

**EXPLORING THE PHENOMENOLOGY OF SELF AND OTHER
EMBODIMENT OF THE VIRTUAL SELF, USING
IMMERSIVE VIRTUAL REALITY**

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Abstract

Immersive Virtual Reality (IVR) has emerged as a novel tool to experimentally study the sense of body ownership (feeling that my body belongs to me) and bodily self-awareness (agency, I am the initiator of my actions) using virtual worlds and bodies (i.e. avatars). Recent studies have shown that embodiment of a White participant in a Black avatar can reduce implicit racial bias. However, no study to date has drawn on a sample of Black participants to explore and measure embodiment experiences or changes in attitude using IVR. Furthermore, only a handful of IVR studies have used qualitative methods to explore the in-depth subjective experience of virtual embodiment. Guided by Embodied Cognition Theory, this study aimed to explore subjective experiences of female and Black-identifying participants (n=8) embodying another raced virtual body using IVR. Semi-structured qualitative interviews and quantitative psychological questionnaires were used following an IVR experience. Quantitative data was (only) used at superficially level to aid in qualitative descriptions. Drawing on Braun and Clarke's reflexive thematic analysis, three main themes were identified, namely: (1) self-awareness; (2) embodiment experiences; and (3) other-awareness. Participants reported a complex interplay between embodiment experiences and emotion in creating a sense of self in the context of the other in the virtual environment. Interestingly, topics around race were not organically shared by the participants during the interviews. Furthermore, qualitative accounts elicited much richer narratives on embodiment compared to the quantitative questionnaire to include experiences around the 'digital divide' (i.e., first-time experiences with IVR), place illusions (i.e., strong illusion of being in a specific place despite not being there), plausibility illusions (i.e., illusion that IVR and events are real) and hybrid racial identities (i.e., the "coconut effect"). The results of the study call for increased diversity in IVR research to include more representative samples and to integrate qualitative methods to understand the complex processes involved in studying embodied self-awareness using IVR.

Keywords: Embodiment; Self-awareness; Other awareness; Race; Immersive Virtual Reality.

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Abbreviations

Abbreviation	Meaning
CCTV	Closed-Circuit Television
HMD	Head Mounted Display
IVET	Immersive Virtual Environment Technology
IVR	Immersive Virtual Reality
LSM	Living Standards Measure
MBI	Mirror Box Illusion
MPS	Minimal phenomenal selfhood
MTBA	Machine To Be Another
RSE	Rosenberg Self Esteem
S.O.E	Sense of Embodiment
S.W.O.T	Strengths, Weaknesses, Opportunities, Threats
VR	Virtual Reality

Chapter 1 : Context of Study

1.1 Introduction and Background

Historically, Rene Descartes (1955) proposed that the mind and body were two separate entities, stemming from a concept regarded as the cartesian dualism. Descartes argued that the distinction between mind and body presented itself in purported differences in their nature, structures, and functions (Berrios, 2018; Yablo, 2005). On the one hand, Descartes viewed the mind as a unit, inseparable, intellectual, un-extended, immaterial, soul-containing, and therefore separate from the body (Mohammed, 2012). He viewed the body as being able to be distinguished by various parts, extended, material, and unthinking (Mehta, 2011).

The now famous debate on mind-body dualism has largely discredited Descartes's assumptions. More specifically, the theoretical viewpoints of embodied cognition have recently emerged which poses that those bodily processes (e.g., sensory and motor) are interlinked with cognition and emotion (Borghi & Carauna, 2015; Damasio, 1994; Shapiro, 2019). Cognition is therefore viewed as a product of an organism's environment and the body it inhabits (Borghi & Carauna, 2015; Shapiro, 2019; Wilson & Golonka, 2013). In essence, it is believed that states of the mind are influenced by environmental and bodily states (Wilson & Golonka, 2013). Therefore, it may be argued that the body helps engage in metacognitive aspects of behaviour such as self-awareness, from the experiences of being in the body and interacting in that body with others. In psychological studies, this self-awareness may be linked to factors such as personality, attitudes, beliefs, and identity (Duval & Wicklund, 1972; Li et al., 2021).

Satre (1956) argued individuals primarily 'know' their bodies externally and are unable to engage in a double relational understanding with their bodies unless they consider and cement the

idea that other individuals have bodies similar to their own. While the body is seen as an extension and an 'object other' through which we unpack the world, several contemporary theories have been proposed to highlight the relationship between the body and the mind (Damasio, 2001; Gallagher, 2000; Gallese & Sinigaglia, 2011).

Through binary opposition (social comparison to entities or 'the object other,' who are different to them), or differences, an individual is able to understand their body, the world and develop a sense of self (Catmur et al., 2016; White, 2017). Similarly, Ferdinand De Saussure and Jaques Derrida argue that the opposed entities are mutually dependent on their differences to make sense of ourselves and our environment (Aprilia & Arianto, 2021; Brabazon, 2012; Schalk, 2011).

Considering the above, and adopting the theoretical framework of Embodied Cognition, it would imply that our body is related to metacognitive aspects of behaviour, such as self-awareness. Self-awareness is an experiential element in psychological and physiological studies that pertains to an individual's aspects of personality and individuality (Li et al., 2021; Longo et al., 2008). It adheres to the conscious experiences of one's own emotions, character, and desires (Hauke et al., 2024; Kiverstein & Miller, 2015). Moreover, self-awareness is regarded as one's ability to engage in reflections on the self, and the ability to identify, process, and store information about the self (Berlucchi & Aglioti, 2010; Morin, 2011).

Immersive Virtual Reality (IVR) has emerged, in recent experimental work, as a powerful methodological tool to manipulate the sense of body ownership; the sensation that an individual's body belongs to them (Gallagher, 2000; Slater et al., 2014). Alongside body ownership, other principle aspects of an individual's embodiment experience such as presence, and agency are also

investigated (Kiltene et al., 2012). In lieu of this, certain studies (Banakou et al., 2016; Barbot & Kaufman, 2020; Blanke, 2012; Harth et al., 2020; Peck et al., 2013; Peck & Gonzalez-Franco, 2021; Petkova & Ehrsson, 2008; Slater et al., 2014; Sora-Domenjó, 2022; Spangenberg et al., 2022; Ventura et al., 2018) have utilised IVR to investigate self and other awareness, with participants experiencing a body ownership illusion of a virtual body of another race group. Here, an individual embodies a virtual avatar (body), which is a different race or ethnic group from their own (by changing the colour of the avatar to dark-skin or light-skin) and engages in simulation or embodiment experience. However, as highlighted in a recent systematic review (Higgins et al., 2024) there are sampling biases in such studies, with no study to date having used Black-identifying participants in IVR to examine embodiment experiments and changes in attitudes when embodying a White body (i.e. light-skinned avatar) in the virtual world.

Similarly, studies have engaged in exploring feelings of embodiment utilising video games, simulations, and other computer-based interfaces such as 360-degree videos that can induce a sense of embodiment (Behm-Morawitz et al., 2016; Slater et al., 2009). These studies incorporate self-report measures such as questionnaires. Such questionnaires have only been standardised as of late (Peck & Gonzalez, 2021; Roth & Latoschik, 2020). Furthermore, only a handful of studies have been conducted on embodiment and the virtual self from a qualitative stance, especially with the intent to explore changes in full body ownership following experimental manipulations (Harth et al., 2020; Pyasik et al., 2022; Spangenberg et al., 2022; Ventura et al., 2018). Further still, fewer studies have explored the phenomenology of this change in full body ownership, both qualitatively and quantitatively. Similarly, a paltry number of studies have qualitatively explored ownership experiences dissimilar from an individual's own experience using Immersive Virtual Reality and full-body illusion experimentation.

Consequently, this study adopted Immersive Virtual Reality (IVR) techniques to create a full-body ownership illusion of a virtual body of another race group (White-female identifying) in a sample of Black-identifying females. This simulation aided in exploring the interplay of other embodiment in an IVR space, and the subjective experience of embodiment and self-other awareness.

1.2 Rationale

1.2.1 Theoretical

As argued above, a handful of studies have used qualitative methods to explore the subjective experience of embodiment following IVR (Harth et al., 2020; Pyasik et al., 2022; Spangenberg et al., 2022; Ventura et al., 2018). To the best of the researcher's knowledge, no study (in the Global and South African contexts) has utilised qualitative methods to unpack the subjective experience of participants following the embodiment of another self-identified race group using IVR. This study aims to explore the subjective experience of self-and-other awareness following a full-body ownership illusion of Black-identifying females in another race group using IVR.

1.2.2 Methodological Significance

This research study may contribute to the growing literature on embodiment and virtual reality in several ways. Firstly, as mentioned above, publicly available, and existing measures and research in this field of study have been predominantly quantitative in nature (Kelly, 2022). As this report is being conducted using qualitative methodology with quantitative measures such as questionnaires to support the descriptive process, it was quickly determined that these measures do not quite capture the individual experiences of using virtual reality which can be regarded as a highly personal and unique engagement for each individual. Thus, one of the goals of the study is to devise

a qualitative measure that can be utilised in understanding the individual context of the embodiment of racially similar and different virtual bodies as well as the virtual self. To achieve this, the researcher has constructed an interview schedule based on the available instruments that aimed to collect data on the self, embodiment, and virtual reality. This interview schedule aims to acquire data on areas of participants' experience such as a feeling of presence and embodiment in the virtual world as well as comparative feelings and notions of the virtual self and the self which will be made available for those wanting to conduct qualitative studies in similar contexts. This will be achieved through making this interview schedule available as an annexure alongside any work it is published.

1.2.3 Practical Significance

Behm-Morawitz et al. (2016) performed a study using the Sims Social game to explore its influence in reducing prejudice against the Black-identifying-American population by making White-identifying participants create and play Black-identifying American characters that were male or female. It provided an explanation of real-world instances in which embodiment and the virtual self can influence an individual's ideology and sense of self. It emphasises the need to research these concepts to understand their potential real-world influence and the potential this study could have in reducing racial bias. Consequently, this research study can be used by gaming companies developing IVR to inform them on topic matters such as embodiment. The results from this study could also bring into question how childhood development of identity/ the self can be influenced by IVR, leading to potential future IVR studies on embodiment and the self. This study could be used to help aid psychologists in understanding clients with body dysmorphic issues better and help contribute to the growing field of virtual reality usage in treating body dysmorphia due to participants embodying bodies that are different from their own and may not align with their body schema (Summers et al., 2021).

Additionally, this study will be employed in the South African context. Given the rich, racially diverse culture of South Africa and its racially discriminatory past, conducting a study in this context while using a sample of Black-identifying participants, may provide phenomenologically rich discursive insight into the components of the self and other embodiment and racial bias. This could be a beneficial tool for the country as the racial discriminations, prejudices and residual effects of apartheid have still occurred within an individual's lived lifetime. Findings from this study could also be used or adapted into interventions that may help promote tolerance and respect between individuals from different racial groups (Slater, 2017; Slater & Sanchez-Vives, 2016). Furthermore, to the best of our knowledge, this will be the first study (in the Global and South African contexts) to include Black-identifying participants in IVR within this stream of research (see Higgins et al., 2024; Chen & White, 2024).

Chapter 2 : Literature Review

2.1 Review of Literature

2.1.1 *The Self and Embodiment*

Self-awareness involves the ability of one to engage in reflections of the self (Carden et al., 2021). This internal representation of the self is then formed by identifying, processing, and storing information about the self, engaging in reflections of the self, as well as external experiences of one's emotions, character, and desires (wants and needs of the self) that contribute to the creation of one's personality, individuality, and sense of self (Duval & Wicklund, 1972; Li et al., 2021; Morin, 2011; Woźniak, 2018). Gallagher (2000) argues that the self can be understood from the two distinct categories, namely: the minimal self and the narrative self. At a fundamental level, the minimal self entails phenomenological, conscious experiences, grounded in the present, and dependent on the embedded body, specifically the body one inhabits (Bortolan, 2020; Forch & Hamker, 2021; Hafner et al., 2022). The narrative self is a self-image derived from past, future, and present narrative telling (stories) of each other and ourselves (Belt, 2019; Bortolan, 2020; Gallagher, 2000).

