What if Reality is Simulated and Simulations are Real?

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Abstract

Movies such as *The Matrix* have stimulated popular interest in "brain in a vat" scenarios. Amidst the traditional questions of mind, we tend to overlook an integral enabling component – the world simulation – which merits consideration in its own right. When facing the simulations in these imagined scenarios, we struggle with conceptual muddles regarding what is "real" and not. In this paper, I argue that simulated worlds are every bit as real as the one we inhabit. This turns out to be important when considering the possibility, as suggested by Nick Bostrom (2003), that the world we experience as "real" is actually a simulation. Can such a hypothetical prospect be reconciled with an orthodox Christian perspective? While the metaphysical status of simulations that I present here points towards such a reconciliation, significant obstacles remain to be addressed. I consider some of these remaining challenges and explore the associated stakes. Although this consideration works through a hypothetical scenario, the exercise provides several insights that may prove valuable apart from the required assumptions.

1 Introduction

The general population has encountered simulated worlds through many books ranging from *True Names* (Vinge, 1984) to *Idlewild* (Sagan, 2003) and movies

ranging from *The Matrix* to *The Thirteenth Floor*. Hundreds of years ago, Descartes anticipated the brain in a vat scenario, and we find a related situation thousands of years ago in Plato's cave. In the contemporary brain in a vat scenarios such as that presented in *The Matrix*, we find human brains connected directly to computer software systems – world simulators – that provide sensory stimulation to the brain and incorporate the brain's volitional motor acts into the simulation's state.

One thing such treatments of simulated reality have in common is an implicit and under-appreciated reliance on the computer simulation. The connection between the brain and simulation and the predicament of the brain itself provide an intriguing scenario in which we can explore conundrums of the philosophy of mind. But these thought experiments do not get started without the simulation itself. Granting that simulations of the type needed to sustain a brain in a vat scenario are still science fiction, it is perhaps understandable (though unfortunate) that when given explicit attention simulations are invariably treated in a dismissive manner. When considering work in virtual reality, much of the attention is focused on methods to 'trick' the human perception into perceiving an immersive environment (Brooks, 1999). This can lead to a view of simulators as engines of deception.

So we find two problems at work in treatments of computer generated worlds. First, the simulation itself is overlooked, minimized or dismissed. Second, the standard view of simulations relegates their ontological status to the unreal. In this paper, I want to redress these two problems, arguing that simulated worlds are "real" worlds. I suggest that the common distinction involving the concepts of real and simulated is based on a confusion. Nevertheless, there is a distinction to be made and I attempt to articulate the key differences between simulated worlds and our physical world.

However, responding to these two problems opens the door on a third problem: What are the implications for Christians if it turns out, as some have suggested, that the world we experience is in fact a simulation? Of course, the prospect of simulated universes raises broad theological questions; for example, Steinhart (2010) has considered implications on the existence and nature of God. In a much narrower context here, I consider the implications and explore how, if at all, we can preserve a traditional Christian worldview in the face of such a hypothetical situation. That is, does traditional Christianity provide a plausible way to live life if it turns out that our universe is simulated? By exploring these ideas and their consequences, I am *not* suggesting that we do in fact live in a simulation, etc. Rather, I view this as an exercise of following claims to their conclusions.

Given my argument concerning the ontological status of simulations, I propose what I believe to be a plausible response to the *hypothetical* situation in which the physical world we experience is actually a matrix.

2 Importance of simulations

In many contexts, the terms *simulation* and *virtual reality* may be used interchangeably to refer to computer generated environments. Unfortunately, this may lead to confusion as they are non-identical overlapping sets. A *simulation* exists in relation to an external set of phenomena of which the simulation is a model. Often, we run simulations that model extremely constrained aspects of our world that would not provide the basis for a brain in a vat experience. A *virtual reality* provides a 'world' that may be sensed and manipulated by an agent within that world. Virtual reality may be employed to explore environments completely alien to our physical world. For the purposes of thought experiments such as the brain in a vat, we primarily think of environments that have laws of physics that correspond to those with which we are familiar – that is, simulations. Thus, I will use the term *physics engine* to refer to a computational arbiter of agents' interactions with the world in which they act whether or not that world bears any resemblance to our own. I will use *physical world* to refer to the environment we normally experience.

