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A Technophilosophical Exploration of the Simulation Hypothesis and Virtual Reality Technology

A SENIOR THESIS PRESENTED
BY
PALIS PISUTTISARUN
TO
THE DEPARTMENTS OF COMPUTER SCIENCE AND PHILOSOPHY

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
BACHELOR OF ARTS WITH HONORS

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A Technophilosophical Exploration of the Simulation Hypothesis and Virtual Reality Technology

Abstract

The simulation hypothesis states that we are living in a computer simulation. That is, our reality is and always has been a simulated virtual reality. Philosophers typically classify the simulation hypothesis as a radical skeptical scenario—a scenario that brings into question our ability to have certain knowledge about the real world outside our own minds. In my thesis, I argue that our epistemological evaluation of the simulation hypothesis, as a radical skeptical scenario, depends on our metaphysical intuitions. Our metaphysical intuitions are our intuitions about the nature of reality that can fall on a continuum between two paradigmatic metaphysical views: subjective idealism and realism. Although subjective idealism may better resolve the worries of radical skepticism, subjective idealism is often seen as a radical metaphysical view.

My thesis—as a project in technophilosophy—explores the influences of VR technology on our understanding of the nature of reality. In my thesis, I argue that experiencing presence—the subjective feeling of "being there" in a virtual world—may lead to shifts in the user's metaphysical intuitions away from realism and towards idealism. To empirically test this hypothesis, I present a mixed-methods study that investigates the effects of presence in a VR environment on the user's metaphysical intuitions. In a study of 22 participants, I show that participants who experienced presence in a VR environment were significantly more open to and accepting of radical metaphysical views—such as subjective idealism—than participants who did not. I interpret the results from the study along three thematic aspects of metaphysical intuition: the nature of virtual reality, the subjectivity of reality, and the plurality of reality. I put forward a novel causal theory to explain the mechanism by which VR produces these effects on the user. Finally, I discuss the implications of these findings on our metaphysical understanding and our evaluation of the simulation hypothesis. Ultimately, I contribute early empirical evidence of the effects that VR may have on our philosophical understanding.

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To my little brother,
If this really is a simulation, I'm glad that I'm in it with you.

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1

Introduction

We usually think we know a lot of things about the real world. As I write the introduction to my thesis, I know that there is a laptop in front of me and a wooden chair on which I am seated. I know that I am currently located at a quiet café in Bangkok, Thailand and that I am a senior at Harvard College. Like the vast majority of other humans, I trust that my perceptions of the external world accurately reflect reality.

Although we tend to be confident in our knowledge about the real world, we can certainly contrive scenarios in which we would be much less confident. Philosophers of various philosophical traditions throughout time have proposed possible scenarios, known as *radical skeptical scenarios*, that undermine our ability to have any certain knowledge about the world outside our own minds. René Descartes, a 17th-century French philosopher, introduced the concept of the "evil demon" (or *Deus deceptor*) as part of his philosophical exploration (Descartes, 1641). In his seminal work *Meditations on First Philosophy* (1641), Descartes suggests that one's perception of the world may be manipulated by an all-powerful, malevolent being. This demon presents a complete illusion of the world in order to deceive one into false beliefs about reality. In such a scenario, my belief that there is a laptop in front of me would indeed be false. Although we cannot rule out the scenario put forward by Descartes, most of us are unalarmed by the possibility. Such a skeptical scenario appears improbable and contrived.

However, a more recent radical skeptical scenario proposed by philosophers—known as the *simulation hypothesis*—has reinvigorated, and in fact, reshaped interest in radical skepticism. The simulation hypothesis states that we are living in a computer simulation. Reality, as we experience it, is in fact a *virtual reality*. That is, our perception of and interaction with reality is induced by a simulated virtual world, as opposed to an independently existing physical world. Initially coined the "matrix hypothesis" by philosopher David Chalmers, the hypothesis was originally inspired by the science fiction film *The Matrix* (1999) which explores a dystopian scenario in which humans live unknowingly in a simulated virtual reality created by intelligent machines (Chalmers, 2003). The hypothesis has since then been formalized and advocated by philosophers in addition to Chalmers, most

notably Nick Bostrom (Bostrom, 2003). Moreover, the hypothesis has escalated to popular attention with the express support of tech entrepreneur Elon Musk (McCormick, 2016) and science communicator Neil deGrasse Tyson (Loria, 2016).

At the surface, it may appear that the simulation hypothesis is simply a variation on the radical skeptical scenario proposed by Descartes. The scenario seems to simply replace a demon-induced reality with a computer-induced reality. Thus, it may be tempting to dismiss the simulation hypothesis on the same grounds as Descartes' scenario—that is, it appears improbable and contrived. However, as I argue in Section 2.1, the simulation hypothesis is a distinctively plausible scenario. Not only are we unable to rule out the scenario, the existence of virtual reality (VR) technology empirically demonstrates that the technology to support such a scenario might be feasible.

VR technology refers to devices, most commonly headsets, that produce immersive environments to simulate physical presence in a computer-generated world. In a VR environment, the user feels some sense of "being there" in the virtual world even though they physically are in another world. By acting on the user's sense perception (such as visual and auditory perception) and responding to the user's action, VR technology manipulates the user's psychological sense of where they are. Since the user perceives the VR environment to be the world they are in, they subjectively experience the environment as if it were, in effect, real. Such an experience—known in the literature as *presence*—is precisely what is meant by the experience of a "virtual reality" (Slater & Usoh, 1993). That is, the world (and the things within it) is only *in effect* real, but not *in actuality* real. The level of presence induced by VR technology is rapidly progressing. Already, current state-of-the-art VR devices can induce an experience of virtual reality that closely approximates that of ordinary

reality—in other words, a very high level of presence (Gonzalez-Franco & Lanier, 2017; Schöne et al., 2023). It is possible that VR technology will soon reach a level of presence at which virtual reality is indistinguishable from physical reality. If we observe that such a technology may be possible, we can question whether another intelligent civilization has already attained it. If so, it is possible that we are living in a virtual reality right now.

As I argue in my thesis, our ability to experience virtual reality is significant—perhaps profoundly so—to our evaluation of the simulation hypothesis. VR provides a means by which we may develop our understanding of the nature of reality as it pertains to a simulated virtual reality. As VR becomes more advanced and more widely adopted by consumers, an increasing number of people will be able to experience reality in a radically different way. In this way, VR technology may present a paradigm shift in the way we understand the nature of reality and virtual reality. Thus, to predict how humans in the future will respond to the simulation hypothesis, we must understand how VR technology influences our *metaphysical* intuitions—in other words, our intuitions about the nature of reality. If we can understand how these intuitions may be altered by VR experience, we can better understand how our engagement with this increasingly plausible scenario may evolve in an era of rapid technological advancement.

This thesis presents several key contributions to the field of simulation philosophy and VR studies. Notably, I combine the approaches of experimental philosophy and human-computer interaction (HCI) to empirically investigate the effects of presence in a VR environment on our metaphysical intuitions.

1. In Chapter 2, I argue that our evaluation of the simulation hypothesis—as a radical skeptical scenario—depends on our metaphysical intuitions. I make a philosophical

argument that experiencing presence in a virtual world may shift these metaphysical intuitions towards a more idealist metaphysical view.

2. In Chapter 3, I present an empirical study that investigates the effects of presence in a VR environment on the user's metaphysical intuitions. By utilizing a mixed-methods approach, I show that participants who experienced presence in a VR environment were significantly more open to and accepting of radical metaphysical views—such as subjective idealism—than participants who did not.

3. In Chapter 4, I present an interpretation of participants' responses to understand the effects of VR experience along three thematic aspects of metaphysical intuition: the nature of virtual reality, the subjectivity of reality, and the plurality of reality. I hypothesize a novel causal theory for understanding the mechanism by which presence in a VR environment may produce these effects. I discuss the implications of these findings on our broader philosophical understanding, including that related to the simulation hypothesis.

2

Philosophical Background

Fundamentally, my thesis is a project in technophilosophy—a field of inquiry that uses philosophy to answer questions about technology and uses technology to answer philosophical questions. Technophilosophers recognize technology not only as a site of philosophical application, but as an active force in shaping our philosophical understanding of age-old questions, such as those about the nature of our reality (Bunge, 1979). My thesis is moti-

vated by the idea that VR technology can lead to substantial shifts in the way we evaluate the simulation hypothesis. This chapter aims to put forward two philosophical arguments: (1) Our evaluation of radical skeptical scenarios such as the simulation hypothesis depends on our metaphysical intuitions; (2) VR may shift these metaphysical intuitions. Moreover, this chapter aims to build a robust foundation of core philosophical concepts to support the reader's understanding of the empirical study and discussion later in my thesis.

2.1 Simulation Hypothesis

In this section, I will explain what the simulation hypothesis is and why it is worth taking seriously compared to other radical skeptical scenarios. I will argue that our metaphysical intuitions play a central role in how we evaluate radical skeptical scenarios like the simulation hypothesis.

The simulation hypothesis states that we are living in a computer simulation. Chalmers defines the simulation hypothesis as the hypothesis that "We are and always have been in an artificially designed computer simulation of a world" (Chalmers, 2022). In other words, reality is and always has been a virtual reality. I proceed with this definition of the simulation hypothesis.

As traditionally defined, a *simulation* is a dynamic representation of the operations of an existing or proposed system by means of a suitable analogue, known as a *simulacrum*. In a simulation, the properties of the simulacrum reflect that of the system it is simulating. A simple example to illustrate this understanding is the simulation of planet Earth with a globe as the simulacrum. Certain properties of the globe, such as distance and angular

position, reflect that of the Earth. The distance between Bangkok and Lima on the globe reflects the distance between Bangkok and Lima on Earth. The fact that they are antipodes on the globe reflects the fact that they are antipodes on Earth. Thus, we can understand a simulation in the general sense as a dynamic representation or imitation of some system.

In the context of the simulation hypothesis, a simulation has two important features worth noting. The first feature is that the simulation is a *computer* simulation. A computer simulation is simply one in which the representation is induced digitally. In a computer simulation, digital variables rather than physical properties reflect the system it is simulating. The simulation is driven by an algorithmic process rather than a physical process. The second feature is that the simulation is of a *world*. In other words, the represented system is an immersive, interconnected space of some sort. Some computer simulations, such as a simulation of the solution of differential equations, do not simulate a world. Other simulations, such a video game like *Minecraft*, do simulate a world—they represent an immersive space in which entities inside the space coherently interact.

Simulacrums can bear different relationships to the represented system. In *Simulacra and Simulation* (1994), Jean Baudrillard, a contemporary French philosopher, distinguishes between four different stages of simulacrum (Baudrillard, 1994). In the first stage, the simulacrum faithfully imitates the system—the simulacrum bears complete resemblance to the system. In the intermediate stages, the simulacrum bears some degree of resemblance to the system. In the fourth stage, the simulacrum bears no resemblance to the system. Baudrillard's framework in which we consider the degree of resemblance is helpful for understanding possible computer simulations of a world. A simulator could create a first-stage simulation that completely resembles their world. For us, we could simulate a

world in which the grass is green, the gravitational constant is 9.807 m/s^2, and there are 8 billion people. However, a simulator could also create a late-stage simulation that barely resembles their world. For us, we could simulate a world in which grass is transparent, gravity is nonexistent, and all people are conjoined twins. Thus, a computer simulation of a world need not bear a high degree of resemblance to the world from which the simulation originates.

These features of a simulation help to explain what it means to be in a simulation. Essentially, being in a simulation means that our experience of reality is not of a fundamental reality, but rather, of some computer-induced *representation* or *imitation* of a reality. We exist in a digitally constructed simulacrum of a world as opposed to the world itself. As beings in a simulation, our perception of and interaction with the world is mediated by a digital construct—a simulated virtual world, as opposed to an independently existing physical world. Our sensory inputs are caused by the virtual world and our physical and mental actions affect the virtual world. Through these interactions, we are immersed in the simulated virtual world.

