presentist or growing block view of time. The difference between these views and eternalism is what we consider our reference class. As discussed in section 6.3, we must define a reference class to test a multiverse theory. Suppose our reference class consists of every observer we could possibly be, given our background knowledge. In that case, the reference class will look very different depending on what theory of time one adopts. On eternalism, we should consider the whole block of time as existing, and hence there is no justification for excluding future BBs from our reference class. However, on presentism on the contrary, the reference class will only consist of observers existing now. The reason is that on presentism, these future BBs do not exist; we cannot possibly be any of these future BBs. If we cannot be these future BBs, we should not include them in our reference class. On presentism, we could argue that although it may be a problem in the future, the future does not exist yet, and hence there is no problem now. However, two further arguments have been given that BBs are a problem. These do not rely on any specific theory of time.

2. *L2M explaining the low entropy by a random fluctuation*

The second BB consideration is very much like the problem that plagued Boltzmann's multiverse. As mentioned initially, the BB problem is a problem associated with the early universe's low entropy condition. The question is in many ways the same as Boltzmann asked, namely, why do we observe a universe with low entropy when it is extremely more likely to be in a high entropy state?

One way to answer this question is to place our universe in a bigger system. Despite the Second Law stating that entropy always increases in a closed system we sometimes experience that entropy decreases in our lives. One example would be the air conditioner; by reducing the heat in the house, the air conditioner will decrease the entropy of the house. However, this does not violate the Second Law because the house is not an isolated system, but it is a subsystem situated in a bigger system. In other words, a known way for entropy to decrease is for it to be a subsystem situated in a bigger system. The air conditioner spews out heat outside the house, so while the house decreases, the universe as a whole increase in entropy. By situating the universe in a bigger system, let us call this the mother-universe[41], one could hope to explain the low entropy of our universe.

To do this, we must, like Boltzmann did, postulate a mother-universe in maximum entropy.[42] Then we could, like Boltzmann, hope that the right initial conditions for inflation would spontaneously occur as a random fluctuation. This is exactly how the L2M tries to solve the low-entropy problem. The standard L2M story is that in the extremely early universe, there were chaos and no order. These random conditions fluctuated from place to place, and by some random coincidence, just the right conditions were stumbled upon for inflation to start, and when it started, it became eternal. In this way, they do not have to assume some special initial conditions of the multiverse (Carroll S. , 2010, pp. 378-379).

The postulated mother-universe would have to be a de Sitter space because, as mentioned, this is the highest entropy state for a universe with a positive cosmological constant and hence the most probable. Thus far, the L2M does the exact same thing as Boltzmann's multiverse. How then is the L2M supposed to avoid the BB problem? To avoid the BB problem, the inflation story needs to make it more likely that the pre-inflationary patch, which expands to our universe, should be stumbled upon rather than a BB, and this is what we will discuss next.

[41] This would be the bigger reality where the pocket-universes would arise.
[42] If we postulated a mother-universe in low entropy, then we have made no progress. We would be left with the exact same question for the mother-universe.

Probability of BB vs pre-inflationary patch

A key question is whether it is more likely to stumble upon the pre-inflationary patch than a BB. Does the pre-inflationary patch have higher entropy than our universe and is hence more likely?

Several physicists have argued that the pre-inflationary patch has to have even lower entropy than the early universe. The reason is that the second law of thermodynamics states that entropy always increases. If the pre-inflationary patch was higher in entropy than the early universe then it would decrease in entropy as it expanded to the early universe. This seems to violate the second law of thermodynamics. According to the second law of thermodynamics if our universe evolved from a pre-inflationary patch, that patch has to have even lower entropy than the entropy of the Big Bang. The Second Law is well understood, and to see its reputation consider a quote from Sir Arthur Eddington (1928):

> If someone points out to you that your pet theory of the universe is in disagreement with Maxwell's equations – then so much worse for Maxwell's equations. If it is found to contradicted by observations – well, these experimentalists do bungle things sometimes. But if your theory is found to be against the second law of thermodynamics I can give no hope; there is nothing for it but to collapse in deepest humiliation. (p. 74)

These sorts of arguments have widely been accepted as persuasive, and the pre-inflationary patch should contain even lower entropy than the early universe (Collins, 2012, p. 265). This leads to the pre-inflationary patch being even more unlikely than the early universe. We then end up in the exact same situation as Boltzmann's hypothesis, and it would be overwhelmingly more likely for us to be a BB.