Traditional brain in a vat thought experiments tend to overlook the significance of the implicit assumptions made about the work that must be performed by the physics engine. These thought experiments provide insight only in so far as the simulated worlds they present adequately mimic the physical world. That is, brain in a vat scenarios assume both the necessary computing platform and the ability to program a physics engine that simulates the physical world, together producing an experience of sufficient fidelity that it fools the brain that is actually floating in a vat.

Scientists and entertainers have discovered the challenges involved with simulating the physical world. Whether attempting to model the aerodynamics of a bicycle or to provide a compelling game experience, physics engines have turned out to be extremely computationally demanding. The simulation must compute the consequences of interactions between entities within the modeled world and, in the case of a brain in a vat scenario, must perform these computations fast enough to stay ahead of the brain's own processing.

The creator of the simulation must not only have the necessary computing

hardware, but must also understand the properties of the environment that is to be simulated. Every simulation embeds a *physics* that determines the nature of interactions between entities. When a simulated world is intended to model our physical world, as in the case of computational fluid dynamics or many computer game experiences, the correspondence between the simulated physics and that of our physical world determines the success of the exercise. This requires an understanding of the physics to be simulated and the coding skill to adequately implement the corresponding simulated physics. Common experience indicates that both of these requirements present significant challenges. Thus, simulations play a much more important role in the brain in a vat thought experiments than we tend to realize.

However, we should note that the problems discussed here (computing hardware and simulation design and implementation) are somewhat mitigated for brains in vats when they never knew another environment. That is, if the hypothetical brain in a vat has only ever received sensory impressions from the simulated environment, and through volitional actions triggered changes in that environment, then only the speed of the simulation remains a problem. Since such a brain would have no comparison environment by which to judge the simulated one it is experiencing, the fidelity of the simulation loses some relative importance. Although the simulation must still keep up with the brain's processing, the designer may arbitrarily simplify the environment and its physics in order to allow the available computing hardware to perform its tasks in a timely manner since the brain knows no better. For that matter, there is no requirement that the simulated world correspond to the physical world; this parallelism merely supports the intuitive leverage of the thought experiment.

Even allowing the mitigation of the challenges faced by the successful simulation, we see that the role of the simulation is more significant than typically thought. Furthermore, brains in a vat are not the only situations in which physics engines play an important role. Suppose that we replace the brain with another computer. Although this introduces its own problems that merit consideration – not the least of which is the support of experience and agency on digital computers – the point for our present purposes is that the simulation continues to play a crucial role. David Chalmers (2005) uses the term *matrix* (lower-case 'm') to refer to a computational system sufficient to run a simulation that a human would find indistinguishable from the physical world. This latter requirement proves unnecessary in light of my argument above. Regardless of the correspondence (or lack thereof) between an computationally realized environment and the physical world, we face the following dilemma. If we suppose that we have access to the

computational resources necessary to run a matrix, we then encounter the problem of determining what is real and what is not – both in the physical world and in the matrix. Thus, we now turn to consider what we mean by "real" and the ontological status of objects that are rendered by a physics engine.[1]

3 Ontological status of virtual reality

Informally, we make the distinction between "real" things and a variety of alternatives including those that are: artificial, imagined, or simulated. In each case, we have a slightly different meaning in mind when we use the word "real". While a meaningful distinction between virtual and real entities *can* be made, we need to reconsider the distinction that we often have in mind when we use these terms. David Chalmers provides a similar line of reasoning in claiming that an agent that lives in a matrix holds, for the most part, *true* beliefs even though the world is simulated (2005). Ultimately, I want to go further and claim that the ontological status of a simulated object is the same as an object in the physical world and thus we ought to consider such a simulated object to be real.