There are several distinct variants of the simulation hypothesis, each asserting a different fact about the nature of the simulation. One distinction that is important for the purposes of my thesis is the distinction between a *pure* simulation and an *impure* simulation. As defined by Chalmers, a *pure* simulation contains only simulated elements—even the subject who experiences the simulation is simulated (Chalmers, 2022). All beings in a pure simulation exist only inside the simulation and do not have an existence outside of the simulation. On the other hand, an *impure* simulation contains elements that are not simulated. A subject who experiences an impure simulation may exist outside of the simulation and

be connected to the simulation through some VR technology. Thus, they have dual existence in the physical world as well as the virtual world to which they are connected. Since my thesis aims to tie together the simulation hypothesis with VR technology, I will focus on the impure simulation hypothesis. This view lends itself to more meaningful discussion about the possibility that we may be unknowingly living in a reality induced by advanced VR technology. The notion of a subject distinguishing between virtual and physical reality makes most sense if they have existence in both a virtual and a physical world.

There are two types of questions that are relevant for further discussing the simulation hypothesis—each of which corresponds to a broad area of philosophy. The first pertains to epistemology. *Epistemology* is the area of philosophy that concerns *knowledge* about reality; that is, the question of what we can know about reality. How do we know whether or not we are living in the real world? The second pertains to metaphysics. *Metaphysics* is the area of philosophy that concerns the *nature* of reality; that is, the question of what reality is. How do we understand what it means for a world to be "real"? In Sections 2.1.1 and 2.1.2, I discuss the simulation hypothesis from these two perspectives respectively.

2.1.1 Epistemology

Philosophers typically classify the simulation hypothesis as a radical skeptical scenario. In epistemology, *skepticism*—broadly speaking—is a view that doubts our ability to have certain knowledge.[1] Skepticism in general can apply to a specific type or aspect of knowledge; for example, moral skepticism holds that we are unable to have certain knowledge

[1] In this thesis, I adopt the account of knowledge as "justified, true belief". For a belief to amount to knowledge, the belief must be true. For example, I may hold the belief that Descartes was born in China. However, this belief does not amount to be knowledge because it is false (Descartes was born in France).

about morality. The skeptical view that is relevant to discussing the simulation hypothesis is known as *radical skepticism*. This view casts doubt on our ability to certainly know anything about the real world outside our minds. In other words, the view questions whether the external world is really as we perceive it. For example, a radical skeptic would question whether I can be certain that there really is a chair beneath me and that there really is a place known as Harvard College. In this view, a *radical skeptical scenario* is a hypothetical situation in which the certainty of knowledge about the real world is brought into question. Such a scenario, denoted *S*, undermines the certainty of our knowledge about the real world, denoted fact *F*, in the following way:

1. If I am in scenario *S*, I do not know fact *F*.

2. I am not certain I am not in scenario *S*.

3. Therefore, I am not certain I know fact *F*. (1, 2)

Several philosophers throughout time—including René Descartes (Descartes, 1641), Hilary Putnam (Putnam, 1981), and Zhuangzi (Zhuangzi, 1968)—have put forward scenarios that can evoke worries of radical skepticism. The most relevant scenarios, which I will discuss in this section, are Descartes' "evil demon" and Putnam's "brain in a vat" scenarios. It is important to recognize that, while Descartes and Putnam are often associated with radical skepticism, these two philosophers did not themselves endorse radical skepticism as a philosophical position. Rather, they employ these radical skeptical scenarios as methodological tools to reach deeper inquiry in their philosophical treatment. Both philosophers ultimately argue against radical skepticism.

Descartes introduces the concept of the "evil demon" (or *Deus deceptor*) as part of his philosophical exploration in *Meditations on First Philosophy* (1641) (Descartes, 1641). Fundamentally, the scenario is designed to bring into question the reliability of our sense perceptions as a way of acquiring knowledge about the real world. That is, the scenario questions whether the world is really as we sensorily perceive it to be. According to Descartes, our senses sometimes deceive us. For example, in an optical illusion such as the Müller-Lyer illusion, we perceive two lines to be of different lengths even though in reality they are the same lengths (Otto-de Haart et al., 1999). Since our senses can deceive us about the real world in some cases, Descartes asserts that we cannot be sure that our senses aren't deceiving us in other cases as well. He imagines a scenario in which an all-powerful, malevolent being—known as the "evil demon"—manipulates our senses in order to make us believe falsehoods about the real world. Essentially, the demon feeds an illusion to our senses such that we perceive the world differently from how it really is. For example, the demon may manipulate my senses such that I perceive that there is a chair beneath me when there isn't really one. Since I cannot be certain that I am not being deceived by an evil demon, I cannot be certain of any knowledge I have about the real world.

A related radical skeptical scenario is introduced by Putnam, known as the "brain in a vat" scenario, in *Reason, Truth and History* (1981) (Putnam, 1981). Putnam's scenario can be seen as a contemporary version of Descartes'. Putnam suggests that we may be a brain in a vat being fed electrical signals that simulate the experience of physical reality. He imagines a scenario in which an evil scientist removes a person's brain from their body and keeps it in a vat with a nutritious liquid to keep the brain alive. The neural endings of the brain are connected to a supercomputer that sends electrical signals identical to those that the

brain ordinarily receives. In this way, the supercomputer simulates a conscious experience of physical reality—thus giving the person associated with the brain the sensation of an ordinary physical reality. Like the evil demon, the evil scientist feeds electrical signals to the brain that trick us into false beliefs about the real world. For example, the scientist may manipulate the signals to the brain such that I perceive that there is a chair beneath me when there isn't really one. Similarly to Descartes' scenario, since I cannot be certain that I am not a brain in a vat, I cannot be certain of any knowledge I have about the real world.

The simulation hypothesis is analogous to Descartes' "evil demon" and Putnam's "brain in a vat" scenarios in important epistemological ways. Namely, the hypothesis undermines the certainty of knowledge about the real world. In a simulation, my senses could lead me to believe false things about the real world, and thus these beliefs would not amount to knowledge. Also, like the other scenarios, the hypothesis is unfalsifiable: I cannot be certain that I am not living in a simulation. The hypothesis cannot be refuted based on empirical evidence. Philosophers such as Chalmers argue that any empirical evidence that would refute the hypothesis fails to be conclusive because the evidence itself may be simulated (Chalmers, 2022). We can imagine that a simulator may design a simulated world such that the beings in it would incorrectly conclude they are not in a simulation. Given such a possibility, we can never conclude with certainty that the hypothesis is false. Thus, the simulation hypothesis is a scenario that falls within the domain of philosophical argumentation as opposed to empirical testing.

Although the simulation hypothesis is analogous to the other radical skeptical scenarios in many ways, I argue that it is distinctively more plausible than the other scenarios. Most of us—even the philosophers who proposed the scenarios—are ultimately unconvinced

by radical skeptical scenarios like Descartes' and Putnam's. I argue that these scenarios are implausible on both empirical and rational grounds. Empirically, there is little evidence to believe that evil demons or evil scientists with such deceptive abilities exist. We do not observe any signs that suggest these scenarios could be likely to happen. Rationally, there is little reason to justify the events in these scenarios. Many aspects of these scenarios are left unexplained and seem to defy common sense. For example, it is difficult to explain the incentives for a demon or scientist to go to such lengths to deceive us. Thus, these scenarios seem contrived and ultimately unreasonable. At the end of the day, these scenarios are usually seen as mere possibilities as opposed to plausible scenarios that we have good reason to believe in.

On the other hand, the simulation hypothesis is distinctively more plausible because there are reasons to believe that such a scenario could occur. Now, I turn to argue that VR technology empirically demonstrates the possibility of being in a simulated virtual reality. By outlining the intuitive argument for the hypothesis, I hope to convince the reader that the simulation hypothesis is not as radical as the other scenarios and therefore worth taking more seriously.

As explained in the introduction, we are now at the cusp of technological advancement across several different frontiers. Currently, we have VR technology that can simulate an experience of reality with an impressive degree of immersivity and realism (Gonzalez-Franco & Lanier, 2017; Schöne et al., 2023). Of course, today's technologies are imperfect and face several limitations that prevent completely realistic simulation. For example, VR devices are not yet able to comprehensively simulate all sensory experiences to the same degree as sight and sound (de Paiva Guimarães et al., 2022; Wee et al., 2021). Although in VR

I may have a compelling experience of seeing a beautiful red rose, I am not yet able to smell its rosy aroma or feel the prick of its thorns. Moreover, the fidelity of these sensory simulations is limited by current provisions of computational efficiency and thus fall short of the fidelity of our sense perception (Chalmers et al., 2009). Certain aspects of a virtual reality, such as resolution, color accuracy, and the intricacies of sound reproduction, often fail to capture the richness and vividness of physical reality. Lastly, the size and obtrusiveness of VR devices tends to interfere with the immersivity and suspension of disbelief (Angelov et al., 2020). In a VR headset, my head is weighed down by the device and I can touch the device to know it is there.

However, despite these current limitations on the perceived realism of VR, researchers are confident that they are not insurmountable (Cuervo et al., 2018). In the future, VR developments will likely allow us to simulate smell, touch, and taste—perhaps even additional senses (Gallace et al., 2012). Computational developments will likely allow us to achieve impeccable fidelity across these senses (Chalmers et al., 2009). Hardware developments will allow these technologies to become increasingly miniature and integrated, shrinking from headsets to contact lenses, perhaps even to brain-computer interfaces (Anthes et al., 2016). All the while, emerging technologies like generative AI will allow us to spontaneously build worlds that are not only realistic but meaningful to us in some way (Dang et al., 2023). As technology gradually surmounts these hurdles, we should expect that virtual reality can become so realistic that it is *indistinguishable* from physical reality. If it would be possible for us to one day simulate indistinguishable virtual realities, perhaps an intelligent civilization has already attained such an ability.

Once a civilization attains such an ability, there may be several compelling incentives to

adopt virtual reality as an alternative to physical reality. Perhaps the environmental conditions on their planet become so degraded that they collectively decide to start anew on a virtual planet.[2]. Perhaps the rise of virtual tourism allows frequent trips to worlds very different from their own—ones where organisms look a certain way or societies work a certain way. Perhaps individuals will simulate their past life to see how their life would turn out had their circumstances or decisions been different—had they had different friends or chosen to go to a different university, for example. Perhaps the academic world will use virtual reality as a means of simulating certain phenomena they wish to learn more about, such as human evolution, presidential elections, and the laws of physics. They may even wish to simulate curious beings to see how close they come to discovering the truth of their existence. Now, consider these aspects of your existence: the world around you, the society you are in, the interesting life decisions and world events you lived through, the thesis on simulations you are now reading. Can you be sure you are not living in a virtual reality right now?

Essentially, the development of VR technology strengthens the skeptical scenario by empirically demonstrating that the ability of simulating a virtual reality that is indistinguishable from physical reality might be possible. As the technology becomes more advanced, it becomes more difficult to distinguish virtual reality from physical reality. Moreover, the potential for its widespread use and adoption suggests that there may be reasonable incentives for someone to be placed in a virtual reality simulating the experience of physical reality. Ultimately, the observed advancement and adoption of this technology makes it

[2] This scenario is not as far-fetched as it may seem. In fact, the island of Tuvalu—in the face of rising sea levels—is currently building and uploading a virtual replica of itself to prepare for a digital future (Fainu, 2023)

more difficult to be certain that we are not in a virtual reality right now. This makes the simulation hypothesis a skeptical scenario worth taking seriously.

2.1.2 Metaphysics

As a radical skeptical scenario, the simulation hypothesis undermines our ability to have certain knowledge about the real world. The simulation hypothesis posits that reality as we perceive it is actually a simulated construct, which undermines our traditional understanding of what constitutes the "real world". However, a deeper question underlies this epistemological worry. What does it mean for something to be "real"? Clearly, how we understand what it means for a world to be real shapes our evaluation of radical skeptical scenarios like the simulation hypothesis. The branch of philosophy that is concerned with questions about the fundamental nature of reality is known as *metaphysics*. A metaphysical view posits a certain perspective on the nature of reality. I will now explain two paradigmatic metaphysical views (subjective idealism and realism) and their implications in a radical skeptical scenario.