Embodiment is conceptualised differently across various disciplines (Blanke & Metzinger, 2009; Metzinger, 2009). For instance, embodiment can be understood as the experience of oneself and the way in which the mind represents itself compared to the schema of how an individual believes they look. Embodiment can also refer to a sense of presence or self-location in the virtual world as well as feelings of controlling and 'being inside' the virtual body (Kiltner et al., 2012; Slater et al., 2010; Skarbez et al., 2017). Further embodiment also refers to a sense of self or embodied identity that arises as a result of the body and environment an individual experiences and interacts in, such aspects are considered to be relevant to embodiment in IVR simulations (Guy et al., 2023; Gyllenstein et al., 2010; Schultze, 2014). There is general consensus in the literature, however, that

an embodied sense of self involves both bottom-up and top-down processing (Pietrzak et al., 2018). This includes the feeling that one's body belongs to them – body ownership (Kilteni et al., 2012; Gallagher, 2000; Tsakiris, 2010; Tsakiris & Haggard, 2005), and body agency as the experience of being the initiator of one's actions (Blanke & Metzinger, 2009). However, similar to Kilteni et al. (2012) working definition of a sense of embodiment (SOE), and the components identified by Peck and Gonzalez (2021) for measuring embodiment quantitatively, this study will refer to the embodiment as the perception that aspects of the object (virtual body) are part of the real body (i.e., aspects denoting a sense of embodiment are felt, such as a sense of presence, ownership, agency).

2.1.2 Embodied Self

Of particular interest to this study, Seghezzi et al. (2019) assert the minimal self includes the aspects of body agency and body ownership as well as embodiment and disembodiment, using the same conceptual framework as Gallagher (2000). Blanke and Metzinger (2009) describe a concept called the minimal phenomenal selfhood (MPS) which is related to embodiment and the lowest level of self-consciousness. Body agency or presence is the sensation of conscious and subjective experience of intentional motor actions made by one's own will and being within the virtual world (Blanke & Metzinger, 2009). Body ownership is considered to be an amalgamation of bottom-up and top-down processing that entails, as mentioned above, a sensation that an individual's body belongs to them (Kilteni et al., 2012; Gallagher, 2000; Tsakiris, 2010; Tsakiris & Haggard, 2005). Disorders of body ownership and body agency following focal brain injury, such as a stroke, have been described in the literature, however, experimental manipulations of this minimal sense of self have been more difficult to conduct (Besharati et al., 2014).

2.1.3 The Rubber hand Illusion

The rubber hand illusion, first pioneered by Botvinick & Cohen (1998), provided the first partial body illusion manipulation of the sense of body ownership within an experimental setting. In the rubber hand experiment, visual feedback is given of tactile stimulation (stroking) of a rubber hand, while the participant's real hand is being simultaneously stimulated (Botvinick & Cohen, 1998; Tsakiris & Haggard, 2005). This change in multisensory stimulation results in the feeling of ownership of the rubber hand (Valenzuela Moguillansky et al., 2013). However, Rohde et al. (2011), assert that proprioception and body ownership are governed by different mechanisms when considering the rubber hand illusion. In recent years, the efficacy of these body illusions has been contested, suggesting this could result from hypnotic suggestibility and expectations (Lush, 2020; Lush et al., 2020). However, Slater and Ehrsson (2022) have argued, through modelling participant expectancy ratings, that the rubber hand illusion is predominantly influenced by multisensory body illusions and minute suggestibility influenced by contextual differences in top-down processes.

As mentioned previously, Body ownership involves bottom-up and top-down processing (Tsakiris, 2010; Tsakiris & Haggard, 2005). Kilteni et al. (2012) posit that the bottom-up processes entail those visuo-tactile and proprioceptive inputs (stimulation of joints and muscles) whereas the top-down process would refer to the moderation of said inputs or stimuli such as acknowledging the stimuli and similarity of a rubber hand to one's real hand and presuming it is their own. These results have been replicated using various conditions such as Serino et al. (2018) who conducted a similar experiment using a full-body illusion and a cohort of women of different age ranges (18-55), finding that the younger individuals (age 19-25) experienced greater flexibility or plasticity towards experiencing proprioceptive drift (referring to the sensation of embodiment or ownership of the "fake hand"/ body). Comparable results have also been found using variations of the rubber hand

illusion on clinical cohorts with right hemisphere damage demonstrating possible neural correlations for body ownership in the right insula cortex (Jenkinson et al., 2020; Martinaud et al., 2017).

The above would eventually lay the groundwork for later renditions of the experiment which incorporated technology as part of the experience. In one such study, Kocur et al. (2022) observed the use of the rubber hand illusion, in tandem with virtual reality. It was proposed that the suggested interaction, in lieu of cross-comparison of the illusion in the real and virtual world, showed varied evidence of proprioceptive drift and temperature changes of the real hand. Similar findings were observed with a rubber hand and Mirror box illusion (MBI) in Crivelli et al. (2023) as well as a rubber hand illusion in Rohde et al. (2013). In the case of Crivelli et al. (2023), it was more prevalent for the left hand in participants due to brain lateralization. Specifically, the right brain ‘controls’ the left side of the body and is involved in processes such as spatial, image and emotional processing (Pitcher, 2022; Schore, 2022).

2.1.4 Immersive Virtual Reality as a Tool

More recently, IVR has emerged as an alternative tool in conducting body ownership illusions, using a similar theoretical concept of multisensory stimulation found with the rubber hand illusion (Blanke, 2012; Slater et al., 2014). Specifically, Slater et al. (2009) conducted a review study on body ownership of parts of the virtual body using a virtual rendition of the rubber hand experiment. Through this, it was determined that the individuals could experience a sense of ownership with the synchrony of movements (i.e., moving their ‘real’ body and at the same time getting visual feedback that the virtual body is moving in tandem with theirs; Slater et al., 2009). The experiments that Slater et al. (2009) critiqued ranged from visuo-motor synchrony (congruence with what is seen and with movement made) to visuo-tactile synchrony (congruence with what is seen

and felt) and finally a computer interface-based experiment. Slater and colleagues (2009) found that the realism of the body parts, arms and hands did not affect how body ownership was perceived. However, it was noted that proprioceptive drift was not experienced in the computer interface-based experiment in either the synchronous or asynchronous conditions that they assessed which involved using a brain-computer interface to open and close the “fake hand” (Slater et al., 2009). This could indicate that feedback is required to elicit a body illusion. In terms of this study, the experiment will be conducted using full-body visuomotor synchrony which according to the mentioned article will likely result in ownership being experienced.

Moreover, recent studies have explored the nature of the full-body illusion experienced in IVR as opposed to a partial illusion seen in the rubber hand-type experiments and often included an element of empathy (Barbot & Kaufman, 2020). For instance, Spangenberg et al. (2022) completed a study in which participants embodied trees in virtual reality. Participants in this study were divided and experienced two conditions in which participants engaged in a simulation of a tree in the Amazon rain forest from a virtual reality (VR) head-mounted display or a desktop screen. Those participants who experienced the IVR condition reported having greater feelings of immersion and feelings of nature relatedness (connection to nature) remained the same between samples (Spangenberg et al., 2022). This article suggested that embodiment is possible regardless of species or sentient species and while not every individual will experience embodiment, it is a valid method to experience other’s perspectives (Spangenberg et al., 2022).

Spangenberg et al. (2022) employed both qualitative and quantitative methods of data collection to measure the illusion of embodiment. Here, Spangenberg et al. (2022), administered a questionnaire was to measure the degree of embodiment, which is the gold standard

measurement of embodiment in IVR (Peck & Gonzalez-Franco, 2021). Spangenberg et al. (2022) also drew on asking four open-ended questions about participants' embodiment experience. The results of these questions revealed that participants using the IVR had a self-reflective, first-person account of their experience (i.e., the other group did not) and felt more nature-relatedness compared to the other group.

Similarly, Harth et al. (2020) and Ventura et al. (2018) utilised questionnaires, a semi-structured interview and HMD displays with 3-D cameras displaying other participants or actors (respectively) and their mirrored interactions using the Machine To Be Another (MTBA). This, qualitatively, revealed participants experienced unique and subjective interactions as well as changes in body and self-other perceptions. However, Ventura et al. (2018) primarily used these results to drive a S.W.O.T (Strengths, Weaknesses, Opportunities, Threats) analysis of participants' experiences using the MTBA. To the best of our knowledge, in the current literature, these are a few of the only studies in the current literature that investigated the qualitative and subjective experiences of embodiment following IVR in a different race body.

2.1.5 Embodiment using IVR

The methods of inducing a body illusion using IVR systems are not uniform across studies, and neither are the actual VR systems used. For instance, Petkova and Ehrsson (2008) discuss a body illusion study they conducted in which they manipulated participants' visual perspective and correlated multi-sensory experiences using both Head Mounted Displays (HMD) and Closed-Circuit Television (CCTV). They conducted five experiments with male and female participants ranging between ten and twenty participants (Petkova & Ehrsson, 2008). They found that individuals can

engage in the embodiment of any humanoid type of figure and are able to move their “perceived centre of awareness” should the right conditions be met (Petkova & Ehrsson, 2008).

In a recent study, Gall et al. (2021) investigated whether, with a high illusion of embodiment, an individual may experience more intense emotional processing in a virtual environment. Gall et al. (2021) found that embodiment in a virtual world increases emotional responses to virtual stimuli. Relatedly, Ahn et al. (2013) utilised Immersive Virtual Environment Technology (IVET) to assess self-other merging with the use of colour-blind filters. In this study, after conducting several experiments, it was noted that participants experienced a sense of self-other merging of the virtual self (refers to the identity that exists in the virtual world) in the virtual environment as participants experienced embodied experiences and perspective-taking through experiences of what is like to be colour-blind (Ahn et al., 2013; McCreery et al., 2012). It was also noted that there was an increase in helping those with colour blindness in real life. These articles establish the significance of the self in the context of virtual reality. Furthermore, they accentuate the need to understand and conceptualise the virtual self and the influence it has in virtual reality and embodiment studies. The lack of existing literature in this research area is an oversight and thus potentially warrants future exploration into this research area.

In related work, McCreery et al. (2012) performed a study to explore the virtual self with regard to World of Warcraft players. World of Warcraft is a large-scale, online multiplayer role-playing game in which players go on adventures in the world of “Azeroth” using customizable “heroes” (Blizzard Entertainment, 2023). This study consisted of thirty-nine participants (thirty male and, nine female) during which the participants played World of Warcraft for two hours with their own in-game avatars and were asked to complete a series of personality, and demographic

questionnaires and an interview about their virtual character or avatar (McCreery et al., 2012). The study's original hypothesis was that the virtual self would be identical to the participant's self in the virtual world by exploring the proteus effect (McCreery et al., 2012).

The proteus effect is described as a conscious or unconscious phenomenon in which an individual's attitude, perceptions and behaviours are influenced by virtual interactions or a virtual avatar (Bian et al., 2015). However, it was found that the virtual self or persona is not the same. Instead, McCreery et al. (2012) noted that role adoption of the character can occur. Heersmink (2020) highlights details in a survey article investigating different types of self, including the self in virtual reality, consequently emphasizing the importance of understanding the various types of self therein. The results of the study suggest that there is potential for an extended embodiment of the self's perceptual and bodily capabilities via technological artefacts. Here, Heersmink (2020) notes that one's body schema and sense of self can be made flexible through experiments such as rubber hand illusions and virtual reality.

In another study, Swinkels et al. (2022) performed a full-body illusion experiment utilising IVR and somatosensory stimuli which explored if the illusion of embodiment is possible within a virtual avatar. Swinkels et al. (2022) conducted a few experiments in which their participants engaged in self-touch using an HMD simulation. It was found that full-body illusions can be self-generated by one's own body movements and positions. These articles establish the significance investigating of the self, as well as self-other awareness, in the context of virtual reality in changing the sense of body ownership using IVR.