First, we observe that a simulation is real in our world. That is, if someone implements a computational simulation of some physical process, we say that the resulting product is a *real* artifact – namely, the simulation itself. If we distinguish between the simulation as a whole and the entities simulated therein, we still find that the simulated entities are real in our world. We attach the "simulated" adjective in order to distinguish entities that exist within the simulation from those that exist in our world. But we see that the simulated object has a reality in the physical universe; we can point to certain memory locations and their interrelationships in the context of the computer hardware running the simulation in question.

Second, we claim that the entities within a simulation are real within the simulation *in the same way that we say objects in our physical world are real*. On what basis do we grant the ontological status of real to, say, a chair in our physical world? We can see and touch chairs; they are accessible to our senses. If we apply the appropriate measurements, we find that a chair is made of the same kinds of "stuff" of which we are made. And finally, if we sit in a chair it will support our

[1] In the remainder of the paper, the distinction between simulation and virtual reality fades into the background. The key issue is that we have an agent experiencing an environment that may be computationally generated or may be physically generated. Some would argue that this last distinction itself is meaningless (Deutsch, 1997). Therefore, I will use simulation, virtual reality, and physics engine interchangeably unless the point being made requires a distinction.

weight. The same line of reasoning must be applied to a simulated chair. A simulated humanoid agent in our simulation observes the chair with its senses. If the agent were to examine the chair closely enough, it would find the chair to be constituted of the same stuff as the humanoid itself. It makes no difference what that stuff would look like to the humanoid. We might design the simulation such that the humanoid discovers particles much like those we find in the physical world; or it might encounter access to the bits and bytes of the simulation. In either case the important factor is that the chair is made of the same stuff as everything else in the simulated world. Thus, a simulated chair is as real to a simulated humanoid as a physical chair is to us.

This approach bears some resemblance to that of the pragmatists (James, 1907). We need not go so far as the anti-realist; the simulated chair exists apart from the simulated humanoid that sits in the chair. But if one wishes to take the leap to anti-realism, we point to Plantinga (1982) who argues that the way to be a consistent anti-realist is to be a theist and rely on God's mind.

Let us examine the intuitive reluctance to grant simulated objects a full ontological status of real. Although our hypothetical humanoid might view the simulated chair as real, none of us would be able to sit in the chair. I claim that it is this difference that fuels or props up the distinction even in the face of agreement on the previous two claims. However, this intuitive objection needs to be challenged. If we hypothesize an interface to the simulation analogous to the one used by Neo and the others in *The Matrix*, then we can easily imagine ourselves sitting in the simulated chair. If queried during his audience with the Oracle, Neo might report that he is reclining on board the ship, Nebuchadnezzar. Much more likely however, he would say that he is sitting in the kitchen chair while talking with the Oracle and eating cookies. Indeed, human experience with gaming in immersive simulated environments confirms that we place ourselves outside our bodies with relative ease.

As another example of simulated entities that we should treat as real entities, consider a simulated proof. That is, suppose we have a simulated world in which simulated mathematicians labor to produce (simulated) proofs (Hofstadter & Dennett, 1981). Because the simulated mathematicians are using the same formal system as mathematicians in the physical world, human mathematicians are able to observe and make sense of the proofs constructed by their simulated counterparts. These proofs, found to be valid, are real proofs even though they originated initially within a simulation. That is, simulated proofs are real proofs.

All this is not to say that there is *no* distinction between objects in our physical world and those in a simulation that we create. The thrust of my claim is that the

distinction is not what is typically taken for granted. Instead, I claim the distinction reflects a *sustaining character* between the physical world and a simulation.[2] That is, a simulated chair obtains its ontological status of existence by way of the simulation running in the physical world. In this light, in may be helpful to think about the physical universe and what its source of existence might be. For anyone adopting at least some form of theism broadly construed, we can think of the physical universe as having its origin and as being sustained in the mind of God. In this sense, the chairs we think of as "real" are analogous to simulated chairs in God's view. That the chair is real to God is uncontroversial; that it is also the case that the chair is essentially simulated from God's view does not take away from the chair's reality (either in our or God's views). Thus, without loss of significance, simulated objects should be granted the same ontological status as objects in the world we experience every day. This conclusion turns out to bear import on our responses to the hypothesis that the physical universe we currently experience is actually simulated.