One paradigmatic metaphysical view—one that may resolve the worries of radical skepticism—is *subjective idealism*. Subjective idealism is a radical metaphysical view that posits that reality exists only in the mind. George Berkeley, a paradigmatic subjective idealist of the 18th century, aptly captures this view in his famous phrase, *esse est percipi*: "to be is to be perceived" (Berkeley, 1881). According to this view, appearance—the world as we perceive it—*is* reality. In other words, if something *appears* to be the case (and there is no appearance to the contrary), then it really is the case. For example, if I perceive that there is a chair beneath me, then there really is a chair beneath me. Thus, the real world is entirely con-

stituted by the minds of the subjects that perceive it. For something to be real, it must be perceived as so by a conscious subject.

One can argue that subjective idealism resolves the radical skeptical worries presented by scenarios like the simulation hypothesis. Recall that in a radical skeptical scenario, we worry that the world as we perceive it may not reflect the world that really is. According to the subjective idealist, the appearance of the world amounts to its reality. Since the real world is entirely constituted by our perceptions, the world as we perceive it *is* the world that really is. In the context of the simulation hypothesis, the subjective idealist would say that the virtual world *is* the real world because we perceive it as so. On Berkeley's view, there is no such thing as an external, material world that is independent of perception. Thus, we need not worry about the gap between appearance and reality; according to subjective idealism, there is no such gap. This would imply that, in a radical skeptical scenario, we are still able to acquire knowledge about the real world based on our perceptions.

I suspect that most readers will intuitively find subjective idealism highly radical, and ultimately, an unsatisfying solution to radical skepticism. Indeed, Berkeley's subjective idealism faced much criticism from philosophers (Dicker, 2011). One of the major criticisms of subjective idealism is that it does not adequately explain the regularity in the perceived world. Indeed, this view struggles to account for the regularities—that is, consistent patterns—observed in our perceptual experiences. In the perceived world, we encounter numerous phenomena that display regularity and predictability. For example, if I leave the room and return five minutes later, the chair I was sitting on will still be there. Things behave according to a regular, predictable pattern even when there is no one there to perceive it. Berkeley explains the regularity in appearances of the world by invoking the existence of

God: the ultimate perceiver. According to Berkeley, God is the perceiver of all things—the entire world exists within the mind of God, who continuously perceives it and thus sustains it. However, many critics will be unwilling to permit Berkely's theological invocation. Ultimately, the regularity in the perceived world suggests the existence of an underlying, objective world—one that is prior to and independent of perceiving minds. This leads to an alternative metaphysical view.

Another paradigmatic metaphysical view—one that may better account for the regularity of the perceived world—is *realism*. Realism is a metaphysical view that posits that reality exists as an underlying, mind-independent world. That is, there is a material world that is prior to and external to the mind. It exists objectively, meaning it exists regardless of whether it is perceived or thought about by conscious subjects. Unlike in idealism, the mind and its contents play no role in determining the existence or properties of the real world. According to John Locke, the 17th-century English philosopher, our perceptions of the world are caused by external objects in it. Locke advanced a version of realism known as *representative realism*, which stresses that our sense perceptions *represent* material objects in the external world (Locke, 1847). In his view, these material substances have a reality beyond individual perceptions. For something to be real, it must be composed of physical matter. According to a version of scientific realism, we may understand this materiality to be atomic in nature. That is, the real world is that which is composed of atoms and subatomic particles.

Realism better accounts for the regularity of the perceived world because it posits an objective world that is prior to and independent of the mind. The objective world behaves according to its own laws, thus producing regular and consistent observations as perceived

by a conscious subject. However, realism is unlikely to resolve the radical skeptical worries presented by scenarios like the simulation hypothesis. There remains the possibility that the world as we perceive it does not reflect the world that really is. Since there exists an objective world that need not align with the subjectively perceived world, we may still worry that we are unable to acquire knowledge about the real world based on our perceptions. In the context of the simulation hypothesis, the realist would say that the virtual world is not the real world because it does not take up physical matter. If I perceive a virtual chair beneath me, the realist would say that there isn't really a chair there because the virtual chair does not take up physical matter. Since the virtual world is all we can perceive, we are unable to have knowledge about the real world—the world outside the simulation.

I suspect that most readers will intuitively find realism much more plausible than subjective idealism. Indeed, realism is by far a more accepted metaphysical view than subjective idealism in the Western academic tradition. In the 2020 *PhilPapers* Survey, which surveyed the views of over a thousand English-speaking philosophers on a variety of philosophical topics, it was found that 80% of philosophers accept realism whereas only 7% of philosophers accept idealism (Bourget et al., 2023).[3] However, while realism is prominent in the Western academic tradition, the landscape of metaphysical view is more diverse globally. In many cultures and religions, the dominant metaphysical view leans towards idealism. Certain Eastern philosophical traditions, such as the *Yogācāra* school of Buddhism and the *Advaita Vedānta* school of Hinduism, posit strongly idealist metaphysical views (Chatterjee, 1987; Indich, 1995). These metaphysical views emphasize the illusory nature of the

[3] This statistic represents the number of philosophers who accept idealism in general, so we can infer that a strictly smaller number of philosophers accept subjective idealism (since it is a specific type of idealism). The remaining 13% of philosophers accept another metaphysical view.

physical world and the primacy of perception, consciousness, and other mental content. The diversity of metaphysical views across cultures highlights that reality is not a universally agreed upon concept.

Although we tend to think of our personal metaphysical view as fixed, there is evidence that these views can shift rather substantially. Several empirical studies show that individuals can adopt changes in their metaphysical view in response to transformative experiences such as near-death experiences (Greyson, 1983), hypnosis (Lynn & Evans, 2017), meditation (Josipovic, 2010), and psychedelic drug-induced experiences (Lerner & Lyvers, 2006; Nayak & Griffiths, 2022; Nayak et al., 2023; Timmermann et al., 2021). For example, the study led by Timmermann et al. (2021) found that psychedelic drug use can induce lasting shifts in metaphysical views away from realism and towards idealism. Therefore, we should think of these metaphysical views as personally held *intuitions* that can shift in response to certain experiences.

In this section, I have laid out the idea that our evaluation of radical skeptical scenarios like the simulation hypothesis is shaped by our metaphysical intuitions. For the purposes of my thesis, I understand a metaphysical intuition to fall on a continuum between the two paradigmatic metaphysical views: subjective idealism and realism. We can understand a metaphysical intuition in terms of the *primacy* it confers to mind versus matter in the account of reality:

- An *idealist* intuition stresses the primacy of subjective perception over objective existence;
- A *realist* intuition stresses the primacy of objective existence over subjective perception.

In the following section, I build on this picture by arguing that experiencing presence in a VR world can lead to shifts in metaphysical intuitions.

2.2 Virtual Reality

In this section, I will explain the concept of *virtual reality*. I will make a theoretical argument that experiencing virtual reality, as induced by VR technology, may lead to shifts in the user's metaphysical intuitions away from realism and towards idealism.

According to the Oxford English Dictionary, the word "virtual" has had the meaning of "being something in essence or effect, though not actually or in fact" (OED, 2022). In the context of describing a reality, it suggests that a virtual reality is in effect real though not in actuality real. At first glance, this seems to be an oxymoron: In what sense can something be real in effect but not in actuality? My goal in this section is to develop a philosophical understanding of virtual reality and its relationship to reality more generally.

It is important to distinguish between virtual reality as an experience and virtual reality (VR) technology. Today, virtual reality is ubiquitously associated with technological devices like headsets; indeed, VR technology induces the experience of a virtual reality. However, virtual reality as an experience stands independently from the technology. In fact, theoretical interest in virtual reality emerged from the discipline of theater, long before the advent of VR technology (Artaud, 1958). Many scholars stress the importance of maintaining a definition of virtual reality in terms of the subject's experience. That is, it is important to consider "virtual reality [not as] technological constructs but as cultural constructs... [not as] a set of technologies but as an experience" (Reid, 1996). This distinction allows us

to also engage with the virtual realities, in a more general sense, produced by movies, games, and other media. Throughout this thesis, I will distinguish between the experience and the technology by explicitly referring to the technology as "VR technology".

Virtual reality can be understood from the perspective of the subject experiencing it. In *The Theater and Its Double* (1958), the French artist Antonin Artaud coined the expression *la réalité virtuelle* (virtual reality) to characterize the nature of theater (Artaud, 1958). Artaud explains that theater creates a "fictitious and illusory" world in which characters, objects, and images depicted effectively constitute a reality (Artaud, 1958). In theater (as in movies and games), characters inhabit their own reality—their own world or realm. To characterize this reality as *virtual* implies that the reality has the *effect* of reality—that is, it *appears* to the audience as if the scene were real—but the reality falls short of *actual* reality—that is, it is not a part of the audience's physical reality. In this sense, *virtuality* can be seen as a domain in which something can exist. Myeung-Sook Yoh, an influential VR scientist at Stanford, explains that "virtuality, together with actuality, forms the two ways objects can exist" (Yoh, 2001). On Yoh's account, we can distinguish between two realities. A virtual reality is a reality in which objects exist virtually—they exist only in effect. Actual reality, in contrast, is one in which objects exist actually—they are actualized as part of our reality. In my thesis, I will use the term "physical reality" instead of actual reality to avoid the prejudiced implication that our reality is the only genuine reality.

In the context of a headset-induced virtual reality, several conditions characterize the experience of virtual reality. Chalmers defines a virtual reality in this context as an "immersive, interactive, and computer-generated space" (Chalmers, 2022). *Immersive* means that the virtual world perceptually surrounds the subject; they are situated at the perspectival

center. *Interactive* means that the world responds to the user's actions; there is a two-way relationship between the perceiver and the virtual world in which one affects the other. *Computer-generated* means that a computer (usually a VR headset) is responsible for inducing and sustaining the appearance of the world. These conditions allow the virtual reality to achieve or simulate the *effect* of physical reality. These condition also distinguish headset-induced virtual reality from that induced by theater, movies, and non-VR games.

Just like in the experience of physical reality, when we experience virtual reality, the world acts on our sense perception in an immersive manner and responds to our actions. As a result of this manipulation, one has the effect of "being there" in the virtual world, as if they were physically there. This effect, as mentioned earlier, is known in the literature as *presence*. Jonathan Steuer, a prominent communication theorist at Stanford, argues that "the key to defining virtual reality in terms of human experience rather than technological hardware is the concept of presence" (Steuer et al., 1995). Whereas immersion is an objective feature of the VR technology, presence is strictly a subjective experience. As such, the concept of presence in VR tracks the extent to which the *subjective* experience of a virtual reality approximates that of physical reality—in other words, how "real" it feels.

Now, I turn to present a theoretical argument that experiencing presence in a virtual world, as induced by VR technology, may lead to shifts in our metaphysical intuitions away from realism and towards idealism. Suppose a user enters a fully immersive virtual world and experiences presence. Per the definition of presence, they subjectively perceive that they are "there" in the virtual world as if they were physically there. During this experience, they have the perception of reality—they intuitively sense that they are really there in the virtual world. However, at the same time, they have the knowledge of its virtuality—they

intellectually know that they are interacting with a virtual construct and that their senses are being manipulated by the device. Yet the virtual world is more immediate and salient than the physical world in the subject's experience of reality. This may prompt the subject to recognize the degree to which their discerned reality is constituted by the appearance of a world as opposed to material existence. In other words, the subject realizes the central role that perception plays in shaping their immediate reality. This may lead them to intuitively confer more primacy to the mind of the subjective perceiver over the matter of an objective world in their account of reality. That is, the subject adopts a more idealist (and less realist) metaphysical intuition. In essence, experiencing presence in a virtual world empirically demonstrates the weight of idealism in relation to realism in accounting for their experience of virtual reality.