A systematic review of body illusion literature established that behaviours shifted from the self to that of the embodied virtual avatar (Pyasik et al., 2022). These articles converse with the manipulation of sensory factors and the resulting notions of embodiment and presence that can be felt in an alternative or virtual body. While this review by Pyasik et al. (2022) indicates that most of the studies they analysed had gathered data through quantitative means, similar to the above studies, it brings about important exploratory questions concerning embodiment and related factors as well as the need to understand this concept for applications outside of an experimental setting.

2.1.6 IVR methods to reduce Racial Bias

In a similar vein to Spangenberg et al. (2022), Peck et al. (2013) set out to explore if implicit (ie., unconscious) racial bias could be reduced in a sample of White-identifying females through the embodiment of avatars they coded as dark-skinned virtual avatars (i.e., simulating being Black), with a control condition using light-skinned avatars (i.e., simulating being or remaining White). Participants used head-mounted displays with body suits that had body tracking in the IVR simulation. In this study, participants in the virtual world were also placed in a hallway with mirrors in which different raced avatars walked past (Peck et al., 2013). Similarly, participants in this study will also be making use of HMD and body tracking to engage in the IVR experiment in which they will be placed in a room with mirrors in which different raced avatars walk past them. Using survey-based methods and a between-group design, the study found that the embodiment of a virtual body of another race (i.e., dark-skinned avatars) group leads to a reduction of implicit (i.e., racial) bias.

Similar to the above, Banakou et al. (2016) sought to explore this concept, instead of using an all-White female-identifying population inhabiting a dark-skinned avatar. Participants were instructed to move around the space and perform activities before the experiment ended and they

were made to answer a questionnaire, finding the same reduction of prejudice. Congruently, Schulze et al. (2019) explored implicit bias from the perspective of gender. The study produced mixed results in both increasing and decreasing implicit gender bias. Congruently, Chen et al. (2021) engaged in a study that dealt with environmental stimuli with the aim of assessing potential bias reduction to immigrants. In this study, participants embodied characters in a series of simulations in which the participants' characters interacted with the other characters in the simulation, similarly finding a reduction of bias. With this in mind, Banakou et al. (2016) and Sora-Domenjó (2022) suggest that caution should be taken when treating virtual reality as an 'empathy machine' as this may not always be the case. With this in mind, Banakou et al. (2016) and Sora-Domenjó (2022) suggest that caution should be taken when treating virtual reality as an 'empathy machine' as this may not always be the case. This is further iterated by the discussion of the ethicality of using IVR or VR-related technology to elicit 'moral desirability' (cognitive or emotional empathy) through personal distress or, as with this study, embodied perspective taking i.e., putting someone in another's shoes (Hamilton-Giachritsis et al., 2018; Madary & Metzinger, 2016; Schoeller et al., 2019). As with the above, authorities in the field of IVR, neuroscience and psychology propose the need for great consideration in using technology this way (Madary & Metzinger, 2016; Slater et al., 2020; Slater & Sanchez-Vivez, 2016). As with Rueda and Lara (2020), this study shares a similar perspective on the use of such technology, that is, it should not be exempt from having the ability to be problematic through not assisting with moral dilemmas and potentially leading to immoral acts. However, provided that it is justified for the context it is addressing, and that aims to do the right thing, using technology this way can become ethically desirable and should not hinder the potential for moral enhancement.

In essence, there is a myriad of various findings that differ from one another. However, it should be noted that these studies arise from different social, contextual, and cultural differences. Due to the duplicity of findings, it is incongruent to say that racial embodiment can or cannot alter social attitudes. Instead, this is something that needs to be explored within the historical, racial, cultural, social, and economic contexts of which each study is a part. Further, likely, this will also have to be considered when exploring the findings in the South African context.

In light of this current research, Higgins, and colleagues (2024) conducted a systematic review and meta-analysis that included 12 studies that used IVR methods to investigate the reduction of racial prejudice following the experience. A large sampling bias was found, with no current study including a sample of Black-identifying participants, which limits the scope and generalisability of the current stream of research.

2.1.7 Conclusion

The convergence of the results from recent studies demonstrates that IVR can be a powerful method to explore questions concerning self-and-other awareness and body ownership. However, there is a need for great diversity in the samples used and the social contexts in which they are studied. Furthermore, Black-identifying participants in IVR examine embodiment experiments and changes in attitudes when embodying a White body (i.e. light-skinned avatar) in the virtual world (Higgins et al. 2024). Therefore, drawing on said qualitative methods of investigation and looking at self-other full-body illusions following IVR will offer unique insights into the existing literature. This may help expand our understanding of embodiment and racial bias from a subjective experiential perspective.

2.1.8 Research Questions and Objectives

2.1.8.1 Aims

Therefore, the main research question guiding this study is: What is the subjective experience of embodiment of the virtual self-using IVR? A secondary research question is: What is the subjective experience of self-and-other embodiment of an avatar (i.e., virtual body) of a different race group (i.e., light-skinned avatar) in a sample of Black-identifying females?

2.1.8.2 Objectives

Furthermore, the objectives of the study are to explore the subjective experiences surrounding embodying another raced virtual body, and the extent to which they experience body ownership, following the use of IVR. Additionally, the study aims to explore perceptual notions of the self and the other in virtual reality versus reality and potentially explore racialisation through questions of the “Self” and “Other.” Furthermore, another objective would be to develop a qualitative measure that explores phenomenology surrounding embodiment following the use of IVR to explore the above-mentioned experiences.

2.2 Theoretical Foundation

2.2.1 The Embodied Cognition Theory

Embodied Cognition is a theoretical movement that was devised in response to the rising increase in computational theories of the mind (Borghi & Carauna, 2015; Shapiro, 2019). This theory has early roots in the thinking and works of phenomenologists such as Martin Heidegger, Edmund Husserl, Maurice Merleau-Ponty and, George Lakoff (Cairns, 2012; Hofstadter, 1988; Lakoff, 2012; Moya, 2014; Smith, 2002; Skorborg, 2013). These thinkers have respectively postulated that our consciousness, conscious activities, thoughts, and the way we experience them are influenced by our

bodies and our environments (Cairns, 2012; Hofstadter, 1988; Smith, 2002; Skorburg, 2013; Wilson & Golonka, 2013).

Similarly, according to Borghi and Carauna (2015) as well as Wilson and Golonka (2013), the fundamental proponent of Embodied Cognition is the assertion that states of body or environment can modify states of mind. Within this, there are three main tenets that the theory is astricted by (Borghi & Carauna, 2015). The first is that our cognition, as asserted above, is effectively influenced by our experiences in our bodies such as those achieved through motor processes, sensory systems, and interactions with the environment. The second is the notion that the kind of body an organism possesses influences cognition. The third is the rejection of analogies and models of the mind which stipulate that the mind functions as software that operates and controls symbols (Borghi & Carauna, 2015).

Most notable in this theory is the role of perception and action (Tsakiris et al., 2007). This speaks well to the theories of the above-mentioned phenomenologists as well as the objectives of this study. Additionally, the discussion of perception and action highlights the philosophical components in the theory regarding body image, agency, the self, and body ownership (Borghi & Carauna, 2015; Tessari et al., 2010; Tsakiris et al., 2007). This links quite well to the research being conducted as it touches on themes that will be explored with regard to IVR usage, racial bias, embodiment, agency, presence, and the experience of interacting in a virtual world with a virtual body and the virtual self.

Chapter 3 : Research Design and Methodology

3.1 Research Design

This study predominantly adopts a qualitative methodology with thick descriptions (rich accounts or descriptions), by drawing on the subjective experiences of participants through semi-structured elicitation interviews, and small engagement in quantitative methods using demographic and psychological questionnaires. In general, the study draws on an Interpretivist Paradigm. From an epistemological, axiological, and ontological perspective, interpretivism is interested in describing several subjective realities with the aim of comprehending, exploring, and describing rich, meaningful, detailed, and unique, subjective knowledge, imperceptible experiences, and interactions (du Plooy Cilliers et al., 2014; Rehman & Alharthi, 2016; Richards, 2003). This aligns with explorative research which is inherently connected to qualitative research and is appropriate to the chosen paradigm and methodology as it aims to give new insight into previously unknown situations (du Plooy Cilliers et al., 2014). However, this study will also draw on some basic psychometric data on the study to assist with the descriptive process of the findings of the study. Furthermore, exploratory research in a mixed methods study design, allows the researcher to employ qualitative data as a basis whilst incorporating some quantitative data for supplementary descriptive means (Creswell & Plano Clark, 2007; Creswell & Plano Clark, 2011). De Wet (2017) and Kumar (2011) affirm that inductive research derives a consensus from premises or data gathered from research which is what this research intended to achieve via the data collected on the phenomenon. Cross-sectional research is a single-point data collection method with intrinsic connections to social science that is utilised to ascertain the influence of a phenomenon (Kumar, 2011). In this regard, this research study collected data at a single point and explored the embodiment of the virtual self-using IVR. Qualitative methodology was selected due to its attunement and synergy with the paradigm's use of subjective research methods (du Plooy Cilliers et al., 2014; Richards, 2003). It is based on social science and aims to explore and comprehend a situation as well as obtain and observe the rich

details and meaning derived from subjective and holistic participant experiences (Kothari, 2004). Quantitative methodology was adopted to support findings and aid the description of data analysis.

3.2 Sample and Sampling Strategy

A total of N = 8 Black-identifying female participants were recruited for the study. This was achieved through nonprobability sampling methods, including convenience, purposive and snowball sampling. This study is part of a larger study that is investigating if IVR can be used to reduce implicit racial bias in the South African context. The sample from the main study was recruited through random assortment sampling, posters and official communication channels of the University (through lecturers and emailers, etc.). The current study conducted the qualitative component of the larger study. Therefore the sample was drawn from the population already available from the main study. More specifically, following the completion of the main study procedures, the participants were invited to engage in an interview process. According to Maree and Pietersen (2020), snowball sampling is a method of sampling typically employed in a situation where a population (often sharing traits or characteristics in the research interest) may be otherwise onerous to come by. The procedure entails finding individuals who fit the parameters of the population and asking if they may put you in contact with others who might also fit the population (Maree & Pietersen, 2020; Richards, 2003). The study inclusion criteria were: English fluency (to be able to follow the study protocol and IVR instructions only available in English); female-identifying (due to the avatars only being female for practical reasons); and being over 18 years old. The exclusion criteria included: Epilepsy or a family history of epilepsy; and any other neurological and psychiatric conditions (to limit any risk in using IVR equipment). The larger study had an additional inclusion criterion of being Black-identifying or White-identifying. However, due to a small number of White-identifying participants recruited for the larger study, the current study only included Black-identifying female participants (see Chapter 4 for further discussion). The target population was therefore recruited from healthy

Black and female-identifying adults participating in the larger study). Due to the data being acquired from individuals, the unit of analysis was individuals (du Plooy Cilliers et al., 2014).

3.3 Instruments

3.3.1 *Demographic Questionnaire*

A standard demographic questionnaire was issued to participants (See Appendix A). This was administered via an electronic platform called Red Cap on a laptop within the dedicated space for the IVR simulation. The demographic questionnaire contained typical fields including the participant's name, surname, age, ethnicity, gender, and home language. In addition to this, a Living Standards measure (LSM) was incorporated into the Questionnaire. The resultant living standard scores fall into three groups. According to Yazi (2020), these are: least access to wealth (an LSM score of 1-4), moderate access to wealth (an LSM score of 5-7) and most access to wealth (an LSM score of 8-10). The name and surname were redacted from the data to ensure that confidentiality would be achieved. A pseudonym, such as Ayanda, was substituted in its place. This data was primarily involved in descriptive analyses to unpack and contextualise participant responses.