4 Are we simulated?

Expanding our thinking about simulations opens the door to considering hypotheses previously unimaginable. For example, in his *simulation argument* Nick Bostrom suggests that we may be living in a simulation (Bostrom, 2003). Others have also treated the possibility seriously (Hanson, 2001; Jenkins, 2006; Barrow, 2007; Weatherson, 2003). Based on his model and analysis, Bostrom asserts that the world we experience and call the "real" world is actually a simulation with a non-negligible chance of approximately one-third. The details of the argument by which he arrives at this claim are unimportant to our present discussion.

However, it is worth noting two preconditions for Bostrom's reasoning. First, in order to create a simulated world the sustaining world must have computational resources adequate to the task. Although one may doubt that our physical world has the necessary resources – even granting advances in quantum computing – a negative outcome on that point does not undercut Bostrom's argument. It only implies that our universe is a leaf-node on the tree of simulated creations. The universe in which our world is a simulation could have vast computational resources beyond our imagination.

[2] Steinhart (2010) uses a similar distinction in his definition of *ultimate* versus *virtual* realities. Although he applies the distinction to software and hardware in ways that appear to have problems, my intuition follows Steinhart's for the purposes of understanding the nature of reality.

Second, the "persons" living in a simulated world must be supported by the computational structures running it. That is, Bostrom assumes that personhood is fundamentally computational. To be more precise, he only requires that subjective experiences arise from computational processes operating at a sufficiently detailed level (Bostrom, 2003). Within the philosophy of mind literature, this position is not particularly radical (although not without controversy). Christians have tended to reject the position although exceptions have attempted to reconcile a faithful view of human persons and a physicalist view of the universe (Corcoran, 2005; Hasker, 2005; Murphy, 2005). While these treatments do not directly address whether or not a person can be supported computationally, they serve as the beginning of a bridge to such a claim. Note also that in regards to traditional physicalism, the simulation argument assumes a non-physical existence apart from the universe we experience.

If the reader rejects the possibility that our physical world is actually simulated, then much of the argument and conclusions presented in the paper would be moot. However, the exercise seems to shed light on the nature of simulations and may lead to insight in how we ought to act in regards to creating simulations and interacting with them. Furthermore, Saint Paul considered the hypothetical that Christ had not risen (1 Cor 15:12-19), which he believed to be false, in order to arrive at a deeper understanding. As such, I suggest it is worth contemplating the possibility and its consequences.

At the heart of the matter, we cannot rule out the possibility that the physical world is a simulation. If we accept that we *might* be living in a simulation and we follow the reasoning presented in the previous section regarding the ontological status of simulated worlds, then discovering that our physical universe is a simulation ought not be catastrophic. The disorientation and identity crisis that attends such an eventuality is based on unexamined senses of real and simulated. If simulated objects are real objects, then if the physical world is in fact simulated, only the underlying makeup of the world is different from what we thought – not the fundamental status of what is real. Again, this parallels the reasoning of Chalmers mentioned above (2005). The situation is analogous to the replacement of the theory of phlogiston with oxygen and the periodic table. Things formerly thought to consist of phlogiston and other stuff were not suddenly dismissed as unreal; instead, our model of their composition changed.

Be that as it may, discovering the world to be a simulation could require revisions of a significant nature for those holding certain specific theistic worldviews. For those within the Christian tradition, the understanding of scriptural revelation, miracles, and the life and works of Jesus would have to be reconsidered and

perhaps modified. Proactively, we now turn to this exercise with an eye toward orthodox Christianity.

5 Exercise: What if

As an attempt to anticipate the relationships between simulations, reality and a Christian worldview, we advance the following thought experiment. Start by assuming that the physical world we experience around us is in fact a simulation being run in some *containing* environment, outside of and subsuming our universe. I am not suggesting that this hypothetical situation is true or even likely. Bostrom (2003) argues the plausibility of the assumption and the claim cannot be entirely ruled out. Thus, I ask for the reader's indulgence and will simply make this assumption without further discussion.