Although I believe my theoretical argument is plausible, it so far remains an *a priori* hypothesis that requires rigorous empirical verification. This directly motivates the empirical study presented in the next chapter.

To recapitulate the philosophical arguments put forward in this chapter:

1. Our evaluation of the simulation hypothesis—as a radical skeptical scenario—depends on our metaphysical intuitions. (Section 2.1.1)

2. Experiencing presence in a virtual world—as induced by VR technology—can shift our metaphysical intuitions. (Section 2.1.2)

3. Therefore, VR technology can shape how we evaluate the simulation hypothesis. (1, 2)

The goal of the empirical project in the next chapter is thus to empirically test the cor-

rectness of premise 2. That is, I aim to test whether the intuitive gravitation towards a realist metaphysical view (and the intuitive pushback against an idealist metaphysical view) may be altered by VR experience. In doing so, I hope to explore whether these metaphysical intuitions may be more malleable and culturally influenced than we imagine. If the above premises are correct, we can conclude that VR technology can shape how we evaluate the simulation hypothesis.

3

Empirical Study

In this chapter, I present an empirical study of the effects of VR technology on the user's metaphysical intuitions. In designing and conducting this study, I adhere to established standards and practices of mixed-methods research in the field of human-computer interaction (HCI) (Van Turnhout et al., 2014). I situate my contributions in the body of existing work in the human-VR interaction literature, particularly that related to presence.

The methodology incorporates a user-centered procedure, ensuring that participant responses are at the forefront of the study. As a mixed-methods study, the study combines both quantitative and qualitative data collection methods in order to uncover the diversity across and nuance within the participants' perspectives. By rigorously following these HCI research standards, I hope to ensure the reliability and validity of the study's finding as much as possible.

3.1 Motivation

As discussed in the previous chapter, my investigation is primarily motivated by a philosophical problem. In investigating the empirical effects of VR technology, my goal is to demonstrate—with empirical results from real participants—that VR technology can influence our metaphysical intuitions and, by implication, our responses to the simulation hypothesis. However, understanding the effects of VR technology on our metaphysical intuitions is significant and consequential beyond simulation philosophy. Indeed, developing a big-picture understanding of VR technology—as with any technology—is fundamental to evaluating the ethical, epistemic, and aesthetic implications of its deployment on individuals and societies. It should be of no surprise that rapidly advancing technologies have the potential to reshape very fundamental views we hold—sometimes for better and sometimes for worse. For example, AI, especially generative AI, may reshape our understanding of intelligence and creativity. Blockchain technology may reshape our understanding of ownership and democracy. Social media may reshape our understanding of communication and friendship. It seems entirely possible that VR technology may reshape our understand-

ing of the nature of reality. The most important questions to ask are: How? How much? Why?

Over the last decade or so, there has been a meteoric rise in commercial VR technology (Bailenson, 2018). Increasingly high-performing and price-accessible VR products continue to be released into the market, allowing consumers to become users of a novel technology. For example, Apple recently released the Vision Pro headset—the company's first venture into VR products (Apple, 2024). Many experts on VR have come forward to claim something to the effect of "virtual reality effectively blurs the line between reality and illusion" (Bailenson, 2018). However, to my knowledge, these claims are based on the *a priori* speculations of academics rather than the empirical experiences of everyday VR users (Heim, 1993). Despite the hefty claims touted by some VR experts, relatively little is known about the empirical impact of VR on metaphysical views related to reality and virtual reality. Although much academic attention has been directed towards the physiological and psychological effects of VR, we are still uncertain about how these effects manifest at the level of the user's philosophical ideas, intuitions, and beliefs. My work aims to contribute to bridging this gap in the literature on the effects of VR. In doing so, I hope to bring VR researchers towards a more comprehensive understanding of the effects of VR across all dimensions.

To the best of my knowledge, no study has yet investigated the effects of presence on the user's metaphysical intuitions. I imagine that this lack of academic attention is due to several reasons. Philosophy is generally regarded as a territory of esoteric subject matters—I imagine this is particularly the case among researchers employing empirical approaches to technology. VR researchers may instinctually defer the philosophical discussion of VR to

expert philosophers rather than aim to learn about the philosophical reactions of lay users. However, this line of reasoning misses the value of experimental philosophy. Many philosophical views—metaphysical views no less—are developed by intuition and consensus. As VR continues to be adopted at a large scale, such insights are valuable for predicting how the dominant philosophical views may change. Another possible reason for the lack of attention is that the effects on philosophical views seem abstract, unquantifiable, and difficult to operationalize beyond anecdotal accounts. Philosophers who study these views theoretically may be reluctant to employ an empirical or statistical approach in their studies. Although these difficulties are worth considering, my study demonstrates that it is certainly possible—indeed fruitful—to operationalize the effects of VR on philosophical views.

In this study, I investigate the following research question: How does experiencing presence in a VR environment affect the user's intuitions about the nature of reality? Based on the results of the study, I show that users who experienced presence in a VR environment are significantly more open to and accepting of radical metaphysical views, such as subjective idealism, than users who did not.

3.2 Related Works

Here, I provide a succinct survey of related literature on two core aspects of my study. First, I survey the literature on the effects of VR technology according to the psychophysiological model of presence. Secondly, I survey the empirical literature on changes in metaphysical views caused by non-VR experiences such as psychedelic drug use. In many ways, these related works capture existing knowledge on my independent variable (presence in VR)

and dependent variable (changes in metaphysical intuitions), in anticipation of my study connecting the two variables.

3.2.1 Presence in VR

My empirical research can be categorized into a subfield of HCI known as human-VR interaction (Slater & Wilbur, 1997). Researchers of human-VR interaction aim to understand the relationship between the user and the VR device, environment, and experience (Bowman & McMahan, 2007). Key research topics include the design and development of VR interfaces (Sutcliffe et al., 2019); the implementation of innovative interaction techniques (Ashtari et al., 2020); and the application of VR to solve user problems in healthcare (Blandford, 2019), education (Gordon & Brayshaw, 2022), and other domains. Most pertinently to my thesis, human-VR interaction researchers aim to understand the effects—physiological, psychological, and behavioral—of VR technology on users (Slater, 2009). These researchers endeavor to build and test an accurate model for understanding the ways in which users' bodies and minds process and react to virtual reality, particularly in contrast to physical reality.

Many researchers have dedicated their efforts to studying the effects of VR technology on the user's physiology and psychology. Researchers generally understand that the various physiological, emotional, and behavioral effects of VR experiences are mediated by the psychological concept of *presence* (Slater & Usoh, 1993). It is the means by which "a virtual experience can evoke the same reactions and emotions as a [physical] experience" (Schuemie et al., 2001). While I earlier explained the concept of presence in the philosophical sense, it is also a psychological construct based on a theoretical model that has been

empirically tested in the HCI literature. Presence—the subjective sense of "being there" in a virtual environment—has strong cognitive correlates. The subjective experience of presence arises from cognitive processes such as multisensory integration (correlation across multiple modes of sensory perceptions); spatial awareness (registering one is enveloped in a space); and attentional allocation (focusing one's attention on coherent stimuli, activities, and events) (Schuemie et al., 2001). Together, these cognitive processes contribute to a subjective sense of "being there" in the depicted environment. Based on this theoretical understanding, several factors have been identified to underlie the level of presence felt. Several researchers have proposed a framework for understanding the determinants of presence that is widely accepted in the literature (Slater & Usoh, 1993; Witmer & Singer, 1998; Steuer et al., 1995). These factors that contribute to presence can be categorized as follows:

- **Fidelity**: the degree to which sensory perceptions are rich and high-quality;
- **Agency**: the degree to which the user can control, influence, and interact with their environment;
- **Realism**: the degree to which the sensorial inputs and world mechanics are true to life[1];
- **Embodiment**: the degree to which the user identifies with their virtual body;
- **(Lack of) Distraction**: the degree to which objects and events in the physical world distract the user from the virtual environment.

[1] Although sometimes grouped together, realism is distinct from fidelity. A user may experience a virtual world to be high in fidelity but low in realism (e.g., a vivid but cartoonish world).

Since the concept of presence is defined on subjective experience, researchers typically operationalize and quantify the degree of presence with a self-report questionnaire. The most widely used questionnaire, by far, is the Witmer and Singer Presence Questionnaire (WSPQ) (Witmer & Singer, 1998). Developed by psychologists Jonathan Witmer and Michael Singer, the WSPQ has come to be accepted as the standard for measuring presence in the VR literature. The questionnaire comprises 32 questions that are answerable on a subjective Likert scale to indicate agreement or disagreement (Witmer & Singer, 1998). Researchers have also condensed the presence questionnaire into a questionnaire with fewer items (Usoh et al., 2000) or even a single item (Bouchard et al., 2004) for brevity and efficiency.

Although presence is inherently subjective, it produces many physiological, behavioral, attitudinal, and emotional effects that can be objectively measured and directly observed. These effects have been well-documented and studied in the literature. Researchers generally agree that these effects of VR are best understood according to a psychophysiological model of VR experience (Martens et al., 2019). According to this view, physiological responses to virtual environments map to psychological or emotional states and processes. Indeed, many studies have shown that presence in a VR environment can arouse a range of intense psychological and emotional reactions akin to physical reality. For example, VR experiences can elicit fear and anxiety in response to height and public speaking (Gromer et al., 2019; Slater et al., 1999). Gromer et al. (2019) shows that the level of presence participants report predicts the intensity of their fear responses. VR can elicit more positive emotional responses as well, including excitement, relaxation, and happiness—all of which are shown to be related to self-reported presence (Diemer et al., 2015).

Researchers agree that presence in a VR environment can induce complex psychological reactions, such as changes in body ownership, empathy, and implicit bias. VR can elicit a strong psychological sense of *embodiment*—defined as the "sensations that arise in conjunction with being inside, having, and controlling a [virtual] body" (Kilteni et al., 2012). In embodiment of a virtual body, VR users form the impression of ownership and control of their virtual body, akin to a "phantom body", through multisensory correlation. This effect is known to facilitate perspective-taking, leading to observable changes. Studies have shown that occupying the body and perspective of a marginalized individual in VR can increase empathy for and decrease implicit bias against women (Seinfeld et al., 2018), black people (Peck et al., 2013), and elderly people (La Rocca et al., 2020). These psychological changes result in attitudinal and behavioral changes. For example, aggressive men—after taking the perspective of a female abuse victim in VR—became significantly better at recognizing fear in women's faces (Seinfeld et al., 2018).

These emotional and psychological states are often linked to the physiological effects that they induce. There have been multiple studies that show users' bodies react to VR environments in much the same way as they do to physical reality. These reactions to VR experiences tend to be much more pronounced when compared to flatscreen experiences. When a user experiences presence in a VR environment, many physiological indicators—such as heart rate (HR), heart rate variability (HRV), electroencephalography (EEG), skin conductance, electrodermal activity (EDA), and skin temperature—are almost indistinguishable from those in physical reality (Martens et al., 2019). These effects have been observed in both stressful and relaxing VR environments. A study showed that height exposure in a VR environment elicited a mostly identical stress response to height expo-

sure in ordinary reality on a physiological level (HRV and EEG) (Schöne et al., 2023). A similar study showed that height exposure on a VR elevator stimulated skin conductance and other stress responses (Martens et al., 2019). Stress responses to VR experiences are usually more intense than stress responses to flatscreen experiences. For example, players of horror games in VR showed a significantly larger increase in EDA and decrease in skin temperature compared to players on a flatscreen device (Clavero Jiménez et al., 2018). Although these physiological effects are measured in response to stressful VR environments, similar results are also observed in response to relaxing VR environments. Several studies have shown that relaxing VR environments—such as virtual meditation or virtual nature scenes—are very effective at mitigating physiological markers of stress and anxiety (Roo et al., 2017; Tarrant et al., 2018).