3.3.2 *Rosenberg Self-Esteem Questionnaire*

The Rosenberg Self-Esteem Questionnaire is a Guttman scale questionnaire that was issued to assess the self-esteem of participants prior to engaging in the simulation (Rosenberg, 1979). This questionnaire included ten questions and a four-point Likert scale (scored out of 4) with reverse scoring (scores out of four in the negative) for negatively coded questions (Rosenberg, 1979). The resultant scores of participants would fall between 1-30 due to the way in which the questionnaire was structured. According to LINGAN UNIVERSITY (2024), a score between 15 and 25 suggests average self-esteem. Therefore scores above or below this threshold would indicate low or high self-esteem

(Lingan University, 2024). The researcher and their supervisors included this questionnaire to explore if self-esteem was a factor in the embodiment experience data required (See Appendix B). This was administered via redcap and was used descriptively alongside the other questionnaires and qualitative data. It should be noted that the reliability and validity of this measure have been supported on a global level and in various cultural and socio-economic contexts, including South Africa (Rizwan et al., 2012; Westaway et al., 2015). It has been established that there is a link between body image and self-esteem (Yiyi et al., 2024). Summer et al. (2021) has also discussed how immersive virtual reality can be used when dealing with body dysmorphia. The inclusion of the self-esteem measure is partly due to these discussions as well as the fact that participants would be embodying a virtual body different from their own. There is a likelihood that conversations about one's body and body image may arise. The interest here lies in exploring if there is a relation between embodiment in IVR, what is said about body image, and self-esteem.

3.3.3 Avatar Embodiment Questionnaire

Peck and Gonzalez-Franco (2021) developed a sixteen-question questionnaire to explore the notions of embodiment in virtual reality (See Appendix C). The questionnaire underwent rigorous validity checks and revision processes to ensure reliability (Peck & Gonzalez-Franco, 2021). The final version of the questionnaire consisted of a seven-point Likert scale that assessed participants' responses ranging from never to always (Peck & Gonzalez-Franco, 2021). This questionnaire was also administered on redcap on a laptop within the designated space for the study. The consequent scores were manually calculated according to a guideline provided in the Peck and Gonzalez-Franco (2021) article (See Figure 1). Thus, participants' scores for factors such as appearance, response, ownership, multi-Sensory, embodiment and agency experiences were acquired. Peck and Gonzalez-Franco (2021) established that if the scores report were closer to seven, this would indicate higher

embodiment experiences (See Figure 2). This data was used superficially to aid in the comparative description of the qualitative data gathered.

$$\begin{aligned} \text{Appearance} &= (R1 + R2 + R3 + R4 + R5 + R6 + R9 + R16)/8 \\ \text{Response} &= (R4 + R6 + R7 + R8 + R9 + R15)/6 \\ \text{Ownership} &= (R5 + R10 + R11 + R12 + R13 + R14)/6 \\ \text{Multi-Sensory} &= (R3 + R12 + R13 + R14 + R15 + R16)/6 \\ \text{Agency} &= R3 + R13 \\ \text{Embodiment} &= (\text{Appearance} + \text{Response} + \text{Ownership} + \text{Multi-Sensory})/4 \end{aligned}$$

FIGURE 1
GUIDELINE FOR CALCULATING RESULTS AS ADAPTED FROM PECK AND M. GONZALEZ-FRANCO (2021)

Figure 2

CATEGORIZATION FOR EMBODIMENT SCORES

<i>Final Embodiment Score (Max score =7)</i>	
<i>Interval</i>	<i>Rating</i>
1-2	Very Low level of Embodiment
2-3	Low level of Embodiment
3-4	Average level of Embodiment
4-5	Above average level of Embodiment
5-6	High level of Embodiment
6-7	Very high level of Embodiment

3.3.4 IVR Environment, Virtual Bodies and Equipment

In terms of the experimental side of the study, a VR environment (See Figure 3) was built using a free cross-platform engine called Unity®Pro software. This engine is typically used to build 2-D and 3-D game environments or simulations (Axon, 2016; Dealessandri, 2020). This environment was paired with avatars built in another generative software called “MakeHuman™”(See Figure 4).

FIGURE 3
VR ENVIRONMENT BUILT USING UNITY®PROSOFTWARE.



FIGURE 4

SCREENSHOT OF "MAKE HUMAN™" SOFTWARE



As previously stated, this study made use of the software Unity®Pro software and “Make Human™” to create an IVR simulation for participants to interact in (See Figure 5). The virtual bodies that were used in the experiment were light-skinned and dark-skinned with features representative of White and Black populations. In this way, the parameters acted as a control, to mitigate the influence of other variables that could be involved in exploring the phenomenology of embodiment such as gender, height, and race. This was due to the populations tested at the time being Black or White females as opposed to participants from other race groups such as Asians. Subsequently, the virtual avatars used were also White and Black female avatars. Females on average are also shorter than men. The IVR experiment was tested by a taller-than-average man. It was noted that the avatar body will scale to the height of the individual, however, extremely tall individuals (like the individual who tested the experiment) may cause the virtual body to distort or float.

FIGURE 5

SIMULATION AND AVATAR



The programs were run using a desktop set up in the space allocated for the experiment (See Figure 6). Participants were provided with equipment to use for the duration of the simulation. This equipment consisted of an HTC Vive wired head-mounted display (HMD), two base stations, two

controllers and three wireless body trackers to provide visuomotor synchrony to aid in the generation of a ‘realistic’ experience (See Figure 7).

FIGURE 7
DESKTOP SETUP AND PROGRAMMES

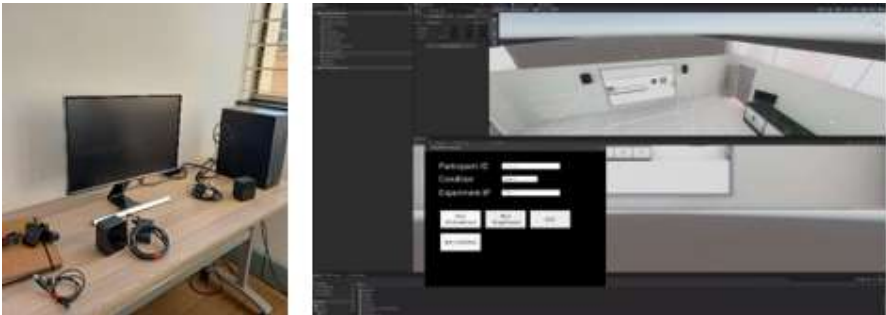


FIGURE 6
EQUIPMENT, BASE STATIONS, AND TRACKERS



The two controllers tracked the movement of the right and left hands (See Figure 7). The Head-mounted display tracked the head movements and position (See Figure 7). The body trackers, situated around the waist and on the feet, tracked the orientation and movements of the participants' waist and left and right feet (See Figure 7).

The dedicated play area consisted of a 252 cm square marked out by electrical tape, near the monitor and desktop used to run the simulation (See Figure 8). This meant that participants were only able to interact in a 252 cm by 252 cm area. If participants approached the play area, blue grid lines would appear in the simulation indicating that this was the edge of the allotted play area. Base station A was positioned on a 70cm high tripod on the top left of the play area (See Figures 8 and 9). Base station B was similarly positioned on a 70cm high tripod, opposite Base station A, on the bottom right of the play area (see Figures 8 and 9). They were positioned in such a way that they were able to detect each other. The tripods were orientated in such a way that one of the legs of the tripod was planted on the boundary line of the play area. The distance between the leg on the boundary line and the centre of the tripod, which supported the base station was 26cm (See Figure 9).

FIGURE 8

PLAY AREA DIMENSIONS, POSITION OF DESKTOP AND BASE STATIONS

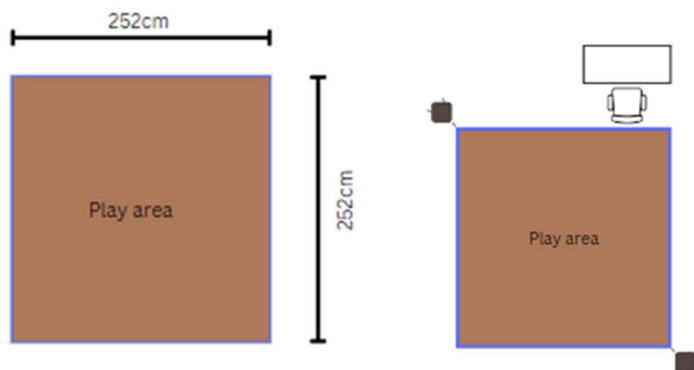
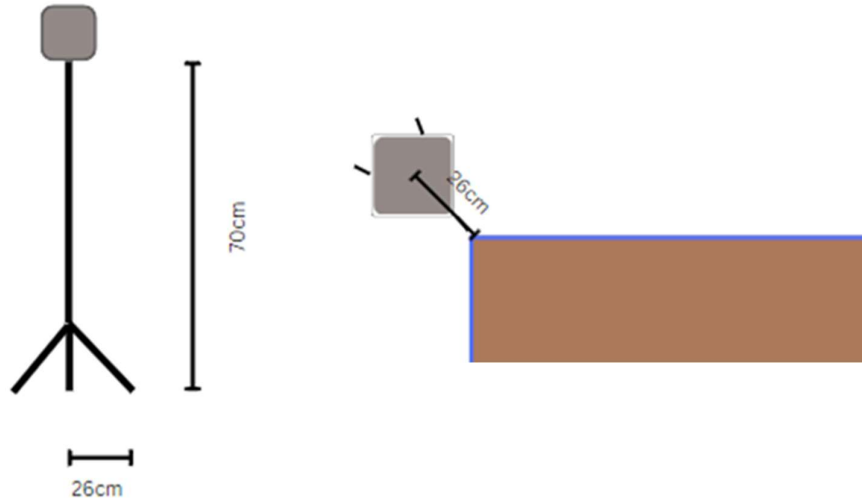


FIGURE 9

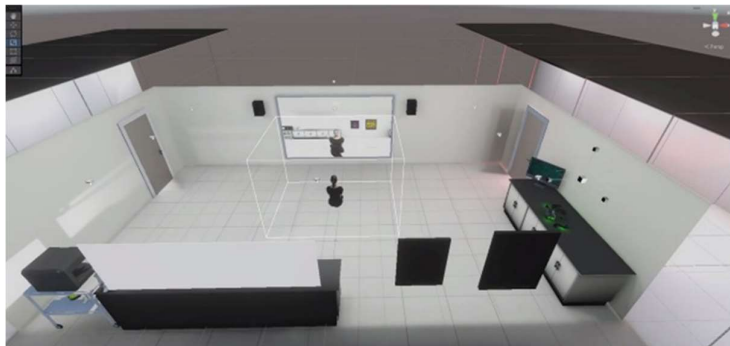
DIMENSIONS AND ORIENTATIONS OF BASE STATIONS



The IVR environment consisted of a stark white, four-walled room (See Figure 10). North of the participants' starting position stood a wall-mounted mirror that reflected the actions of those in front of it and two wall-mounted speakers on either side of the mirror. East and west of the participant were doors. Finally south of the participant were decorative features such as tables with a monitor, a coffee maker and IVR equipment as well as a 3-D printer and posters along the south wall.

FIGURE 10

THE IVR ROOM



The participants had the opportunity to embody avatars coded opposite to their identified race. Such that, Black-identifying individuals included in the current study embodied light-skinned avatars.

Following the completion of a few preprogrammed instructions, Participants were provided with the latitude to interact with themselves and the virtual environment (See Figure 11). Thereafter other female avatars (See Figures 12) of various physical aesthetics, were coded to walk into the virtual room from the east door, stop in front of the participant, in front of the mirror, look at them and exit the door to the west of the participant. Once all of the other avatars had walked through the room, the simulation was completed.