Next, let us define a zero-level world to be one that exists independently of any other world. Since we are making the assumption that the physical world is a simulation, a naturalist might imagine a zero-level world to be a physical universe much like, *but other than*, our own. For a theist, the zero-level world would be God's existence. Next, define a nth-level world to be a world that is created (i.e., simulated) and sustained by a world at level $n-1$. In these terms, our initial assumption states that the world we typically think of as the real world is at level k, where $k > 1$ is assumed[3]. Note that worlds with larger level-values are actually lower or sub-worlds of those with smaller level values. For our exercise, it does not matter at which level our physical world exists as long as it is at least 1.

A confusion lurks in this hypothetical that must be addressed. We should distinguish the brain in a vat scenarios as exemplified in the movie, *The Matrix*, and the type of simulated world hypothesized by Bostrom and that we are assuming as the basis of our thought experiment. In the traditional brain in a vat scenario, the brain exists at a $k-1$-level world but interacts its entire life with a k-level world. When we assume that the physical world is actually a level k ($k > 1$) world, Bostrom, adopting a physicalist position, assumes that human cognitive function relies on processes taking place within the simulation at the level that we experience (*i.e.*, the k level)[4].

[3]The corresponding assumption for the naturalist would presumably allow $k > 0$. Since I am writing from a Christian perspective and Christians are special-case theists, let $k > 1$ without loss of generality.

[4]Note, the Cartesian dualist assumes those functions are performed at level $k-1$, giving us the original brain in a vat scenario.

5.1 Approach

The discussion in the previous section above concludes that my basic premise need not drastically impact the way we should understand the universe or relate to it. However, it could be the case that a traditional Christian faith would be incompatible with the assumption; if that is the case, we want to know it. My approach to exploring this question uses the Nicene Creed as a rough and ready proxy for a statement of orthodox Christian commitments. If we can work through this creedal statement making sense of the claims within the context of my initial assumption, we can conclude that Christianity is compatible with the possibility that we are living in a simulation.

> "We believe in one God, the Father Almighty, Maker of heaven and earth, and of all things visible and invisible."

The first concern we encounter in this exercise revolves around the scope of "heaven" and "*all* things ... invisible." If heaven refers to the heavenly bodies – moons, planets, stars, etc. – then we have no problem. The creator of the simulation clearly is responsible for creating everything that exists within the simulation. This naturally includes things which may be invisible to agents within the simulation. For example, objects or events outside the range of our senses would be invisible although we might create instruments to detect such things. But this could also include the environment's *hidden state*, that no instrument could be devised to measure or detect; yet that inaccessible state is established by the simulation's creator. In both cases, the initial assumption that we are living in an kth-level simulation can be reconciled with traditional Christian beliefs by referring to the creator of our world, living at level $k-1$, as "God".

If instead, "*all* things" refers to all simulations at levels $k > 1$, then we let "God" refer to the creator of all level 1 simulations. The creedal claims about this god do not preclude any number of intervening or encapsulating worlds. This second explanation preserves our traditional picture of God at the cost of requiring God to jump through levels (at least conceptually) in order to interact with us. The first explanation makes our connection to God more direct but requires a more radical revisioning of that particular god and its place in the bigger scheme of things. Despite the greater revision of our current conceptual framework, that approach provides the more parsimonious approach. So far, either explanation could work.

> "And in one Lord Jesus Christ, the only-begotten Son of God, begotten of the Father before all worlds, Light of Light, very God of very

God, begotten, not made, being of one substance with the Father;"

We again have two ways to approach this portion of the creed. First, we can let the "before all worlds", which refers to all ages, refer to the space-time of our physical universe. This allows "one Lord Jesus" to be particular to our universe and leaves open the possibility of other Jesus-like persons appearing in other simulations that are parallel to our own. Alternatively, we can again refer to God at level zero, the creator of all level one simulations. Either explanation suffices for our purposes here, with the same qualifications mentioned above.