My survey of the human-VR interaction literature shows that researchers in this field have reached a thorough theoretical and empirical understanding of the effects of VR. Various studies have shown that VR indeed has far-reaching psychological and physiological impacts; it influences the user at various levels, including the emotional, behavioral, and attitudinal levels. In forming a theoretical interpretation of these results, the psychological construct of presence is key. The idea that the user subjectively registers themselves present in the VR environment explains the observations that their body and mind processes virtual reality similarly to physical reality. Piecing together these findings, researchers arrive at a model for understanding VR in which cognitive processing of virtual stimuli produces observable effects.

Although VR researchers have undoubtedly made some remarkable progress, we are still lacking a key part of the picture. Still little is known about how presence in a VR environ-

ment affects the user's philosophical views and intuitions. The philosophical dimensions of VR effects—such as philosophical thoughts, ideas, reflections, beliefs, and questions in response to being present in a VR environment—has been left largely unexplored. These effects may be internal (thoughts inside the user's head), verbalized (beliefs that the user utters or endorses), or observable (changes in the user's behavior). Even though we know that, in many ways, the user's mind and body processes virtual realities as if they were physically real, we are still unsure how this sensation of reality manifests in the user at the more abstract, intellectual level. My study aims to bridge this gap in the existing literature—all the while accounting for the role of presence and other psychological foundations of VR as established in the literature.

3.2.2 Metaphysical Views

Another significant source of literature I draw upon is the study of metaphysical view changes in response to non-VR experiences, most noticeably psychedelic drug use. Much experimental evidence has demonstrated that lay people hold implicit metaphysical views and intuitions about the nature of the physical world (Demertzi et al., 2009; Forstmann & Burgmer, 2015) and the role of mind and matter in relation to reality (Reggia et al., 2015; Stanovich, 1989). Furthermore, anecdotal accounts and studies have shown that individuals can adopt changes in these metaphysical positions in response to radically transformative experiences such as near-death experiences (Greyson, 1983), hypnosis (Lynn & Evans, 2017), meditation (Josipovic, 2010), and psychedelic drug-induced experiences (Lerner & Lyvers, 2006; Nayak & Griffiths, 2022; Nayak et al., 2023; Timmermann et al., 2021). Out of these experiences, psychedelic drug use has received the most academic attention.

Unlike those of VR, the effects of psychedelic drugs on philosophical views—particularly metaphysical views—are rather well-studied. Multiple studies have shown that the use of psychedelic drugs alters metaphysical views (Lerner & Lyvers, 2006; Nayak & Griffiths, 2022; Nayak et al., 2023; Timmermann et al., 2021). Specifically, these studies show that psychedelic drug use leads users to adopt and endorse more idealist (i.e., less realist) metaphysical views. For a long time, it has been anecdotally documented and popularly assumed that psychedelic drug use can induce spiritual transformations associated with altered metaphysical views. However, this claim was never empirically tested until these studies were conducted. These researchers operationalize the notion of metaphysical view change with the use of novel questionnaires such as the Metaphysical Beliefs Questionnaire (Timmermann et al., 2021) and the Core Metaphysical Beliefs questionnaire (Jylkkä et al., 2024). These questionnaires assess participants' metaphysical views by asking them to rate their agreement with a number of statements along a Likert scale. The statements are designed to articulate various metaphysical positions in a jargon-free and accessible manner for non-philosophers. Participants' responses in the questionnaire can be compared either by question or in aggregate.

A survey of the literature shows that metaphysical views can indeed be changed by transformative experiences such as psychedelic drug use and that these changes can indeed be operationalized and assessed with a well-designed questionnaire. These findings are promising indications that an analogous experiment can be performed for VR experience. They provide insightful precedence and guidance on the design of the questionnaire for my study.

3.3 Method

To investigate how presence in a VR environment affects the user's metaphysical intuitions, I designed a between-subjects, mixed-methods study in which participants engaged in an identical activity—either in a VR headset or on a tablet—and subsequently reported on their metaphysical intuitions in an interview and a questionnaire. In developing my method, I had the following hypothesis:

Hypothesis 1 (H1): *Participants in the VR condition would be more open to or accepting of radical metaphysical views (such as subjective idealism) than participants in the non-VR condition.*

In this section, I explain in detail the method that was employed in the study to test this hypothesis and uncover further insights.

3.3.1 Participants

I recruited 22 participants to take part in the study. Potential participants were invited to fill out an interest form for study participation through a student mailing list at Harvard College. Out of the 26 potential participants who filled out the form, 22 reported that they had little to no prior experience with or knowledge of VR technology. These participants were selected in order to test lay users' initial experience of a VR environment. The views of more experienced VR users may be shaped by technological and philosophical narratives they have been exposed to prior to the study. All selected participants volunteered to take part in the study and completed all components of the study.

The recruited participants were undergraduate students at Harvard College and represented a diverse and balanced demographic. In terms of gender identity, 12 participants identified as female; 9 participants identified as male; and 1 participant declined to report their gender. The ages of the participants ranged from 19 to 26 years with an average of 21.7 years. The participants studied a wide range of disciplines, with 5 majoring in the natural sciences; 6 in the social sciences; 4 in the arts and humanities; 5 in the engineering and applied sciences; and 2 in interdisciplinary studies. The diversity of academic interests indicates that the study includes the perspectives of individuals from various intellectual backgrounds.

3.3.2 Experiment Design

The experiment had a between-subjects design in which the participants were randomly and evenly assigned to one of the two following conditions:

- **VR condition (P1–P11)**: The participant used a state-of-the-art VR headset with fully immersive capabilities. In order to maximize the participant's level of presence, the VR experience employed a 360-degree head-mounted display, high-fidelity, photorealistic graphics, spatial audio, responsive haptic feedback, precise head movement tracking, and advanced hand tracking for interactivity. The participant can move their head around to get an immersive view of the environment. They can use the hand controllers to interact with the environment. These immersive features serve to maximize the determinants of presence (as discussed in Section 3.2.1) during the activity.



Figure 3.1: An illustration of the VR condition (left) and the non-VR condition (right). (Source: BRINK Traveler, retrieved from https://www.brinkxr.com).

- **Non-VR condition (P12–P22)**: The participant used a flatscreen tablet with minimal immersive capabilities. Unlike in the VR condition, the non-VR experience lacked the 360-degree head-mounted display and the other features that provide immersivity and interactivity. The participant can move the tablet around to get a flatscreen view of the environment. They can tap on the screen to interact with the environment. The absence of immersive features serves to minimize the determinants of presence during the activity.

An illustration of the two conditions is provided in Figure 3.1.

3.3.3 Materials

The VR device used in the VR condition was the Meta Quest 3; the tablet device used in the non-VR condition was the iPad Pro (6th generation). These devices were recently released in 2023 and 2022 respectively, ensuring a computationally comparable experience and software support for the activity. For the VR condition, the Meta Quest 3 was chosen

since there is substantial research supporting the immersive performance of its predecessor: the Quest 2 (Abdlkarim et al., 2024). Moreover, many non-academic reviews of the Quest 3 praise its ability to induce a high level of presence (Pierce, 2023).

The activity that participants engaged in was an interactive exploration of a nature scene in a virtual travel app called BRINK Traveler (BRINKXR, 2024). The app—available on and compatible with both devices used—transports the user to beautiful natural travel destinations such as Horseshoe Bend in Arizona, USA; Pulpit Rock in Norway; Navagio Beach in Greece; and Mount Cook in New Zealand. Users can walk around the scene, exploring the destination and interacting with it such as by throwing rocks off a cliff, wading through the water, and drawing on the sand. Participants were tasked to collect at least 3 postcards—a feature in the app that requires users to comprehensively explore the scene.

This activity was chosen for a few reasons. Multiple online sources claim that the app provides one of the most realistic environments they have ever encountered in virtual reality (No-Dot-3992, 2022). The app, and many of its reviews, describe the depicted environments as "photorealistic" (realistic akin to a photograph) (BRINKXR, 2024). Photorealism is vital as it is one of the foremost determinants of presence. Moreover, the content of the activity is relevant to the hypothesis I am testing. We tend to think of the beautiful wonders of nature as an inimitable aspect of the physical world that is hard to capture in photographic or virtual rendering. Thus, attempting to capture the natural beauty of physical reality prompts participants to reflect on the comparability of virtual reality to physical reality. Lastly, the app provides a directly comparable experience between the VR version and the tablet version, ensuring experimental validity in comparing the two conditions.

A single-item measure (i.e., "Did you feel present in the environment, as if you were re-

ally there?") was used to assess the level of presence experienced by the participants. This measure served as a manipulation check to confirm that the participants experienced the intended level of presence for their condition. In terms of measuring the effects on metaphysical intuitions, I conducted a semi-structured interview and administered a questionnaire. I designed the interview questions to be open, non-leading, and subtle in uncovering the participants' metaphysical views. The questionnaire I used to assess the participants' metaphysical intuitions was an original questionnaire I formulated for the study—designed to measure an individual's openness to or acceptance of radical metaphysical views. I will call the questionnaire the Metaphysical Intuitions Questionnaire (MIQ). In the MIQ, I consider the degree to which participants' intuitions are open to or accepting of possible, radical metaphysical views, such as:

- **The subjective idealist view of reality**: What is real is ultimately determined by subjective experience rather than objective existence (akin to subjective idealism, as discussed in Section 2.1.2).
- **The possibility of multiple realities**: There may be multiple, equally valid realities; for example, alternate realities and virtual realities in addition to "our reality".
- **The relativity of reality**: Many aspects of reality are arbitrary or culturally defined and are not fixed or absolute.
- **The genuineness of virtual reality**: Virtual reality is a genuine form of reality and is metaphysically and ethically comparable to physical reality.
- **The obscurity of reality**: Much of reality is unknown or unknowable and we cannot rule out speculative hypotheses such as the simulation hypothesis.

Table 3.1: Examples of radical and traditional metaphysical views.

Radical metaphysical views	Traditional metaphysical views
Reality is determined by subjective experience.	Reality is determined by objective existence.
There may be multiple valid realities.	Our reality is the one true reality.
Some aspects of our reality seem arbitrary.	The nature of our reality seems absolute.
Virtual reality is genuine reality.	Virtual reality is an illusion.
Reality is inherently mysterious.	Reality can be understood rather well.

Table 3.1 offers some examples of statements indicating radical and non-radical (i.e., traditional) metaphysical views. Note that not all of these statements were used in the MIQ.

The MIQ consists of 13 metaphysical statements to which participants were asked to rate their agreement or disagreement on a 1–7 Likert scale. The statements in the questionnaire anticipate potential metaphysical intuitions facilitated (or counteracted) by VR technology. The questionnaire includes both radical statements and traditional statements, as reverse-coded questions to reduce response bias. The questionnaire was administered after the interview per general recommendations that more direct assessments be conducted after indirect assessments.

3.3.4 Procedure

Each study session—which was conducted individually—comprised 30 minutes of completing the activity, followed by about 15 minutes of answering the interview questions and completing the questionnaire. In the VR condition, the participant was first instructed to have their interpupillary distance measured using a facial scan app. Participants were given a short tutorial on how to wear the headset. I then worked with the participant to strap on and adjust the VR device onto the participant's head to ensure comfort, security, and clar-

ity of vision. I provided basic instructions on how to navigate the user interface and how to use the hand controllers. A boundary was drawn in the room to prevent physical collisions and ensure the safety of the participant. When the activity was introduced, I played a short video demonstrating the features of the BRINK Traveler app and how to use it.

In both conditions, participants were encouraged to "think out loud" as they were engaging in the activity in order to facilitate spontaneous verbal observations. These verbal observations were noted down. After the activity was completed, participants were asked to rate the level of presence they experienced. In the interview and questionnaire that followed, participants were encouraged to "go with your gut" and "not to overthink" the questions in order to obtain the participants' authentic intuitive responses. With the participant's permission, the interview was audio-recorded for subsequent analysis. At the end of the study, participants were thanked for their time.

3.3.5 Data Collection and Analysis

I analyzed the participants' responses during the interviews to uncover consistent themes (thematic analysis) across participants' thoughts, experiences, and realizations following the activity. Moreover, special analytical attention was paid to the language and word choices of participants as these may subtly reveal their metaphysical mental model of reality.