One worry of the above argument is that the pre-inflationary patch is of such small proportions that it would seem likelier to stumble upon than a BB. The pre-inflationary patch would be an extremely tiny patch of space, and our brain would be the size of a normal brain. However, as Collins notes "The decrease in likelihood resulting from the higher degree of order compensates for the increase in probability resulting from the size of the patch" (2012, p. 271). The order needed by the small pre-inflationary patch would compensate for the smallness of the patch.

If the above considerations are correct, then the L2M suffers from the same problem that plagued Boltzmann's multiverse. Namely, it would be incredibly more likely for BBs to form in the highest entropy state rather than the pre-inflationary patch needed for OOs. If our existence is just the result of a random fluctuation in a de Sitter space, then we should expect to be a BB rather than an OO.

3. *Not fine-tuned for observers but for embodied conscious agents*

A third argument that BB will dominate over OO can be found in Collins's article "Modern Cosmology and Anthropic Fine-tuning: Three approaches" (2012). He argues that our universe is not fine-tuned for observers but rather for embodied conscious agents (ECA).[43] He states, "The reason that it is not fine-tuned for observers is that sufficiently large non-fine-tuned universes will still contain observers, at least for many of the fundamental parameters of physics" (Collins, 2012, p. 174). He argues that BBs would exist even in non-fine-tuned universes. Because BBs will exist in non-fine-tuned universes they will exist in a bigger percentage of all the universes in the L2M. Collins argues that,

[43] Embodied conscious agents are Collins term for ordinary observers.

> The existence of such observers is especially clear for those fine-tuned parameters – such as the strength of gravity, the dark energy density, and the strength of the primordial density fluctuations – that can be varied without affecting the properties of atoms or molecules. (2012, p. 176)

Those parameters will allow BB in a larger range of values than it will allow ECAs. If we postulate the L2M and ask what observer we should expect to be, it will be incredibly more likely for us to be a BB because many more universes in the L2M would allow BBs than ECAs/OOs.

Is this a reliable prediction of the Level 2 multiverse?

These three considerations give us good reason to think that the L2M predicts BBs rather than ordinary observers. However, in section 6.3, we discussed how making predictions in an L2M multiverse is very difficult. What can be said of this prediction?

The difficulties seem to be largely solved in the case of the BB prediction. Firstly, there should be no controversy that BBs should be in the reference class of observers we could be. This is because a BB could have all the same experiences as we do, and hence, we could be a BB. Second, we saw how predictions of the L2M multiverse often relied on proxies to evaluate how many observers the theory predicted. In the case of the BB prediction, this is not needed. We calculate the probability of the universe fluctuating into existence through inflation against a BB fluctuating into existence. Or alternatively, we look at the number of universes in the L2M that would produce BBs and compare it to universes that would make ECAs/OOs. There is no need for a proxy. Lastly, there is the measure problem. In the BB prediction, this is somewhat problematic. Different measures lead to different predictions. The proper time measure and pocket-based measure leads to BBs dominating, while the scale factor measure and casual diamond measure do not (Friederich, 2021, p. 123). What should we conclude when there is no accepted solution to the measure problem, and the measures lead to different predictions? Should we conclude that we just do not know whether BBs will dominate the multiverse?

In contemplating this question, I mailed Jeffrey Zweerink and asked whether the BB problem was generic problem or if it depended on specific solutions to the measure problem. He answered,

> It is true that different measures give different predictions regarding BBs. However, many of the articles I have read state that the preferred measures are the ones that minimize BBs--which seems to be a form of fine-tuning in my assessment. Pretty much any measure that has large universes with vast stretches of time (well more than billions of years) will result in BB domination. That is true for inflationary models (which are future infinite by most models) and most realistic cosmological models. (Zweerink J. , 2021)

His answer highlights two important points: Firstly, those models minimizing BBs are preferred, and secondly, the majority of measures lead to a BB-dominated multiverse. In my previous discussion in section 6.3, I argued that it is wrong to choose measures as one chooses theories of the universe, namely based on what matches observation. When we prefer measures that match our observations, we assume that a multiverse exists and that a measure correctly matches that multiverse. In my judgment, this will make the multiverse immune to wrong predictions, and as Friederich has argued, this function as researcher's degree of freedom. If one prefers measures based on the fact that they match reality, then I think Zweerink is correct in considering this as a kind of fine-tuning.