FIGURE 11

3RD PERSON PERSPECTIVES OF AVATAR STANDING AND SITTING IN FRONT OF THE MIRROR

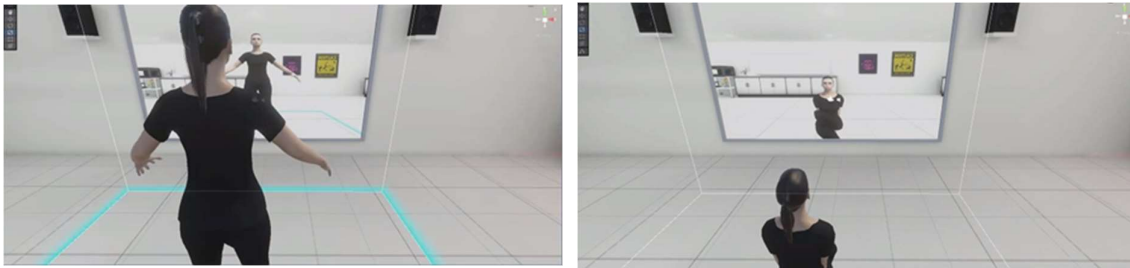


FIGURE 12

THE OTHER FEMALE AVATARS



3.3.5 Adapted Embodiment and Self Semi-Structured, Elicitation interview

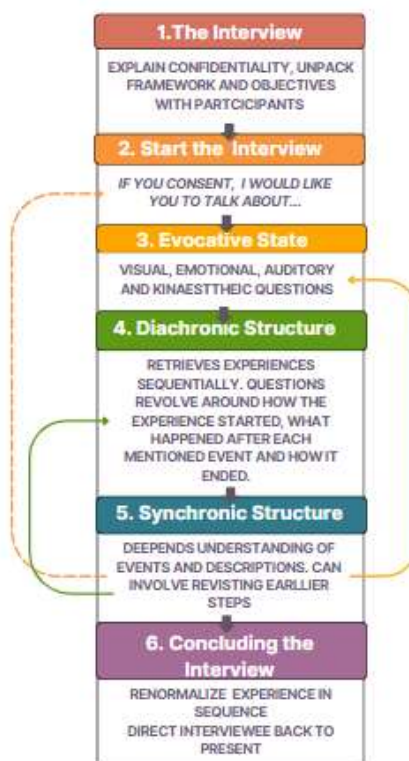
As mentioned above one of the measures that were utilised is a semi-structured, in-depth, elicitation interview schedule (See Appendix D). The interview schedule was predominately based on The Avatar Embodiment questionnaire. A few other measures from related studies and studies of the self were also utilised, and obtain a qualitative account of embodiment, identity, and self-other experiences. These instruments ranged from surveys, interviews, and Likert scales to questionnaires (Dolczewski, 2022; Flury & Ickes, 2007; Groom et al., 2009; Igroup, 2016; McCreery et al., 2012; Peck et al., 2013; Peck & Gonzalez-Franco, 2018; Peck & Gonzalez-Franco, 2021; Petkova & Ehrsson, 2008; Roth & Latoschik, 2020; Slater et al., 2010; Snyder & Gangestad, 1986; Wilkinson et al., 2019). In general, these measures and their corresponding studies converse with six key factors. These are the self (individual's identity and their conscious, unconscious, or mental and physical attributes), virtual self, agency, presence, autonomy (independently acting from one's own choices), and the proteus effect which proposes the ability of an individual to 'take on' characteristics of the avatar they embody that may be represented in their cognition and behaviour (American Psychological Association, 2023; Liu, 2023; Yee & Bailenson, 2009). The interview schedule was developed using these validated measures as a guide to develop deductive and inductive open-ended questions.

The two existing measures (the Embodiment Questionnaire and the Avatar Questionnaire (McCreery et al., 2012; Peck & Gonzalez-Franco, 2018; Peck & Gonzalez-Franco, 2021) served as the primary basis for the adapted measure to fit the context of a qualitative direction of the study. To the researcher's knowledge, these measures have not been employed in the South African context. The remaining eight measures served as a guideline for questions on additional areas of interest (embodiment, identity, and self-other experiences). Furthermore, the elicitation interview technique was used to help structure the flow of the interview schedule.

The elicitation interview was first used in the 1990's as a method of data employed to obtain detailed accounts of human experiences on specific phenomena (Hogan et al., 2016, Vermersch, 1999). These types of interview structures are typically adopted for the purpose of exploring rich singular lived experiences and minimising biases which may utilise probing questions for clarification (Hogan et al., 2016, Vermersch, 1994). Moreover, the elicitation interview technique is grounded in the philosophical interest of experience (Spielberg, 1975). Elicitation interviews often consist of various stages which may vary depending on the context of the study, with some topics elicited tending to explore kinetic, auditory, visual, and emotional experiences. It is commonplace for iterations to occur between these stages to, clarify, and reaffirm aspects of the interview and its processes (See Figure 13). While this interview structure is directive and non-inductive, the research has used this structure as a basis to develop a semi-structured interview schedule that explores experience through combined inductive, deductive, directive, and non-directive questioning (Hogan et al., 2016). The interviews were used as a primary source of data for the data analysis. The average length of an interview was 23 minutes and 8, 3 seconds.

FIGURE 13

ELICITATION INTERVIEW STRUCTURE AS ADAPTED FROM HOGAN ET AL. (2016)



The interview schedule was initially piloted to discern the kind of data that would be acquired, and if the questions were appropriate to the research interests. At the time, participants did not engage in rich accounts of their experiences and discussions of their feelings and emotions during the experience were limited (See Appendix E). This is likely due to the limited questions, initial structure, and engagement of participants. Furthermore, interviews had an average length of 10 minutes. Consequently, it underwent several changes to obtain richer interview data. One such change involved the segmentation of the interview into several parts, following the Elicitation interview technique, which was adopted to encourage participants to engage in reflexive discussions about various aspects of their experiences (as mentioned above). The other changes involved sentence structure and word choice changes to mitigate the use of certain academic jargon which confused participants and resulted in misunderstandings. This led to the current interview schedule structure (See Appendix D), and average interview time of 23 minutes and 8, 3 seconds (as mentioned above).

3.4 Procedure

Eight Black-identifying participants were recruited through online advertisements, convenience sampling, and visiting lectures to recruit participants (with the lecturer's permission), and snowball sampling through other participants. Those individuals interested in partaking in the study contacted the researcher through the email addresses provided and scheduled. This study consisted of a two-step process, which entailed two on-site visits, scheduled approximately three to five days apart. After participants were recruited for the larger study they were invited to the research laboratory of the Wits Neuroscience Research Laboratory (Wits NeuRL) in the Emthonjeni building at the University of the Witwatersrand. Following informed consent for the larger study, participants were also asked if they would like to participate in the qualitative aspect of the study, which forms part of this current study.

In the first session, participants worked with the individuals (research assistants and supervisors) involved in the larger pilot study. Participants then completed the demographic and Rosenberg questionnaire and other assessments needed for the larger study. Following this, another day was scheduled with the participants within the 5-7 day period for the second component of the study.

During the second on-site visit, the participants experienced the IVR simulation which the researcher assisted in helping them put on and take off the IVR equipment. Following this, the participants completed the Avatar Embodiment and Self-Esteem questionnaires. Thereafter, the researcher guided the participants, who agreed to participate in the interview in the first session, into a separate room to explain the information sheet, fill out their consent forms and conduct the interview process (See Appendix F and G). The semi-structured nature of the interview allowed the researcher to ask the participant probing or follow-up questions and prompts surrounding the topic to gain more data. This helped to reveal themes or aspects that the researcher had not considered (du Plooy Cilliers et al., 2014; Richards, 2003). These interviews were recorded with the participants' written and verbal consent using a simultaneous transcription and recording tool called Otter.ai (Otter.ai, 2023).

Once the interview was completed, the researcher and the participant engaged in a short debrief to consolidate expectations, their experience, give feedback and final thoughts about the simulation, and expected or emerging results. Participants were also permitted to ask further questions about the study and the overall IVR project. Baked goods were also given to the participants after the data was collected (See Appendix H). Participants were not informed they

would receive this; therefore this gesture would not have contributed to biases. Finally, the quantitative data which was collected by one of the researcher's supervisors was shared with them to aid in describing their qualitative data.

As mentioned above, a VR environment was built for participants to interact in. This was used in conjunction with the IVR equipment to create an IVR simulation for a full-body immersive experience. As all participants were Black-identifying females, they embodied a light-skinned avatar in the virtual world. Once the individual put on the IVR equipment and the simulation started, a pre-recorded voice provided instructions guiding the participant through the experiment. The instructions would guide the participants through three stages of the simulation. First, the participant would be asked to view their body and move their arms from a first-person perspective (i.e. looking down at their virtual body) and then from a third-person perspective by looking at their body moving in a mirror using synchronous movements. This alternative perspective taking (i.e., looking at their own virtual body and looking in the mirror) and synchronous movements have been found to achieve the highest embodiment experience (Peck et al., 2013; Peck & Gonzalez-Franco, 2018; Peck & Gonzalez-Franco, 2021; Slater et al., 2009). Second, the participant would be free to explore the virtual environment. Lastly, other virtual avatars would enter the room, and the participants would be free to watch them enter and walk around the virtual room freely. No real social interaction was however possible with the other virtual avatars in this created virtual world. The virtual interactions involved a mirror interaction in which the participant could see their avatar (third-person interactions) and look at their virtual body as well as interact with the environment and virtual avatars (first-person interactions).

3.5 Data Analysis Methods

The qualitative data analysis method of Reflexive Thematic analysis was utilised (Nowell et al., 2017; Vaismoradi et al., 2013). It is noted that there are several other methods of data analysis which would prove as useful as Thematic analysis such as phenomenological analysis and content analysis, this was chosen as the primary method due to the reasons listed below.

This process was guided via the article by Braun and Clarke (2006) which details methods of engaging in thematic analysis. This analysis seeks to derive meaning by interpreting patterns which link back to the Interpretivist paradigm and qualitative method (du Plooy Cilliers et al., 2014). Braun and Clarke (2006) and Howitt & Cramer (2020) argue that Thematic analysis can be used to interpret both data from a psychological frame and transcripts from in-depth interviews which is what the researcher intended to do as it also lends itself well to the nature of the study.

Reflexive thematic is described as a method of analysis that can be, as mentioned above, used to identify raw data and to describe the data in rich detail through an Inductive lens. However, this type of analysis may also be conducted through a deductive lens. While deductive is typically associated with positive or essentialist approaches, it is noted that inductive and deductive analysis is not bound to a particular epistemology (Boyatzis, 1998; Byrne, 2022). In essence, Coding-type analyses can be used for either deductive or inductive approaches (Braun & Clarke, 2013, 2019, 2021). This links well to the inductive and deductive structure of the interviews which explores perceptions of the influence of pre-determined factors affecting embodiment as well as probing them about their general experiences and interactions.

The themes were identified in correspondence with Braun and Clarke's (2006) six-phase protocol for engaging in thematic analyses. Once the transcripts had been generated, the researcher engaged in rigorously reading the data to familiarise themselves with the contexts and make notes on related text (Howitt & Cramer, 2020). Following this engagement, the research attempted to group related items of texts and produce initial codes from the data (Braun & Clarke, 2006; Howitt & Cramer, 2020). While initial codes were generated, through inductive means, the researcher also developed codes based on deductive means. More specifically, as the interview questions were generated through existing themes or codes outlined by questionnaires codes (self (individual's identity and their conscious, unconscious, or mental and physical attributes), virtual self, agency, presence, autonomy (independently acting from one's own choices), this specific data was also categorised and grouped according to those initial codes. The researcher developed themes from the initial codes accordingly (Braun & Clarke, 2006). These themes and codes were scrutinised by the researcher in a review process to assess the adequacy of the thematic map generated (Braun & Clarke, 2006; Howitt & Cramer, 2020). These themes and the overall narrative of the analysis were refined and defined (Braun & Clarke, 2006). This approach to the thematic analysis method is non-linear as phases were revisited (See Figure 14) for refinement purposes (Braun & Clarke, 2006; Braun & Clarke, 2019; Howitt & Cramer, 2020). Due to the content of the participant responses, the process of organising the deductive and inductive codes into themes posed a significant challenge to the researcher as they did not fit neatly into categories. Consequently, the amalgamation of deductive and deductively generated codes and themes, and the lack of available articles within similar contexts, the researcher engaged in a rigorous and lengthy process of revisiting the initial codes, generating themes, reviewing, and redefining themes to generate categories that neatly encompassed both the deductive and inductive codes that arose.