The participants' responses to the questions in the questionnaire were recorded along a 7-point Likert scale. After data collection, this was standardized to a centered scale from -3 to 3, with positive values indicating openness to/acceptance of radical metaphysical views, 0 indicating neutrality, and negative values indicating closedness to/unacceptance of radical metaphysical views. Responses to non-radical statements were reversed to suit this scale.

Thus, an overall questionnaire score can be calculated by summing the individual scores. For example, if a participant *strongly agreed* with the statement "Perception is reality" (3) and *moderately disagreed* with the statement "Something about our physical reality feels absolute" (2), their overall score would be $3 + 2 = 5$.

For my data analysis, given that Likert scale data is generally considered ordinal data, I compare median values and use the Mann-Whitney U test to determine statistical significance. Likert scale data represents ordered categories rather than true interval data. The Mann-Whitney U test is appropriate for analyzing such ordinal data, as it assesses the likelihood that a randomly selected score from one condition is greater than a randomly selected score from another condition. Moreover, unlike parametric tests such as the t-test, the Mann-Whitney U test does not assume a normal distribution—an important factor since the participants' scores did not follow a normal distribution.

3.4 Results

The presence measure indicates that all participants in the VR condition experienced a substantial level of presence in the VR environment. All participants in the condition strongly agreed or agreed that they did "feel present in the environment, as if [they] were really there". Meanwhile, all participants in the non-VR condition experienced a minimal level of presence in the environment depicted on the tablet. All participants in the condition strongly disagreed that they felt present in the environment. Verbal observations also confirmed that the conditions had the intended effects: most participants in the VR condition ($n = 7$) spontaneously uttered that the experience felt real (e.g., "It feels like I'm actu-

ally here") during the activity, whereas no participants made such remarks in the non-VR condition. Here I present both quantitative and qualitative results from the study. Both suggest that participants in the VR condition exhibited more open-minded and accepting metaphysical intuitions following presence in the VR environment.

3.4.1 Questionnaire Results

The results show that the participants in the VR condition scored significantly higher than the participants in the non-VR condition in the MIQ. I calculated a participant's overall questionnaire score as described in Section 3.3.5. Across both conditions, the overall questionnaire score ranged from -15 (P13) to 24 (P6). The analysis revealed that participants in the VR condition were, on average, more open to or accepting of the radical statements. The median overall score in the VR condition is 16, suggesting participants, on average, agreed with the radical statements. Meanwhile, the median overall score in the non-VR condition is 0, suggesting participants, on average, felt neutrally about the statements in the questionnaire. The Mann-Whitney U test revealed that the difference in the overall questionnaire scores between the two conditions is statistically significant ($p = .01$).

When comparing the medians at the level of individual questions, I found that participants in the VR condition, on average, exhibited more open or accepting intuitions than participants in the non-VR condition on 11 out of 13 questions. The median scores for each question is provided in Table 3.2, which compares the medians between the two conditions. To determine statistical significance, I first performed factor analysis to determine latent factors in the questions. Each factor represents a set of thematically related questions whose scores tend to co-vary together. These factors provide a way to meaningfully aggre-

Table 3.2: A comparison of median scores for individual questions between the two conditions.

Question	Statement	VR median	Non-VR median
1	Our reality is the one true reality.*	0	1
2	Perception is reality.	2	1
3	Many aspects of our reality are arbitrary.	2	1
4	Reality is fundamentally subjective.	2	1
5	Parallel universes or alternate realities may exist.	2	0
6	Our subjective consciousness plays a fundamental role in shaping reality.	3	2
7	There may be multiple valid realities.	2	1
8	Virtual reality is genuine reality.	0	-2
9	Reality may be a simulated or virtual reality induced by a computer.	1	-1
10	I can lead an equally meaningful life in a virtual reality.	-2	-2
11	Something about our physical reality feels absolute.*	-1	-2
12	The nature of reality is inherently mysterious.	2	1
13	The advancement of virtual reality technology may influence what reality means to us.	3	2

Note: * indicates a reverse coded question.

gate data to arrive at a larger sample size for testing significance. Performing factor analysis on correlations with 3 factors revealed that almost every question on the questionnaire strongly correlated ($r > .6$) with one of three factors and can be categorized according to these factors. Only one question (Q12) was not strongly correlated and was conceptually unrelated to other questions in its factor; I thus excluded it from further analysis according to these factors.

The grouping of questions by factors seems to reveal three underlying themes in the questions. These themes form a basis for meaningful discussion of these results in the next chapter. Questions in Factor 1 seem to concern the comparison between virtual reality and physical reality. Questions in Factor 2 seem to concern the role of perception and subjectivity in relation to reality. Questions in Factor 3 seem to concern the plurality of reality and the possibility of alternate realities. As in calculating the overall questionnaire score, I calculated the score for a given factor by summing the scores for questions in that factor. The median scores for each factor is provided in Table 3.3, which compares the medians between the two conditions.

I performed the Mann-Whitney *U* test to determine the statistical significance of the differences between the two conditions in their responses to the questions in each factor. The test revealed significant differences in the responses to Factor 2 questions ($p = .02$) and Factor 3 questions ($p = .002$). The test revealed a marginally significant difference in the responses to Factor 1 questions ($p = .09$).

Table 3.3: A comparison of median scores for each factor between the two conditions.

Factor	Statements	VR median	Non-VR median
1	Virtual reality is genuine reality. I can lead an equally meaningful life in a virtual reality. Something about our physical reality feels absolute.* The advancement of virtual reality technology may influence what reality means to us.	0	-4
2	Perception is reality. Many aspects of our reality are arbitrary. Reality is fundamentally subjective. Our subjective consciousness plays a fundamental role in shaping reality.	7	4
3	Our reality is the one true reality.* Parallel universes or alternate realities may exist. There may be multiple valid realities. Reality may be a simulated or virtual reality induced by a computer.	4	1

Note: * indicates a reverse coded question.

3.4.2 Interview Results

When assessing and comparing the participants' responses during the interview, several qualitative findings emerged. I identify key themes in the participants' verbal responses—many of which closely aligned with themes uncovered through factor analysis on the questionnaire responses. The thematic differences between the two conditions illuminate the effects of VR on the user's metaphysical intuitions as manifested in their verbal tendencies, realizations, and reflections.

One key thematic difference is the relationship between perception and reality, particularly as it pertains to objects in virtual reality. Participants in the VR condition tended to factor the sensory perceptions of virtual objects into subjective judgments of reality, whereas participants in the non-VR condition tended to maintain an objective distinction between the perceived and the real. When asked to describe their understanding of virtual reality, participants in the VR condition tended to focus on the subjective experience of the user and the effect of reality experienced by the user. Participants described virtual reality as what "seems real", "looks real", "appears real", "feels real", or something to that effect. Participants also focused their remarks on the reactions of the user to this perceived reality: P1 described virtual reality as being "trippy" to the user—implying that their sense of reality is manipulated or distorted in some way. Others mentioned that the user might "buy into the world they experience" (P8) and "act accordingly" (P2), implying that their sensation of and interaction with a virtual world amounts to a certain subjective reality. On the other hand, participants in the non-VR condition tended to emphasize the objective features of virtual reality, with little sensitivity to the subjective effects these features might have on a

perceiving user. For example, participants described virtual reality as a technology with "realistic graphics" and described the content of VR as a "program" that "imitates the physical world".

This theme pertaining to the distinction between virtual reality and physical reality is further evidenced in the participants' linguistic characterization of physical reality. Participants in the VR condition were more likely to qualify or clarify their reference to physical reality, whereas participants in the non-VR condition tended to reference physical reality without additional nuance, relying on assumptive language. When asked to contrast virtual reality and physical reality, participants in the VR condition tended to add nuanced qualifiers to clarify that they were referring to physical reality. Out of the 11 participants in this condition, 7 referred to the reality outside of VR as "physical reality", "material reality", or "normal reality". In comparison, only 3 out of the 11 participants in the non-VR condition used such nuanced clarifiers. The other participants referred to physical reality simply as "reality" without additional qualification.

A related thematic difference evidenced in the participants' interview responses is plurality versus singularity. Participants in the VR condition were more likely to pluralize reality ("realities") whereas participants in the non-VR condition were less likely to do so. When referring to virtual reality and physical reality collectively, participants in the VR condition tended to conflate the two concepts together with the plural form "realities". Out of the 11 participants in this condition, 4 participants pluralized reality as in generalizing phrases like "both realities" or "many realities". On the other hand, only one participant in the non-VR condition linguistically indicated a pluralization of reality. The rest maintained the singularity of reality (to denote physical reality) and spoke of virtual reality in separate terms.

A final thematic difference is the emotional and philosophical content in the participants' language. Participants in the VR condition tended to express concern and excitement for the potential consequential impacts of virtual reality whereas participants in the non-VR condition tended to indicate less interest in this regard. When asked about the future of virtual reality, using the recently released Apple Vision Pro as a demonstrative case, participants in the VR condition tended to adopt more emotionally and philosophically charged language to describe the foreseeable ethical and metaphysical implications of VR technology. For example, two participants in this condition, P2 and P5, described that they found the "[blurring]" of realities "scary", suggesting that they feared the implications of the growing metaphysical legitimacy of virtual reality. P5 compared the effects of advanced VR to that of a "drug", suggesting the far-reaching psychological effects of VR on how we think about the nature of reality. Other participants, such as P3, P4, and P11, saw the developments as "exciting" or "fascinating", expressing a sense of enthusiasm for the transformative potential of virtual reality. P6 recognized these implications rather explicitly in metaphysical and ethical terms:

> "[This technology] makes me question what is real and what is not. And if we can actually manufacture reality to this degree so far, and if it will just get better, [it brings into question] so many things we cherish because we think they're real."

A few other participants built on the idea that VR technology can "construct" (P11) a new reality and represent a "new world" (P9). One participant, P1, characterized the existence of VR technology as "very meta," suggesting they view virtual reality as an inherent reality within physical reality. The intense reactions and speculations of users in the VR

condition suggest that they view VR as a technology with significant metaphysical implications.

4

Discussion

In this chapter, I provide a detailed discussion of the results of the empirical study in relation to the hypothesis and the motivating philosophical problem. Based on the results of the study, I put forward a novel causal theory for understanding the mechanism by which VR may influence the user's metaphysical intuitions. I discuss the various implications that the emergence of advanced VR technologies may have on our philosophical engagements,

particularly with regards to the simulation hypothesis. I also discuss the limitations of the study and present clear future directions for further research to build upon these preliminary findings.

4.1 Interpretation

The results of the empirical study suggests that VR experience may have effects on the user's metaphysical intuitions. The results on both the questionnaire and the interviews support the hypothesis that experiencing presence in a VR environment alters the user's metaphysical intuitions. We can generally interpret this finding in one of two ways. The first interpretation is that presence in VR makes the user *more open* or *more accepting* towards radical metaphysical views (i.e. the nature of a subjective, plural reality). In this interpretation, we understand the user's response as affirmation of possible radical metaphysical views. Thus, this interpretation is a *positive* interpretation that leads to a stronger conclusion of the effects of presence on the user's metaphysical intuitions. Alternatively, the second interpretation is that presence in VR makes the user *less certain* or *less confident* about traditional metaphysical views (i.e. the nature of an objective, singular reality). In this interpretation, we understand the user's response as skepticism of existing traditional metaphysical views. Thus, this interpretation is a *negative* interpretation that leads to a weaker conclusion of the effects of presence on the user's metaphysical intuitions. Given that the study was the first of its kind, I am cautious not to imply the stronger conclusion until we have further evidence to support it. Instead, I prudently proceed with the interpretation that VR experience, at least, makes users less sure about traditional understandings of real-

ity, and possibly, could lead to affirmation of more radical understandings.