Preferring multiverse models without BBs is exactly what Sean Carroll does, in debate with William Lane Craig, when he says,

> Different multiverse models will have different ratios of ordinary observers to random observers. That's a good thing. That helps us distinguish between viable models of the multiverse and non-viable models, and there are plenty of viable models where the Boltzmann Brain, or random fluctuations, do not dominate. (Carroll S. , 2015, Opening speech para 13)

He is arguing that there exist models without the BB problem, and we should prefer them. However, even though there exist models where BBs are not dominating the multiverse, these models nevertheless are a minority of multiverse models. To prefer one of those models would be a kind of fine-tuning.

If we ask out of all possible multiverse models how many predict that we should be BBs and how many predict that we should be OOs and the proportion of multiverse models that predict that we should be BBs vastly outnumber the models that predict that we should be OO then it seems like we have moved the fine-tuning from wondering why we are in such a special universe to wondering why we are in such a special multiverse. The problem remains, why do we live in a special reality rather than an ordinary reality?

Collins solution to the measure problem

Collins suggests another solution to the measure problem. He argues that in cases where there is an infinite number of BBs and ECAs, we should use the judgment that there are more values of parameter space that allows for BBs than ECAs, and hence we should use this as an intuitive guide that BBs will dominate (2012, p. 179).

This response is directly related to his argument that BB will dominate because more values in parameter space allow for BBs rather than ECAs. If more values allow for BBs than ECAs, then BBs will dominate any finite model of the L2M. It seems plausible that this should be our intuitive guide to the infinite cases where proportions are more difficult to assess. If we cannot make these intuitive judgments, then even the fine-tuning is unjustified since it rests on such intuitions. In the case of the fine-tuning argument, we also judge the fine-tuned universes more unlikely than non-fine-tuned universes based on the proportion of universes in the L2M. There are vastly more life-prohibiting universes than life-permitting universes in the possible values the initial conditions and constants can take. Hence, this is what makes fine-tuning a puzzling feature needing explanation. If we can use the measure problem to suggest that we simply do not know whether fine-tuned universes are more likely than non-fine-tuned universes because in an infinite multiverse, there would be an infinite number of fine-tuned universes and an infinite number of non-fine-tuned universes, then this would undermine the need for a multiverse in the first place. This is also a problem for the prediction's inflation makes; as seen in section 6.3, Steinhardt argued that all the predictions of inflation are undermined because of the measure problem. However, the multiverse proponents argued, *pace* Steinhardt, that there probably were measures that lead to normal predictions. If our intuitions that the predictions of inflation hold in the infinite multiverse, then why should our intuitions that BBs would dominate not hold? It seems that if in the one case normal probabilities hold, then it should hold in the other case as well, and as argued, in any finite multiverse the BBs would dominate.

Conclusion

In conclusion, we have seen that the objection that undermined the first formulated multiverse, namely Boltzmann's, is also the most formidable objection to the L2M. Either the BB problem will undermine the L2M, or the multiverse needs fine-tuning to avoid this. Collins (2018) notes that, "Advocates of the multiverse are well aware of this problem and have been attempting to find acceptable multiverse models that avoid it without the models themselves requiring extensive fine-tuning. So far, no such models have been produced" (p. 91). The BB objection is a big problem for the L2M proponent, and without reasons as to why BBs will not dominate the L2M, the L2M faces a significant problem. This problem led to the universal rejection of the Boltzmann multiverse. Time will show whether the same fate awaits the L2M. Until an L2M model is provided that does not need significant fine-tuning to avoid BBs, the BB problem remains a formidable challenge for the multiverse proponent.

6.6 Assessing the restricted multiverse

How shall we evaluate the restricted multiverse objection to the fine-tuning argument in light of these objections?

We began our discussion of the restricted multiverse by assessing the scientific status of the L2M multiverse. We concluded that it is not a well-established scientific theory, nor is it just a desperate move cooked up by the desperate atheist. Instead, we concluded that it is a speculative theory based on interesting theoretical reasoning and hence is not just an *ad hoc* attempt to explain away the fine-tuning; it deserves to be taken seriously.

Then we considered whether the multiverse itself needs fine-tuning of its fundamental laws. We saw that although the L2M will explain our universe's initial conditions and constants, it still needs just the right fundamental laws to contain even one life-permitting universe. There is, however, no quantitative way of checking whether the combination of those laws is unlikely. The existence of an L2M would remove the quantitative aspects of the fine-tuning argument, and we would be left with the question of the fundamental laws. Whether the right fundamental laws need any explanation would probably be judged differently by different people. Hence the restricted multiverse would undoubtedly diminish the force of the fine-tuning argument. However, there would still be possible to argue that something is puzzling about the existence of just the right fundamental laws to bring about a multiverse with even one life-permitting universe.