Additionally, the demographic data, Rosenberg questionnaire and embodiment questionnaire were all scored according to the scoring guidelines available. Furthermore, the researcher engaged in report writing by making a composite of relevant extracts and analyses which were related back to the literature review and the overarching research question/s and objectives (Braun & Clarke, 2006; Howitt & Cramer, 2020). Finally, basic descriptive statistics were generated using Excel and used for the participant demographic details and for simple comparisons to the qualitative results.

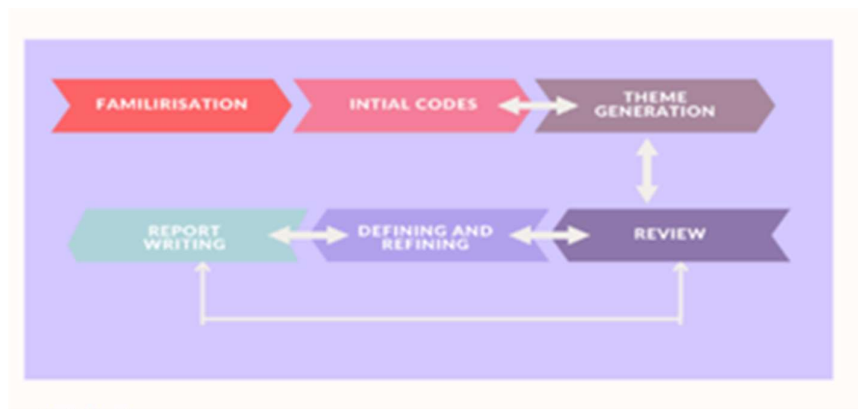


FIGURE 14

MODEL OF THEMATIC ANALYSIS BASED ON BRAUN AND CLARKE (2006)

3.6 Ethics

This study formed part of a larger study, on the reduction of racial prejudice using IVR, which has received ethical clearance from the Human Research Ethics Committee (Medical) of the University of the Witwatersrand (Ethics number M211139; See Appendix I for ethics approval). An amendment had been added to the larger study to include this MA project, and separate ethics were obtained from this study specifically from the Human Research Ethics Committee (non-Medical) of the University of the Witwatersrand was also obtained (Ethics number: MAPSYC/23/01, See appendix J). Participants were taken through the participant information sheet (See Appendix F), and written informed consent was obtained from all participants (See Appendix G). The researchers had

also undergone ethics training at the Department of Psychology and externally (See Appendix K for the ethics training certificate).

3.6.1 Ethics regarding the Participant

Ethics pertaining to participants were consent, confidentiality, respect for people's rights and dignity, bias justice, and fidelity and trustworthiness (Howitt & Cramer, 2020). Regarding consent, the research intended to gain informed consent from individuals prior to participation. Specifically, they were informed that of risks for participation, using IVR equipment or any type of video equipment, there is a possibility of a degree of nausea or an epileptic episode to be induced. This risk was included in the information sheet in which participants had been urged that they were not obliged to participate in the study, and they may withdraw at any point without a given reason. Additionally, participants were informed that although full anonymity cannot be guaranteed, due to study protocol involving face-to-face interaction, their identity and data would remain confidential. Appropriate measures were implemented to prevent the disclosure of any information that could be used to identify the participants, including replacing participants' real names with pseudonyms. An identification file was used to link participants to their pseudonyms. The identification file and data are currently stored in a password-locked computer behind an encrypted folder with a 'passphrase' only made available to the researcher and supervisors (American Psychological Association, 2022; du Plooy Cilliers et al., 2014). Any physical documents were also stored in a locked drawer. Furthermore, the researcher asserted that the participant has the right to refrain from answering any questions and withdraw themselves and their data from the study, should they feel it a necessity and they may do so without a given reason or fear of negative consequences (American Psychological Association, 2022; du Plooy Cilliers et al., 2014; Howitt & Cramer, 2020). The research also attempted to uphold the principles of justice and respect for people's rights and dignity by continuing to practice respect and tolerance towards other individuals and attempting to be aware

of potential biases that may arise (American Psychological Association, 2022; Howitt & Cramer, 2020). In addition to this, the researcher discussed the facilitation of counselling in the scenario that the participant may have adverse reactions during an interview. This information (free South African Depression and Anxiety counselling hotline) was included in the information sheet (See Appendix G).

3.6.2 Ethics Regarding the Researcher

Ethical issues regarding the researcher entail fidelity and responsibility, biases, misusing information, distorting results, falsifying information, and inappropriate research methods (du Plooy Cilliers et al., 2014). Regarding fidelity and responsibility, as the researcher existed as a representative of the field, it was important to build and maintain trust with people (Howitt & Cramer, 2020). The researcher aimed to do this by building rapport, making the participant feel comfortable, and being candid and open about their and the participant's role in the study. Furthermore, as mentioned above, the researcher gifted the participants baked goods after the data was collected, with permission from the researcher's supervisors (see Appendix H). Participants were not informed they would receive this; therefore this gesture would not have contributed to biases. This was done to foster good researcher-participant relations as a representative of the profession as expected by the ethical guidelines of a researcher. Bias in light of the researcher refers to an unintentionally passive act that can occur in which a researcher may unknowingly distort results to align with subconscious expectations of the study (du Plooy Cilliers et al., 2014; Howitt & Cramer, 2020). Due to the lack of prior research on the phenomenology and embodiment of the virtual self, the researcher had no expectations of results and was, therefore open-minded. Misusing information is defined as using data for purposes other than its intended purpose which is not something the researcher intends to do (du Plooy Cilliers et al., 2014). Distorting results is the active unethical act of manipulating data to fabricate desired results (The American Psychological Association, 2022; Howitt & Cramer, 2020). Falsifying information is marked by the method of

manipulating results and data in order to appease, gain prestige or save time (du Plooy Cilliers et al., 2014; The American Psychological Association, 2022). The researcher believes that this study could greatly benefit the cognitive psychology community and, therefore, believes in the need for honest and factual data. Finally, in order to address the potential of using inappropriate research methods, the researcher attempted to maintain a continual line of communication with their supervisors to confirm the researcher's methods and approaches were appropriate and necessary to the current study (du Plooy Cilliers et al., 2014).

3.7 Trustworthiness

Trustworthiness is a data assurance method comparable to that of validity and reliability in quantitative research (Nieuwenhuis, 2020). Trustworthiness lends itself to the qualitative-driven paradigms as far as providing a non-number-oriented method as a means of ensuring reliability and validity in qualitative research (du Plooy Cilliers et al., 2014). While this report does incorporate some quantitative data, it primarily uses qualitative data for analysis and quantitative as a superficial auxiliary. Trustworthiness as a conglomerate is formed by the categories of Credibility, Transferability, Dependability, Confirmability and Reflexivity which have been engaged with throughout this report (Lincoln & Guba, 1985).

3.7.1 Credibility

Credibility primarily deals with the congruency of findings with reality as well as whether or not findings are believable from the participants' perspective (Collis & Hussey, 2003; Nieuwenhuis, 2020). Credibility was enhanced through the length of time that the researcher spent with participants during, prior and following the IVR simulation and the interview processes (Korstjens & Moser, 2018). Following interview processes the researcher discussed the anticipated themes and

results with several of the participants and peers to obtain feedback (du Plooy Cilliers et al., 2014). Furthermore, this study makes use of triangulation and crystallisation through means of using multiple forms of data collection to reduce the risk of chance association and systemic bias (Maxwell, 1996). Triangulation in this research was used to assess the extent to which conclusions made on qualitative sources were reflected in quantitative sources and vice versa (McMillan & Schumacher, 2001). Crystallisation was achieved through the researcher attempting to be aware of their own biases and assumptions that could potentially affect the “crystal reality” or the ability of other individuals to uncover similar emerging patterns in the data (Nieuwenhuis, 2020). Furthermore, the researcher made sure that participants were aware that they may stop the interview at any point and that participation was voluntary (Shenton, 2004). This was done to ensure that participants who were part of the study were truthful and genuine about their answers and participation. Additionally, the researcher engaged in iterative questioning with participants and clarified what participants meant by specific responses as well as short debriefs with their supervisor following the completion of interviews (Shenton, 2004).

3.7.2 Transferability

Refers to the degree to which the research analyses and results may be applicable beyond the scope of this research (Lincoln & Guba, 1985; Shenton, 2004). Thick descriptions of participants, context and designs were used to allow readers to make their own decisions about the transferability of the study (Nieuwenhuis, 2020). Furthermore, careful thought was given to selecting participants that represent the phenomenon being studied (Shenton, 2004). The analyses are applicable to contexts similar to research such as those investigating race, body illusion, the interaction between the self and other, self, and other embodiment and embodiment using virtual reality or games. However, it is limited to specific races in the South African context due to the race

of the participants sought, as stipulated by the participant parameters. It is thus up to the discretion of the researcher and readers to determine the level of transferability of the analyses.

3.7.3 Dependability

Dependability entails reflexive appraisal and detailed descriptions of various data-gathering processes, implementation, interpretation, and recommendation in the research project (du Plooy Cilliers et al., 2014; Korstjens & Moser, 2018; Nieuwenhuis, 2020). To address this, the researcher has engaged in a detailed audit trail throughout the report as well as reflexive inquiries in order to allow the reader to follow their reasoning. Additionally, this was done in such a way that other researchers may be able to replicate the study and obtain similar results (Shenton, 2004).

3.7.4 Confirmability

The purpose of confirmability is to establish that the claims made in the analyses stem from the derived data and not in fact from the researcher's imagination or biases (Lincoln & Guba, 1985). Confirmability, much like that of Dependability, requires a level of transparency achieved through reflexive inquiry and triangulation, crystallisation (Korstjens & Moser, 2018; Nieuwenhuis, 2020; Shenton, 2004). As mentioned above, the researcher has engaged in an audit trail within the report. Moreover, the researcher has incorporated quotes into the interpretation section to evidence where claims are derived from and reduced bias by admitting predispositions (Shenton, 2004).

3.8 Reflexivity: Motive for Research

In my more formative years, I had always been interested in philosophical questions surrounding, identity, the self and the other. Growing up in the household and the culture that I was in, I often found it difficult to fit in, not to mention the added difficulty of my orientation.

Furthermore, as an Indian living in Johannesburg north, I grew up as some would describe, too White to be Indian and too Indian to be White. Even then there was a distinction between Johannesburg North and South Indian and Durban Indian. I could never quite fit into a box neatly. I often found myself trying to establish my own identity through binary opposition that I found in my interactions with other individuals. Of course, I was not able to put a name to these underpinning interests at first. Until I started to explore them theoretically in the English and Psychology courses in my undergraduate degree. There was something truly fascinating about the way an individual's identity is shaped by the world around them and what they are and are not. In fact, the original concept document that I applied for this degree included a central focus on identity and the self.

I grew to love these concepts and would often unintentionally watch media that involved identity as a core genre. It was not till I was approached with the prospect of doing a research study related to embodiment and Immersive Virtual reality that gears in my head started to turn. I remembered that there was an anime that I had watched in 2012. It was set in the year 2022. The concept involved these characters that were playing a game using Immersive virtual reality gear far more advanced than what we had currently. This IVR gear tapped into the neural network of the players, allowing them to fully immerse themselves as the avatars that they created, and later avatar bodies made to be replicas of themselves. The plot entailed them being forcefully stuck in the IVR world and having to complete the game in order to escape whilst navigating the complexities of the world and their avatars and their own identities.

With this in mind and the current advancements in technology as well as the shift in interest towards metaverses and virtual avatars, I became increasingly interested in answering questions on embodiment in relation to the self. I also pondered what the difference would be

between an individual's real identity and virtual identity. My research question and objectives naturally arose from the recognised importance of asking questions about embodiment and the virtual self due to the rise in the availability and appearance of immersive virtual reality in video games, virtual tours, and entertainment such as virtual idols and v-tubers. However, I tailored these questions to fit the context of the study.