The factor analysis and the thematic analysis suggests that the effects of virtual reality extend beyond a general sense of metaphysical understanding, instead affecting specific aspects of the participants' metaphysical intuitions. These aspects are the comparability between virtual reality and ordinary reality, the subjectivity of reality, and the plurality of reality. Examining these aspects individually sheds light on the nuances of the effects of VR technology on the user's metaphysical intuitions.

4.1.1 Nature of virtual reality

The marginally significant difference in the responses to Factor 1 questions—statements related to the nature of virtual reality compared to physical reality—suggests that presence in a VR environment leads users to be more accepting of (or less resistant to) the metaphysical and ethical significance of virtual reality. VR users are more likely to recognize some equivalence between the subjective experience of virtual reality and physical reality, and thus the comparability between the two forms of reality. In other words, direct experience of presence in a VR environment may facilitate the user's spontaneous reflections on the nature of virtual reality. The perceived realness of the VR environment seems to open up users to the idea that virtual reality shares more similarities with physical reality than previously imagined. Perhaps their perception of and interaction with a virtual world allows them to realize the ways in which virtual reality is analogous to physical reality. Of course, this does not mean that the VR user will believe that virtual reality is genuine reality or on par with physical reality; the difference between the two conditions was only marginally significant. However, it seems that these users tend to be more sensitive to their similarities as opposed

to dismissive to virtual reality (that it is an "illusion") entirely.

The findings from the interviews also support the interpretation of increased openness to or consideration of the comparability between virtual and physical reality. As described in Section 3.4.2, participants in the VR condition more often qualified their reference to physical reality. This suggests that they perceive virtual reality and physical reality to be similar enough as to warrant verbal distinction. According to the Gricean maxim of manner, conversational agents strive to maximize linguistic clarity and minimize ambiguity (Grice, 1991). The fact that many participants in the VR condition qualify their reference to physical reality reveals their intuition that virtual reality is also a form of reality; their qualification thus serves as disambiguation. Meanwhile, the fact that few participants in the non-VR condition felt the need to add such qualifications reveals their intuition that physical reality is the only true form of reality; thus no linguistic nuance or disambiguation is warranted. This difference may reflect a fundamental contrast in the ways the two groups recognize and classify virtual reality versus physical reality in their respective mental models.

4.1.2 Subjectivity of reality

The significant difference in the responses to Factor 2 questions—statements related to the subjectivity of reality—suggests that presence in a VR environment leads users to be more sensitive to the role that subjective perception plays in making sense of their reality. The experience of presence within a virtual environment may contribute to a heightened recognition of the notion that one's subjective perceptions fundamentally shape one's reality. The perceived realness of the VR environment, in contrast with the knowledge that the environment is not physically real, may prompt the user to question the relationship between

perception and reality. Given the subjective resemblance of virtual reality to physical reality, users may consider placing more emphasis on the mental content of the perceiving subject over material existence in an objective world. The user's placement at the perspectival center in a VR environment positions them as the subject of VR experience, thus highlighting the role the perceiving subject takes in constructing their own experience of reality. Their knowledge that a physical reality exists outside of the virtual reality is a point of contrast that may allow them to identify that it is the perceived virtual environment that is most immediate and salient to their experience. Thus, their perception of and interaction with a virtual reality may allow them to directly experience the intuitiveness of an idealist and subjectivist metaphysical view.

The findings from the interviews also support the interpretation of increased openness to or consideration of the subjectivity of reality. As described in the Section 3.4.2, participants in the VR condition tended to describe VR in terms of the subjective experience of virtual reality whereas participants in the non-VR condition tended to emphasize the objective technological features. The difference in emphasis may reveal a fundamental contrast in the conceptualization of reality as it pertains to virtual reality. The VR participants' focus on the effects of virtual reality on the user (that it "seems real") suggests that the perceptual experience of the user amounts to a certain subjective reality which, in the context of a VR environment, is more immediate than the objective physical reality. This supports the idea that directly experiencing a VR environment heightens the user's sensitivity to the primacy of perception in shaping one's experience of reality. In contrast, the non-VR participants' emphasis on the technological capabilities of VR suggests an objective conceptualization of VR around its ability to "realistically" mimic the physical world, as opposed

to the subjective experience of the VR user. In this view, virtual reality is merely an imitation or a derivative of a physical reality, as opposed to a reality with a distinct metaphysical quality. This suggests a stronger attachment to a realist view of reality, with less regard for the subjective mental effects on the perceiver, among the non-VR participants.

4.1.3 Plurality of reality

The significant difference in the responses to Factor 3 questions—statements related to the plurality of reality—suggests that presence in a VR environment leads users to be more open to the idea that a plurality of realities can structurally coexist. That is, users may be more likely to realize that the structure of reality may extend beyond their singular, immediate experience and encompass a multiplicity of coexisting alternate realities. It seems that participants who experienced presence in a VR environment are more able to comprehend or imagine the way in which multiple realities might coexist. Since a virtual reality, in many ways, represents an alternate reality that coexists with physical reality, their experience of virtual reality may have altered their mental model by which they make sense of the structure of reality. Perhaps some participants take the virtual reality they experienced, alongside their physical reality, to demonstrate the possibility of this plurality. This supports the idea that VR experience may shift the user's mental model on the structure of reality—resulting in one that more readily admits plurality. It seems that directly experiencing VR can draw out the distinction between reality as the aggregate of everything that exists, versus reality as a particular world or realm. VR experience may introduce a metaphysical paradigm in which many (virtual) realities exist, encompassed within a broader (physical) reality. As a result, users may be less sure about a monistic view of reality (that "our reality is the one true

reality"), instead opening up the possibility for a plurality of coexisting realities.

The findings from the interviews also support the interpretation of increased openness to or consideration of the plurality of reality. As described in the Section 3.4.2, participants in the VR condition more often pluralized the noun, "realities". The language here suggests a difference in underlying metaphysical intuitions. By the principle of cognitive economy, individuals tend to organize concepts in a way that is cognitively efficient; this can involve the extension of semantic meaning to encompass related instances within a broader category (Rosch, 1975). The pluralization of "realities" as a linguistic shortcut may indicate that virtual reality and physical reality are recognized as comparable entities and are thus semantically grouped together. It may reflect that VR participants tended to view "virtual reality" and "physical reality" as members of the broader category of "reality" due to shared membership attributes. Meanwhile, the preference for a singular "reality" may signify that participants in the non-VR condition tended to conceptualize virtual reality and physical reality as distinct entities; their commonalities are not sufficient to justify pluralization. This difference may reflect a contrast in their underlying mental models on the structure of reality. It suggests that VR participants were more comfortable conceptualizing reality as a pluralistic metaphysical structure, or at least were less sure about the nature of the singular reality.

4.1.4 Causal Theory

Given the interpretation I have laid out thus far, I henceforth hypothesize a novel causal theory to explain the mechanism by which presence in VR may produce these various effects on metaphysical intuition. My formulation of this theory draws upon my interpreta-

tion of all aspects of the empirical study, as well as psychological and philosophical literature discussed earlier in my thesis.

When a user enters a highly immersive and realistic VR environment, they feel an inherent tension between their *perception* and their *knowledge*. In line with the concept of *presence*, they subjectively *perceive* that the environment around them is real—that they are really there in that reality. In terms of perception, they recognize the resemblance and comparability between the immediate virtual reality and the physical reality they ordinarily experience. However, they also *know* that the environment they perceive does not exist in the physical reality that is objectively shared by the world outside the VR device. This tension is registered by the user and thus prompts the user to resolve the tension through cognitive adjustments pertaining to their conceptualization of "reality". In order to recognize the perceived parallel between virtual reality and physical reality, they transfer emphasis from that placed on objective materiality to subjective perception. Such a conceptualization of reality accommodates the subjective equivalence or resemblance between virtual reality and physical reality with respect to the perceiver. The possible result is a mental model that classifies virtual reality alongside physical reality as parallel forms of reality, thus positioning the immediate reality as one of multiple realities. The resulting model permits the pluralization of reality, as in the plurality of coexisting virtual reality and physical reality (and possibly other realities too).

This theory explains the different metaphysical themes observed in the study. The initial recognition of the comparability between virtual reality and physical reality explains the results that virtual reality was perceived as more metaphysically comparable to physical reality in the VR condition than in the non-VR condition. The transfer of emphasis towards

the subjective perceiver explains the results that more conceptual emphasis was placed on subjective perception of a reality in the VR condition than in the non-VR condition. The resulting mental model, which positions the user's immediate reality as one of many realities, explains the results that participants were more open to the possibility of multiple co-existing realities in the VR condition than in the non-VR condition. In this way, the theory explains how VR experience can either *introduce* new ways of thinking about the nature of reality—or at the very least—*challenge* and *complicate* existing ways of thinking about the nature of reality.

The hypothesized theory unites the different aspects of the effects of presence in VR on metaphysical intuition in a causal, and possibly temporal, relationship. It explains how the cognitive effects of VR, like presence—as previously studied in the literature—can ultimately manifest at an intellectual level. Of course, the causal theory is still a conjecture, and many of its aspects invite further empirical testing and corroboration with existing psychological theories. Given the preliminariness of the evidence, I will discuss some vital future directions to build upon this evidence in Section 4.4.

4.2 Implications

My thesis, as a project in technophilosophy, aims to use empirical evidence to predict the long-term impact of VR technology. In this section, I hope to explicitly draw out, with substantiating empirical evidence from the study, some of the implications of advanced VR technology on our future philosophical understanding.

4.2.1 Metaphysical Understanding

Technology forms no small part of the ways we make sense of our reality at the metaphysical level. Thus, we may expect the rapid advancement and adoption of VR technology to shape our individual and collective notions of reality. The results from the empirical study fundamentally suggest that VR technology alters our metaphysical intuitions—either by introducing new intuitions or challenging old ones. I'm careful not to suggest that VR technology will certainly change our beliefs on the nature of reality. Instead, what I argue VR may do is that it may open us up to possibilities of metaphysical understanding that, without it, we would be less likely to take seriously. These include the possible understandings of the nature of virtual reality, the subjectivity of reality, and the plurality of reality. As such, we should take seriously the idea that VR does not passively reflect existing philosophical thought—rather, it represents a new and growing force that may actively open up philosophical possibilities and shape philosophical understanding and discourse.

Currently, there is a conception that VR devices are "illusion machines" that distort one's experience of reality in some way (Chalmers, 2022), or that they are escapist vehicles that transport one away from ordinary reality (Siricharoen, 2019). In my view, this negative conception of VR—that it somehow "takes away" from reality—fails to properly recognize the philosophical implications of the technology. Namely, these associations about VR technology do not recognize the ways in which the technology may positively *construct* a new reality or *introduce* a new way of experiencing reality. As suggested by my study, we ought to be mindful of the effects of VR technology that manifest in the users' metaphysical intuitions. We should pay attention to these effects and closely examine the subtle ways

in which socially agreed-upon understandings of reality may be revised or complicated as a result. Adopting a positive conception of VR—one that takes into account the possible construction and introduction of a new form of reality—enables us to accurately predict and explain the trajectory of philosophical thought and consensus. In my personal view as a philosopher, I believe we may predict a shift in the way we view reality in relation to the subjects and objects of perception and interaction. As more people spend more time in virtual reality, and as VR technology improves in its ability to induce presence, we might expect decreased emphasis on *our* reality, and increased emphasis on *one's* reality.

VR technology may provide a means by which one can construct and control one's reality independently of preexisting physical reality. The openness to these metaphysical possibilities allows VR technology to literally construct and shape the user's lived experience along ethical and aesthetic dimensions. In the future, we can imagine that VR technology may serve to liberate individuals from the constraints of physical reality—whether from their physical environment or their physical body. Already, we see that VR technology is being used in service of people living with inhibitory circumstances, such as disabled people (Weiss et al., 2003), incarcerated people (Nadkarni et al., 2021), or elderly people (La Rocca et al., 2020). Virtual reality has been used to provide people with disabilities with enriched experiences that they would not traditionally be able to fully access, such as travel (Iftikhar et al., 2023), social interaction (Montoya-Rodríguez et al., 2023), and entertainment (Weiss et al., 2003). For people who are incarcerated, virtual reality offers an opportunity to access experiences that are otherwise prohibited by physical and legal constraints (Nadkarni et al., 2021). In this way, VR technology can be seen as a means of ethical enhancement.