We then saw the need for the restricted multiverse to make predictions. The importance of this is that if it does not make predictions, it will fall prey to the objections leveled by Steinhardt and others, that the multiverse makes no predictions and hence removes the theoretical reasons supporting the L2M. Without any theoretical reasons supporting the L2M, postulating an L2M just because of the fine-tuning would probably make it *ad hoc*. The normal way of making predictions in an L2M is to assume that one is a typical observer and check whether the L2M predicts our observations as typical.

We discussed two problematic predictions by the L2M. Firstly that the L2M makes it more likely that we live in a simulation. By removing the most plausible proposition in Bostrom's trilemma, the L2M makes the simulation hypothesis significantly more likely. However, there certainly are questionable premises that the multiverse proponent can deny. Either that it is possible to simulate consciousness or that simulated worlds will dominate in the multiverse. However, I find both these premises more likely than the existence of a multiverse and hence find the simulation objection to give some evidence against the L2M. Lastly, we discussed what I assess to be the most formidable challenge to the L2M; that it predicts that we should be BBs. This leaves the L2M with a difficulty of explaining why we find ourselves in a universe with as low entropy as we observe. If we live in a random multiverse, we would expect to live in the highest possible entropy state and be a BB. Until the L2M finds a plausible solution to this BB problem, it faces a serious difficulty. While I find the L2M more plausible than the UM, I still find it unlikely as an explanation of the fine-tuning evidence.

7. Conclusion

In this thesis, I have discussed the resurgence of the design argument based on the discoveries that our universe is fine-tuned for life. A number of objections have been raised against this argument; however, no objection is as widely raised as the multiverse objection. Therefore, I have probed the research question, "does the multiverse objection undermine the fine-tuning argument for God's existence?" In section 3.2, I surveyed the different multiverse theories in the literature and concluded in the end that the multiverse objection could be divided into two categories; unrestricted and restricted theories. I started out by considering two preliminary worries for the multiverse objection; that it commits the inverse gambler's fallacy and that it is less simple than design. I concluded that the multiverse does not commit the inverse gambler's fallacy and that whether the multiverse is less simple than God depends on the model one has in mind. I argued that the UM model postulates the least simple theory possible and hence is less simple than design. The restricted multiverse, however, I argued, are on an equal footing with design concerning simplicity.

In chapter 5, I discussed three arguments against the UM theories of Lewis and Tegmark; that they involve the metaphysical possibility of actual infinities, that they remove responses to skeptical arguments, and lastly, I offered my own argument that our universes lax laws either undermines the UM or probabilistic reasoning collapse. The UM theories face, in other words, severe difficulties. I, therefore, conclude that the UM theories of Tegmark and Lewis are highly unlikely as explanations of the fine-tuning data and does not undermine the fine-tuning argument for design.

In chapter 6, I discussed problems related to the restricted multiverse represented by L2M. The first consideration was whether the universe generator of the L2M itself would need fine-tuning.

As we discussed, the L2M would need just the right laws to produce universes. Whether this is a reason to prefer design seems to be based on different intuitions. This is an area where I think further research could provide better clarity. Are just the right laws more unexpected than a God with just the right properties?[44] We also saw that without a standard multiverse model, it is difficult to know whether any free parameters would need fine-tuning on L2M. Secondly, I discussed how to make predictions in an L2M. We concluded that although it is possible, it has three components that can significantly affect the outcome of the prediction, namely the reference class, the proxy, and the chosen measure. Thirdly I offered two predictions the multiverse would plausibly make. First, it would be more likely that we lived in a simulation, and secondly, the multiverse predicts that we should be BBs. Although more plausible than the unrestricted multiverse, I concluded that the restricted multiverse is not a plausible explanation of the fine-tuning evidence.

To choose between the design hypothesis and the multiverse, one would ideally discuss every objection raised against each hypothesis. Because of space limitations and the vastness of such a project, I have limited my thesis to discuss the plausibility of the multiverse hypothesis. In the end, I conclude that neither the unrestricted nor the restricted multiverse hypothesis is a plausible hypothesis for explaining the fine-tuning of our universe. Unless comparably well-founded objections exist against the design hypothesis, it should be the preferred explanation of the fine-tuning evidence. In the end, I conclude that the multiverse objection faces several difficult objections and hence should not undermine the fine-tuning argument for God's existence.

[44] The most thorough work I am familiar with in this area is Robin Collins chapter "Hume, Fine-Tuning and the "Who Designed God?" Objection" (2005).

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