Chapter 4 : Results

4.1 Demographics

Eight participants were recruited, included in the data analysis process, and asked to participate in several questionnaires, an IVR simulation and an interview (please refer to chapter three for more in-depth details). All eight participants had reported that they were Female and Black-identifying, as aligned with the study's inclusion criteria. Participant ages ranged from 19 to 33 years of age. The average age of participants was 23.35 years (standard deviation = 5.18). Although all participants were fluent in English as per the study's inclusion criteria, the participants spoke an array of home languages such as Xitsonga, Ndebele, SiSwati, IsiZulu, IsiXhosa, Sepedi and languages other than the above-mentioned (See Table 1). This showcases the diversity of cultures and languages within the Black-identifying sample of the current study.

In terms of Living Standards, five participants fell into the bracket of “most access to wealth.” They are regarded as having a high standard of living. The remaining three participants fall in the upper echelon of the middle bracket. They are regarded to have moderate access to wealth (Please see Chapter 3 for an explanation). In terms of the Rosenberg self-esteem scores, four participants scored within a normal range (See Chapter 3), three participants scored low self-esteem and only one participant scored high self-esteem (See Table 1). Finally regarding embodiment scores, two participants reported a very high level of embodiment, one participant reported a high level of embodiment, four participants reported an above-average level of embodiment, and one participant reported a low level of embodiment (See Table 1). Here, it is worth noting there is no apparent relationship between embodiment scores and ages, as with the Serino et al. (2018) study. More specifically, embodiment scores were not higher with younger participants compared to older participants. Instead, these scores varied amongst participants (See Table 2 below for embodiment scores in order of age)

TABLE 1

DEMOGRAPHIC TABLE

Code	Age	Self- Identified Gender Gender	Self- Identified Race	Home Language	Living		Rosenberg		Final Embodiment Scores	
					Standards		Results		(Max score =7)	
					Measure Results		(Max score =30)			
					(Max score = 10)					
					Score	Rating	Score	Rating	Score	Rating
P1: Lebo	33	Female	Black	Other	1.8	Level 10 (Low)	21	Normal	4.4	Above average
P2: Thobekile	30	Female	Black	Ndebele	1.5	Level 9 (High)	17	Normal	5	Above average
P3: Dikeledi	22	Female	Black	SiSwati	0.4	Level 7 (Low)	12	Low	6.3	Very High
P4: Nhelo	21	Female	Black	Xitsonga	1.5	Level 9 (High)	13	Low	5.2	Above average
P5: Ayanda	20	Female	Black	IsiZulu	0.5	Level 7 (High)	18	Normal	3.1	Below Average
P6: Nonnie	19	Female	Black	IsiXhosa	1.1	Level 8 (High)	8	Low	4.4	Above average
P7: Bonolo	20	Female	Black	Sepedi	0.5	Level 7 (High)	28	High	6.6	Very High
P8: Twelani	25	Female	Black	Xitsonga	1.1	Level 8 (High)	23	Normal	5.8	High

Note. Participants were assigned random pseudonyms for ease of understanding.

TABLE 2

FINAL EMBODIMENT SCORES IN ORDER OF AGE

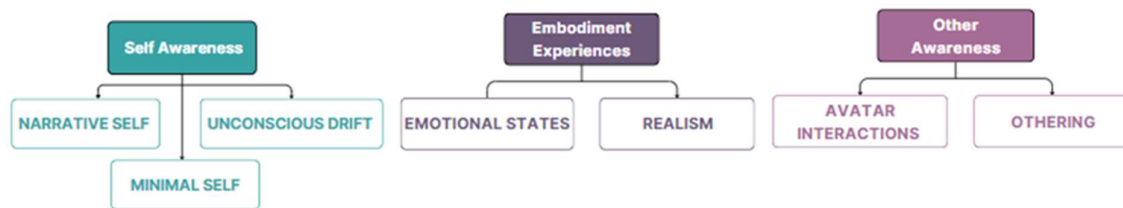
Code	Age	Embodiment Score Results (Max score = 7)
P6: Nonnie	19	4.4
P5: Ayanda	20	3.1
P7: Bonolo	20	6.6
P4: Nhelo	21	6.4
P3: Dikeledi	22	6.3
P8: Twelani	25	5.8
P2: Thobekile	30	5
P1: Lebo	33	4.4

4.2 Introduction

Following the implantation of reflexive thematic analysis as described in Chapter 3, several themes emerged. Specifically the three main themes of: (1) Self-Awareness, (2) Embodiment Experiences, and (3) Other Awareness was identified. These themes were informed by the sub-themes as represented in Figure 15 below. Subsequently, these sub-themes have been explored with the aid of participants' experiences and direct quotations.

FIGURE 15

MAIN THEMES IDENTIFIED FROM THEMATIC ANALYSIS FRAMEWORK



4.3 Theme 1: Self Awareness

This theme explores participant experiences in terms of the self and the experiences of the various forms of the self they interact with. This is achieved through exploring the narratives they have created for their real self and virtual, their self-awareness interacting in the virtual world, and their conscious and unconscious experiences.

4.3.1 Narrative

Participants discussed two types of narrative self. That being, the narrative self is confined to the participant and the narrative self of the participant in the virtual body. All of the participants had reported as being Black-identifying females in the demographic questionnaire. However, this was not entirely reflective of their lived experience. While most participants vocalised that they consistently identify as Black, are proud of it and believe others would identify them similarly, this

was not the case for some of the participants. Lebo and Ayanda expressed that while they identify as Black, they do not always associate with that identity and feel that others of the same race often do not associate them with that identity. They have stated that while they may be classed as Black on a superficial level by individuals of other races and sometimes their own race, they feel they would be classed using such terms as 'Oreo' and 'Coconut' to describe themselves. Lebo explained that this category distinction consolidates a term used to describe an individual who is 'not Black enough.' Lebo and Ayanda further iterate their proposed reason for this:

Lebo: *I was very ostracized because I would be told that I act quote on quote White you know. Cuz I went to I had the privilege to go to like an English speaking school, like here in (redacted), and then when I moved to where I'm from now, from (redacted). There were kids who just didn't have that. So obviously I would, and also like the cartoons I would watch they would be in English. So I would teach myself through those cartoons. So as a child, you know, you just like imitate everything you see. So the way they spoke, the way that they acted, I would imitate that. So that become became a part of my, my identity. So, moving to a place where that wasn't like an everyday thing. I was very much ostracized. So it created this thing where I felt like I was not Black enough for, for those groups of people. And then being that I was also too Black for the White people.*

Ayanda: *Being articulate in English... with those languages such as English, Afrikaans, other than most Black people; the quality of education I've had when you look at the inequality in our country and yeah, socioeconomic levels, I'd say, I don't always fall under the statistics of Black people.*

Interestingly, the final embodiment scores of these individuals were comparatively lower with scores of 4.4 and 3.1, respectively. However, should there be a relatedness between these scores and the category distinction, it would necessitate further research with larger samples containing those who identify similarly, as well as debriefing sessions with participants and their results to ensure no rash conclusions have been made.

Regarding the narrative self and being in the virtual body, some participants began to construct a narrative self around aspects of being in the virtual body. Some participants attributed this virtual self to criteria such as '*older, taller, shorter, different body shape, thinner and lighter complexion*'. A few participants expressed that they began to identify as light-skinned however others were aware of the difference in identity and were conscious of it during the simulation process. Three of the participants stipulated that they felt their own personality and the avatar's personality were largely the same. However, many participants voiced the avatar did not share an identity with them as it lacked the aspects that coincided with their Black and African identifying identities. Despite this, some participants expressed that the virtual body's mind and their mind were thinking the same things and were orientated towards achieving the same goal. Additionally, one participant proclaimed that they experienced a hybrid identity as they felt like they were '*two people at once*'.

Twelani: *OK, in that virtual body, I looked a bit older... Oh, I'm actually in a white body. I'm not in a black one.*

Ayanda: *Yes, definitely (would be a different experience of embodying the virtual body)... Because I realized the skin tone of the arms, it was very light, it was lighter, and even the the body shaping the size the, the height, yeah. shorter than my height. The body size, yeah.*

Nhelo: *I felt like I was light skinned... I feel like that helped me feel lighter with myself, like my whole body. I just felt like I took of a certain number of kgs.*

Bonolo: *So the virtual body is white and I'm not. It looked a bit taller and I'm not. It was a bit thinner than me.*

Dikeledi: *Besides being white...*

4.3.2 Minimal Self

For several participants, the synchronous nature of the embodiment condition contributed to feelings of ownership and selfhood. Lebo, Dikeledi, Nhelo, Ayanda, Nonnie, Bonolo, and Twelani found that the avatar mimicking their movements solidified a recognition of 'me' or selfhood in the virtual world as it moved in accordance with their intentions:

Lebo: *I would move my real body and then I would see my action being reflected in the VR mirror. So that's an... I knew that this is me, me and the VR body are one.*

Dikeledi: *When I move, you can actually see I move my legs, and I move everything. It's just same as me. It's just that it's in a kind of 4D world.*

Ayanda: *Because me moving my arms, they would move instantly and me walking, it would also walk. It was like mirroring me,*

Nonnie: *Like I could see myself in the mirror and move around. My body felt real as well. It didn't feel like I was holding the controllers, or I had anything on my body.*

Bonolo: *So I think for the most part, it's like when I move my head, the virtual body moves its head. When I move my arms. It moves its arms, but obviously, the foot was like it just looked*

weird and was like rotated and it didn't move exactly how I was moving. So yeah, it was doing what I was doing, but not exactly what I was doing.

Twelani: *I'm aware I don't originally look like that, but it sort of becomes a part of me in a way like whenever I'm moving my hands, I am moving those hands.*

Analogously, a few participants remarked that moving in front of the mirror assisted in a sense of self-presence. Nonnie and Twelani stipulated that this interaction allowed them to feel immersed enough to '*forget*' their real body and the 'contraptions' on it. Through this mirror interaction, participants were able to confirm that the reflection was supposed to portray a virtual representation of them as the avatar.

However, while able to acknowledge the purpose of the reflection, a number of participants found that first-person interactions in the mirror disrupted their sense of ownership and self-presence in the IVR world. Whilst the recognition of '*me*' held true, for most participants, this feeling of ownership and selfhood was limited to the ability of the virtual avatar to mimic participant movements. Participants reflected that this provided them with a limited sense of autonomy and control. Thobekile found that the structured nature of the virtual session made them feel they were "*in another body, that I cannot control*". Similarly, Nhelo and Bonolo note that the experience felt like they were "*taking over*" or "*borrowing*" someone else's body and "*moving on behalf of someone else*". Furthermore, the sensation of "*oneness*" was not always paralleled with participant sensations of connectedness, relatedness or alignment with the virtual avatar.

Lebo and Twelani explained that they felt connected to the virtual body in the sense that it felt like their *“real human body”* when they moved. Lebo, in particular, stated that this real body sensation stemmed from the mirrored speed of the movements. Dikeledi Nhelo and Ayanda shared a similar sentiment regarding feeling connected to the virtual body. However, the above participants

noted that this sensation was primarily due to the synchronous nature of the mirrored actions such as when they moved their arms, and legs or danced. In contrast to this. Thobekile and Nonnie found it difficult to feel connected to the virtual body as they recounted that it *“felt like that’s the other person and that’s not me”* or *“it was different from the way I looked”*. Likewise, Bonolo was unable to feel completely connected to the virtual body commenting: *“It just wasn’t mine. I don’t know. I’ve been looking at this body for a very long time. So I look in the mirror and I see another body. Yeah, but I did have moments where I sort of forgot about my own body for a while. But for the most part, I didn’t really feel connected to that body.”*.