Moreover, from an aesthetic perspective, VR technology may also provide a means by

which the individual can curate and construct aesthetic experiences that transcend physical possibilities. Philosophers of aesthetics, such as Oscar Wilde, argue that art serves to rewrite and reimagine the mundanity of physical reality. In "The Decay of Lying," Wilde contrasts his account of art against the natural world, which he sees as dull, incomplete, deficient, and fundamentally inferior to art (Wilde, 1889). The physical world as it is given to us, according to Wilde, "has no suggestions of [its] own," so our aesthetic experiences of the physical world are inherently crude, common, and uninspiring (Wilde, 1889). The deficiency and inferiority of physical reality thus invites us to reimagine and remake its mundane existence through artistic practice. Aesthetic VR experiences exemplify Wilde's account of art as the imaginative reconstruction and elaboration of our given physical reality. The advent of virtual worlds allows us to literally reprogram the constraints of physical reality to produce novel aesthetic experiences. Many artists have already taken advantage of this opportunity, leveraging VR technology as a medium to create fantastical, otherworldly realities (Ornes, 2022). If we open up to the metaphysical legitimacy of virtual reality, artists may also embrace virtual reality as a metaphorical canvas for aesthetic expression.

If we, as a society, open up to the legitimacy of these virtual realities and the validity of these subjective experiences—as shown may be possible in the study—we may see increasing use of VR as a means of negotiating with the ethical and aesthetic constraints imposed on certain individuals or communities by the physical world. Ultimately, people's experience of reality may not be as inhibited or constrained by the givens of physical reality in the advent of advanced VR technology. Such considerations should also inform our judgments and processes in other disciplines in order to establish the most pertinent and meaningful economic, legal, and societal frameworks around virtual reality. Although it is beyond the

purview of my thesis to accurately assess how these effects of VR will intersect with other practical dimensions, I hope to draw attention to the pertinence of these related disciplines in relation to VR advancement and adoption.

4.2.2 Simulation Hypothesis

Since my thesis is motivated to better understand our philosophical engagement with the simulation hypothesis, I aim to explicitly draw out the implications of the emergence of VR technology on our evaluation of this radical skeptical scenario. Indeed, these implications are speculative in nature; however, these speculations might allow us to make more informed predictions about the future of this philosophical hypothesis.

As argued in Section 2.1, our evaluation of the simulation hypothesis depends on our metaphysical intuitions—that is, our views on the nature of reality and what constitutes reality. Fundamentally, the results of the study suggest that the metaphysical intuitions that are central to evaluating the simulation hypothesis—particularly our inclination towards a realist metaphysical view—may be more malleable than we imagine. If subjective experience of VR can indeed shift these metaphysical intuitions, we would have reason to believe that these metaphysical intuitions are at least partially shaped by the cultures and technologies we are exposed to in the present era. Thus, our evaluation of and engagement with the simulation hypothesis may change with time.

If our metaphysical intuitions do shift towards idealist intuitions—that is, we place more primacy on subjective perception in the determination of reality—we may predict that our epistemological evaluations will shift as well. Namely, the worries presented by the simulation hypothesis, as a radical skeptical scenario, may be received differently. If our subjec-

tive perception and experience of reality amounts to a sort of reality (as is the case under the view of subjective idealism), the hypothesis that we live in a virtual reality could be less threatening to our ability to have knowledge about the real world. In other words, we may decide—after experiencing the perceived "reality" of virtual reality—that the simulation hypothesis does not undermine our knowledge about reality to the same degree, or in the same way, as previously imagined. Of course, this shift in perspective would not resolve certain worries that we might have about a hypothetical simulation (e.g., Who made the simulation?). However, it may relieve certain skeptical worries we might have about the reality—or, rather, illusoriness—of the perceived world.

As VR becomes increasingly advanced and widely adopted, perhaps we will also open up to the plausibility of the simulation hypothesis. I suspect that many readers may find the simulation hypothesis counterintuitive because they do not imagine that virtual reality can replicate the richness and vividness of the reality in which we find ourselves. However, as virtual reality becomes more proximate to and indistinguishable from physical reality, it becomes easier to imagine that our physical reality can be approximated by a virtual reality. This implication reflects Chalmers' idea that VR offers a tangible metaphor for thinking about the simulation hypothesis (Chalmers, 2022). In a sense, presence in a VR environment allows users to comprehend or imagine our reality being a simulated virtual reality. The experience of VR may directly demonstrate the possibility of simulating a detailed world via a computer. Thus, users are more able to make the connection and realize the analogy between the VR interface and our larger perceptual interface through which we experience our physical reality. The facilitation of such a realization *opens us up* to the possibility of a scenario that would otherwise be hard to take seriously. Thus, the rapid ad-

vancement and adoption of VR technology may facilitate consideration—perhaps even endorsement—of the simulation hypothesis.

4.3 Limitations

In presenting the results and interpretation of the empirical study, I recognize that there are limitations in the methodological and interpretive approaches employed. In this section, I will detail some of the limitations and the ways in which they may impact the validity or generalizability of the findings presented.

One of the significant limitations is the relatively small sample size and the potential selection bias in the narrow demographic represented in the participants. Participants in the study represented college-aged individuals who study at a highly selective college. Due to limited time and resources in recruiting for the study, it was difficult to include a larger sample size with more diverse participants. This limitation may prevent us from generalizing the findings to all individuals who may be potential users of VR technology. Research shows that technological acceptance varies by age (Hauk et al., 2018); thus, we may be unable to extrapolate these findings to other age groups such as older adults and younger kids. It is also possible that younger people are more likely to have radical world-view shifts than older adults. Moreover, since the participants are all students at a college that selects for intellectual vitality, they potentially possess intellectual inclinations that are more pronounced than individuals outside this demographic. In other words, they may be more open or sensitive to the philosophical aspects of VR or are more able to express its effects through the interview and the questionnaire. Thus, the effects of VR on intellectual

outlook may be specific to certain demographics of users that were overrepresented in the study.

Another significant limitation is that the study only focused on individuals with little prior exposure to and knowledge of VR technology. It may be possible that the observed effects are strong in the introduction of a new technology but taper off as the user becomes more familiar and experienced with VR technology. Thus, the observed effects may not be generalizable to users with more exposure to VR and it cannot be assumed that these effects will be sustained as the user becomes more familiar with the technology.

Another significant limitation is that the questionnaire relied on subjective self-reporting on abstract, ambiguous concepts that participants may not be familiar with, such as "reality" and "perception". Since it was not feasible to educate and inform all participants on the philosophical concepts mentioned in the questionnaire, participants were free to interpret the terms in the sense most intuitive to them. This means that participants may have differing or unclear interpretations of these terms. Moreover, given the nature of Likert scale data, there is inherent subjectivity in the responses spanning "strongly disagree" to "strongly agree". As a result of this limitation, the observed effects may not reflect sustainable philosophical beliefs or discourse. Well-formed philosophical beliefs require careful thought about and definition of concepts. Moreover, for these beliefs to develop into meaningful discourse, we require some degree of agreement on the definitions of these terms. Thus, these questionnaire responses should not be taken as indications of well-formed, sustainable philosophical beliefs. Rather, we should recognize them as preliminary intuitions occasioned by VR experience that may or may not be reflective of more substantial philosophical engagements.

Another significant limitation is that of the interpretive approaches employed in analyzing the interview responses. Given the nature of qualitative responses to interview questions, the analysis is dependent on the psychological frameworks applied in the interpretation. Although I have thoroughly familiarized myself with the psychological and linguistic theories invoked in my discussion, I recognize that these theories themselves have limitations and may be misleading in certain interpretations. Thus, I invite further discussion of these interpretations and further corroboration with other psychological and linguistic frameworks in the literature.

4.4 Future Directions

There is much room for further exploration and validation of the effects of VR technology on metaphysical intuition. Here, I propose several future directions to build upon and validate the results and interpretations presented.

Firstly, we should replicate the study with a larger sample size and across a more diverse participant demographic. A future study should focus on the effects of VR on participants much older or younger than the college-aged participants represented in this study. This will allow us to understand the generalizability of these findings to age groups with generally different relationships to technology. A future study should include participants with different educational backgrounds. This will allow us to understand how and whether these effects on the users' intellectual outlook can be generalized to individuals who have not been surrounded by a highly intellectual environment. Moreover, a future study should include participants with more exposure to VR technology, or examine the

longer-term effects of VR as the user becomes more familiar with the technology. This will allow us to understand whether these initial effects taper off after continued exposure to VR or whether these effects are sustained.

Secondly, we should conduct a similar study with a different approach to assessing and measuring the participants' metaphysical intuitions. Instead of a questionnaire that relies on subjective self-reporting to highly abstract statements, we could concretize the statements by describing a concrete scenario or specifically referencing the virtual experience they had. This would allow us to learn how these metaphysical intuitions may manifest in more concrete scenarios. Another approach to qualitative assessment would be to hold a guided discussion in a focus group. The presence of other participants would mimic a more naturalistic setting for sharing intellectual views, thus allowing participants to develop and share their reflections following the VR activity in a more natural manner. The facilitation of discussion would also allow us to learn how these metaphysical intuitions can go on to influence interpersonal dialogue—bringing us one step closer to understanding the social and discursive implications of these findings.

Thirdly, we should continue to investigate successive generations of VR technology, such as the newly released Apple Vision Pro. Given the rapid advancement of VR technology, there are generational hardware and software developments that allow the latest VR devices to provide increasing levels of presence in a VR environment. Thus, we should replicate the study and other variants of the study on the latest technology to understand how the effect size changes with increasing levels of presence induced. Accounting for the iterative nature of VR development will allow us to more accurately comprehend the implications of the rapid development of VR technology.

More generally, we should continue to investigate the intersection of VR and philosophical thought through a combination of both theoretical and empirical approaches. As mentioned in Section 3.2, HCI researchers of VR tend to refrain from engaging with more abstract philosophical theory, whereas philosophers of VR tend to refrain from taking an empirical, quantitative approach to this study. As I have shown in my thesis, we may uncover novel insights through the integrative approaches of HCI and experimental philosophy. This may represent a relatively unexplored territory at the intersection of the two disciplines; I invite more scholars to contribute to bridging the gap that exists between technological and philosophical literature through an integrative scholarly approach.

4.5 Conclusion

In this thesis, I explore the ways in which VR may influence our metaphysical intuitions, particularly in the evaluation of the simulation hypothesis. I am motivated to understand, from both a philosophical and empirical standpoint, the effects and implications of the user's experience of presence in a virtual world on such philosophical understanding. My empirical study suggests that experiencing presence in a VR environment can alter the user's metaphysical intuitions—as subjectively reported in the questionnaire and verbally reflected in the interviews. I also contribute an interpretation of the nuances of these effects pertaining to the nature of virtual reality, the subjectivity of reality, and the plurality of reality. I propose a novel theory that links these effects on metaphysical intuitions in a cognitive and causal relationship. Moreover, I discuss the possible implications of these findings on future philosophical understandings of reality and virtual reality.

This work serves as early evidence that VR may influence our intuitions about the nature of reality, including those that are central to evaluating the simulation hypothesis. These effects, by implication, may even come to impact our responses to radical skeptical scenarios like the simulation hypothesis. Despite its current limitations, my work demonstrates that we should take seriously the idea that VR technology does not merely reflect metaphysical views but may indeed actively shape them. As such, my work presented in this thesis is a preliminary demonstration of the influence of VR technology on the philosophies of individuals and societies. The fruitfulness of this work calls for further inquiry and collaboration between scholars of computer science and philosophy on the metaphysical significance of virtual reality. Ultimately, through further technophilosophical inquiry, I hope that we can continue to understand, predict, and mitigate the impact of emerging technology on humanity's collective philosophical project.

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