> "by whom all things were made; who for us men, and for our salvation, came down from heaven, and was incarnate by the Holy Ghost of the Virgin Mary, and was made man;"

For this portion of the creed, we do not encounter any serious issues to explain. We note that coming "down from heaven" must necessarily refer to a kind of movement from a level $k-1$ world to our own world. As the creator of the simulation, Jesus can arrange for his own immaculate conception and subsequently "jack in" to our world. But the assumption that we are artifacts of the simulation with Jesus interacting with us in a way analogous to a brain in a vat introduces no difficulties that do not already exist with our traditional understanding of these mysteries.

> "he was crucified for us under Pontius Pilate, and suffered, and was buried, and the third day he rose again, according to the Scriptures, and ascended into heaven, and sitteth on the right hand of the Father; from thence he shall come again, with glory, to judge the quick and the dead; whose kingdom shall have no end."

First we note that, based on our earlier discussion of the ontological status of simulations, Jesus' passion was "real" and not to be diminished in any way on account of its having been simulated (under our working premise). Objections based on this portion of the creed reflect an erroneous understanding of the distinction between simulations and the worlds that host them, rather than genuine creedal contradictions arising from the supposed simulated nature of our world.

But we also encounter a problem at the end of this portion of the creed with the claim "whose kingdom shall have no end." Clearly, if we are living in a level k world with $k > 1$, then the level $k-1$ world will come to an end. Unless we

significantly alter our understanding of time (which might be called for independently of the arguments put forth in this paper), this creedal claim seems to rule out the "many Jesus" approach to explaining things introduced above. Thus, we should fall back to the second approach in which we refer to God at the zero-level who creates and sustains all level one worlds (as well as all worlds having level number greater than one, including our level k world).

> "And in the Holy Ghost, the Lord and Giver of life, who proceedeth from the Father, who with the Father and the Son together is worshipped and glorified, who spake by the prophets."

This part of the creed presents no serious difficulties to explain. We note that two-way communication between the creator of a simulation and the simulated entities is straightforward to imagine.

> "In one holy catholic and apostolic Church; we acknowledge one baptism for the remission of sins; we look for the resurrection of the dead, and the life of the world to come. Amen."

This final portion of the creed presents no problematic issues for our premise, but in it we encounter a tool or a model for understanding the resurrection and the afterlife. The brain in a vat scenario provides numerous opportunities for thinking about a person at level k taking on a body and interacting with a world at level $k + 1$. But thinking in terms of nested simulations provides a way for understanding how a person could be "promoted" from level k to level $k - 1$. To see this, imagine a simulation in our world. This simulation models our physical world with high fidelity. Now, suppose we build a robot body that can sense, move about, and manipulate our physical world; we design this robot body with the same sensory-effector interface as exists within the simulation. Finally, imagine taking an individual from the simulation and placing it in control of the robot body. The "person" would interact with our world as we do and would gain a perspective of its prior existence within the simulation. If we imagine two successive simulations at levels k and $k + 1$, both with a foundational substrate of information, then the robotic body that is provided for the resurrected person can be indistinguishable from the bodies of persons living at level k. This presents one way to make sense of a resurrection and afterlife.

It is important not to confuse the direction of movement between levels that I'm suggesting here. This is opposite to the "immortality" that Ray Kurzweil suggests (2005). There, he imagines humans migrating to a computational platform

hosted within our physical world. As such, the human would transition to an $k+1$ level world. Such a world, however, is dependent upon our physical world (simulated or not), and therefore could not lead to immortality in the full sense of the word. My proposal in this thought experiment is that the afterlife depends on our *promotion* to a $k-1$ level world which ultimately is sustained in the mind and will of God.

5.2 Results

In this exercise, we started out by pursuing two seemingly parallel approaches to making sense of the Nicene Creed based on our initial premise that the physical world around us is actually a simulation. The first referred to God as the creator who lives in a level $k-1$ world and who created the world we experience. The second referred to God as the creator at level zero, who interacts with us through any number of levels of worlds. Although we ended up abandoning the first approach based on problems it raised with our understanding of the temporal continuum, we note that it could turn out to provide a better explanation than the second contingent on an appropriate reconceptualization of time. But our purpose at the outset was merely to examine the consequences for a Christian belief system in the case where our premise holds.

As such, there are three possible results that could obtain. First, we might find that there is no problem to be resolved whatsoever. That clearly is not the case, as we have had to stretch our understanding of creedal claims on several points. In particular, our preferred explanation treats God as our *indirect* creator who created all level-one worlds, and then relies on agents in one of those worlds to develop level-two worlds, and so on, until our particular level-k world is created.

As a second alternative, we might have found that there is no possible reconciliation with the premise. This does not seem to be the case either. The core doctrines are preserved in so far as Jesus could have *really* lived, died, rose again and ascended into heaven. Their reality and significance are not diminished because they were merely simulated events.

So our third alternative seems to be that some theory revision is necessary. To respond to a discovery along the lines of our initial premise we need to modify our understandings of "real" and "simulation" as well as of some of the creedal doctrines. The real question here is: Does such a theory revision amount to a move from geocentric to heliocentric models of our world, or is it analogous to a move from orthodox Christianity to Gnosticism? It is certainly the case that the view of simulations that I am proposing places great value on the body, and thus

does not lead to Gnosticism in particular. However, whether it leads to some other heretical position is a question for others to decide.

6 Discussion

In this paper, I have argued that we need to enlarge our view of simulations with respect to what is real and what is not. In particular, I have attempted to reconcile a traditional Christian worldview with the possibility that the world we experience is actually a simulation. This attempt could be viewed as an instance of theological exploration prompted and informed by possibilities enabled by technology (Kelly, 1999). Norbert Wiener suggests that "it is the part of the scientist ... to entertain heretical and forbidden opinions experimentally, even if he is finally to reject them" (1964). In conclusion, I want to consider what we, as Christians, gain through this exercise, what we might lose, and further implications.

I suggest that the analysis and the exercise above provide at least three benefits. One of these is better precision and accuracy in our use of the word "real" and a richer understanding of simulations. Through these reflections, we see that a simulation, taken narrowly, only makes sense with respect to some reference world that is being simulated. Given such a reference, we can talk about how faithful or accurate or useful a given simulation is. But not all virtual realities attempt to model such reference realities. Instead of focusing on simulations, we should talk about creations. Some creations will simulate processes or phenomena found in other creations and we can rightly call these simulations in the narrow sense. But other creations may establish environments with novel physics populated by agents that learn to make sense of their peculiar world.

A second benefit takes the form of a plausible Christian response if we discover that our world, the creation in which we live, is implemented on some type of computer system. This holds whether or not our world is a simulation of some reference world. Third, even in the case where our universe is not computationally sustained, the nested simulation model provides a concrete model for thinking about resurrection and the afterlife.

Although we may obtain these and other benefits, we would do well to consider what we give up in the process. As I hope to have shown above, we do not give up anything along the lines of human dignity, the goodness of God, or the meaning of life. Of course, the way we think about the universe changes significantly, but only in an analogous manner to the changes accompanying the Copernican revolution.

Finally, there are further implications to consider. Thinking more broadly about simulations may lead us to reconsider ethical issues (Moravec, 1999). If simulated agents are real agents, then we may need to exercise restraint with respect to some types of experiments we might like to run in simulations. For example, if there are things we would not do to living rats on ethical grounds, then those things would also be suspect in a simulation with simulated rats. Generally, this expanded view of simulations as computational creations leads us to think and act more responsibly with respect to simulations as well as with respect to our own universe.

For ages, humans have sensed that the world we see around us is not all there is. As real as this world is, many have the sense that there is something "more real" out there. Regardless of the underlying makeup of our universe – whether or not it is simulated – as Christians "we look for the resurrection of the dead, and the life of the world to come. Amen."

7 References

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