In tandem with the feeling of connectedness, Thobekile found themselves unable to relate to the virtual body as they did not enjoy being in the virtual body. Much like their response towards a feeling of connectedness, Bonolo also reported being unable to relate to the virtual body. While able to feel connected to the virtual body, Dikeledi found they could not relate to the virtual body as the aesthetic of the body did not coincide with the representation of themselves. Ayanda followed suit by affirming that despite the liminal connectedness, they could not entirely relate to the virtual body due to similar aesthetic disparities observed. Interestingly, despite acknowledging these aesthetic differences, most participants scored high for appearance and embodiment scores (See Table 3 below)

TABLE 3

EMBODIMENT AND APPEARANCE SCORES

Embodiment and Appearance Score Results (Max score = 7)		
Code	Final	Appearance
P1: Lebo	4.4	4.1
P2: Thobekile	5	4.5
P3: Dikeledi	6.3	6.4
P4: Nhelo	6.4	5
P5: Ayanda	3.1	3
P6: Nonnie	4.4	4.3
P7: Bonolo	6.6	6.5
P8: Twelani	5.8	5.9

Note. Participants were assigned random pseudonyms for ease of understanding.

Nhelo, on the other hand, declared that the feeling of connectedness extended to their ability to relate to it. Nhelo illustrated the experience by stipulating: *“I think it's because she was operating on my levels. I think my head was her head, my brain was her brain. Should I have wanted to go read the thing on the wall there, I would have just gone to read the thing on the wall. So, I feel like it was my personality, in a body.”* Withstanding the onerous sensation of feeling connectedness, Nonnie found they could relate to the virtual body due to their *“body movements and being able to interact with the world”*. Interestingly, Nonnie scored above average in both appearance (contributed to lack of connectedness) and agency and responsiveness (provided the ability to relate to the virtual body). Twelani extended their comparison of the virtual body as their real body by affirming their ability to relate to it: *“Yes, I do. I felt in control that like it was my body ... because when I move my hands, the hands were also moving. Feet. Same. Face. Like the whole body.*

When I move my original body it also moves. So in a way because. I paid so much attention on the mirror, the body on the mirror, if it did, whatever I did, I do not think of it. Like I just saw it as a reflection because I was... I was told I was looking at the mirror, so it was actually a reflection of me. Yeah". This is reflected in their high embodiment scores for agency and responsiveness. This begs the question of what combinations of aspects of embodiment are required in order to experience certain increments of embodiment.

Dikeledi and Nhelo reported feeling aligned with the body. Dikeledi in particular noted that they felt aligned despite the aspects that prevented them from being able to relate to the virtual body. Nhelo, on the other hand, asserted they felt complete alignment with the virtual body due to shared goals and mental orientations. On the other hand, Twelani reported that they felt aligned with the virtual body till they interacted with the other avatars which interfered with their sense of ownership. Twelani stated this resulted in them realising they were embodying a virtual body of a different race. Nonnie felt their alignment was temporal and dependent on whether or not their emotions interfered with their sense of embodiment. Similar to their feeling of relating to and notions of connectedness, Bonolo argued they did not feel aligned with the virtual body due to the lack of aesthetic similarity.

Dikeledi: *Yeah, in a way. Yeah, besides, of course, the differences that I mentioned before.*

Nhelo: *I think because... I was the person that was in that body, so it was literally just myself from a different perspective. I think my brain was operating on a me level, but on a different body. So, I feel like we were on the same page with that girl. So, I think we were aligned... I mean, if my brain wanted to think I need to go and drink water in the virtual room, she would have wanted to go and drink water.*

Nonnie: *I can say yes and no because at some point I did get scared. Like it was me and you know, because I was like, this isn't me at the beginning until my feelings came to play.*

Bonolo: *Not really. It just. Didn't look like my body. Didn't look like my body.*

Twelani: *No (did not feel aligned with virtual body), until I saw the Black ones cause for some reason I wanted that body because I know that I'm Black. So yeah... At first, it felt like my own. And then as it went on, like, as I interacted with the Black ones, reality kicked in. You're actually Black but, you're in a White body. It's like that.*

4.3.3 Unconscious Drift

Throughout the experiment, participants disclosed sensations that were attributed to a drift of self-consciousness when interacting with the virtual body. These sensations are more appropriately described through exploring participant experiences of proprioceptive drift, projective identification, and re-embodiment of the real body or actual self.

Two of the eight participants interviewed, Ayanda and Bonolo, described interactions with their virtual selves which were reminiscent of the sensation of proprioception. Proprioception is often associated with sensations of drifting or moving towards an embodied fake limb (Serino et al., 2018). However, in this instance, while adopting the visual synchronous capture required to potentially trigger proprioception, Ayanda and Bonolo noted they experienced this at a holistic level, with regard to the virtual body (Pavani et al., 2000). Interestingly, despite this sensation, Ayanda situated feeling low levels of body ownership in her embodiment results (See Table 4 below). This is consistent with Rohde's et al. (2011), assertion that proprioception and body ownership are governed by different mechanisms. Whilst this was true for Ayanda, Bonolo reported an above-average perception of body ownership. Full body proprioception explored through the

qualitative lens is an under-researched area, particularly with the sample at hand. As such, this would necessitate testing on a larger population to explore the frequency of similarly reported events.

TABLE 4

INDIVIDUAL EMBODIMENT SCORE

Code	Embodiment Score Results (Max score = 7)					
	Final	Appearance	Responsiveness	Ownership	Multi-Sensory	Agency
P1: Lebo	4.4	4.1	3.3	3.8	6.2	7
P2: Thobekile	5	4.5	4.2	4.8	6.7	7
P3: Dikeledi	6.3	6.4	5.8	6.2	6.8	6.5
P4: Nhelo	6.4	5	5.7	5.5	9.4	5
P5: Ayanda	3.1	3	3.3	3	3.2	3
P6: Nonnie	4.4	4.3	4.3	4.7	4.5	3.5
P7: Bonolo	6.6	6.5	6.8	6.2	7	7
P8: Twelani	5.8	5.9	6.3	5.3	5.7	7

Note. Participants were assigned random pseudonyms for ease of understanding.

Ayanda: *Like I said, it felt like an out of body experience. Yeah. I could say I felt like I was floating. I was just not in this room, anymore. Yeah. Definitely (felt like was in the virtual body)... I don't know. Like I said, I was... I was out of touch with reality... I kind of left this room. I just went to a different place. I'd say my mind went to the virtual space and it wasn't... it was no longer here... because there was this... I wouldn't say I felt like I was floating, but there was this different feeling of, ok, I'm, I'm on my feet, but are these really my feet? It gives you... You sort of feel different. Yeah. An outer body experience. I think that's like a proper way to put it.*

***Bonolo:** I did feel myself. I don't know... drifting away from my own body a little. But then I come back after like a few seconds... I think maybe because I was looking into a mirror and it wasn't me and I was for a second, not controlling my body, I was controlling this other body that I didn't feel connected to. I don't know if that makes sense, but yeah.*

Projective identification is described as a manifold aim mechanism involving the splitting-off and projection of internal objects and aspects of the self which are then cast upon an external object (Waska, 1999). This often consists of a form of transference in which the parts projected may be used to avoid separation from the object, keep themselves safe or validate the sense of unease felt by the object to subjugate, gain control of or improve it through primitive forms of reparation (Segal, 1974; Waska, 1999).

In this regard, participants reported a few, in some cases unique, similarities with the virtual body. For instance, several participants noted that they and the virtual body mirrored each other's movements and control of the body. Nonnie reported that they and the virtual body were alike in terms of the clothes they wore. Nonnie further stated that the virtual body *"looked like mine, a little."* Thobekile expressed that the virtual simulation created a sensation in which they felt both they and the virtual body felt *'trapped'* in the virtual world. Nhelo felt that they shared a personality with the virtual body despite aesthetic differences. *"I was tapping into, like I was creating a personality for her, which is me. So I feel like I have my personality, but in a different body and there was a principal that was different.."* Similarly, Twelani remarked that *"personality wise.. was still the same"*. In addition to this, Nhelo argued that at some point they began to *"identify as light skin"*. Finally, Nonnie expressed that they did feel human in the virtual body and *"did not feel like an avatar"*.

Congruent with this, a few participants outlined strange or weird sensations when returning to their bodies when the head-mounted display was removed. Nonnie and Twelani noted that they felt weird after removing the head mounted display. Nonnie regarded this sensation as weird due to being used in the virtual body and suddenly going '*back to being human*'. Twelani commented that removing '*the cap*' allowed them to feel reacquainted with what their real body looked like. Twelani noted that the sensation felt was almost similar to being able to see their real body in a mirror as opposed to the virtual body.

Nonnie: *It felt weird because I was so used to that body. And now I'm out of it I was like... ohh. I'm back to being human. Yeah, weird.*

Twelani: *Weird but, but OK, it was just weird. OK, I no longer see that. Yeah. Like, it's like after taking off the caps, like within a blink of an eye, I am back. I'm seeing myself. And now remember I no longer have a reflection of my body, but for somehow it feels like I'm seeing myself like originally. OK, I know myself. I saw how I was dressed in the morning, but I do not have a mirror that, you know, when after removing the cap and then let's say there is a mirror in front of me. I would literally see myself, but I didn't see myself, but I felt like I'm back to like my original self.*

While this was the case for Nonnie and Twelani, this experience was not shared by other participants. Lebo expressed that while they did not feel their sense of self was lost, they felt as though they still existed in the virtual world despite the simulation being completed. Thobekile was happy to return to their real body as they felt most comfortable and in control of it. This sentiment was shared by Bonolo who equally felt more comfortable in their own body. Dikeledi asserted they

felt no changes when exiting the virtual world. Nhelo felt disappointed returning [to](#) their real body as they like to fantasise about being in a body different from their own.

Lebo: ... It was easy, quick. Like I was in there. I wasn't there. Quick. Easy. It didn't feel like I lost a sense of myself in the VR. It was just still me. I felt one with the VR world. So when I left, it wasn't as if I was leaving. I was still there as a person.

Thobekile: I was so happy. I couldn't wait. Like it was just like when are we finishing and I just wanna go back to my own body. Yeah. Because I wanna be me. I love being me. I'm comfortable with myself, the way I am. I am happy with everything that is inside my body, so I wouldn't wanna be in another body, that I cannot control. I can control myself. So, there I don't, I don't think I'll have that.

Nhelo: Felt the same. Yeah, felt the same like before I entered.

Dikeledi: It felt boring guess, but I realized that I took a break from my body. That was really exciting because sometimes I fantasise about it to which I could just step out a little. So I felt like, I got the chance to like, step out a little and be in someone else's body and you get the sense of how it feels and then I tapped into my body. It was just like, OK, back to usual.

Bonolo: Great. It's just me, you know, I'm more comfortable in my body.

4.4 Theme 2: Embodiment Experiences

Embodiment experiences refer to participants' experience of embodiment. In the interviews, two main aspects of experiences were discussed. These are emotional states and the 'realistic-ness' of their experiences.

4.4.1 Emotional States

Several questions in the interview process encouraged participants to engage in introspective reflexivity in regard to their thoughts and feelings throughout the IVR simulation process. This resulted in a plethora of evocative words which culminated in many shared and tangential emotional experiences at different stages of the experimental process. In reflecting on their first-person experiences in an IVR environment, many participants reported a range of emotions from apprehension to excitement:

Lebo: *Very weird. Like. Cuz, I could, I'm not, I'm not in it... Felt like... I was there. Like, nothing had changed, I was just me... I thought I was going to be aware of the fact that I'm not in that world.*

Thobekile: *OK. I don't know how to put this. So, it was great, I enjoyed it. Honestly, yeah. It's like it was like one another world like... I don't know were, this, those really people that were coming in. Yeah, I felt like. Just in, that I was wondering where am I? Like as in, am I here or I'm outside?*

Dikeledi: *A 4-D experience. I've never, you know, experienced it before. It's kind of new, awesome. You know, when I entered the room and once you wear that thing, the room is completely different. Like, I'm not in the same place where I was before. You know that was...*

Nhelo: *... I just felt like I was in a different dimension, like living in a picture.*

Ayanda: *I was really excited, and it was kind of fun.*

Nonnie: *It was... Can I say out of this world? It didn't feel real until some point which was frightening a bit...*

Bonolo: *I felt awkward. I think it was mostly... what made me feel awkward the most was the knowledge that there are people outside watching. It was a little scary. It was my first experience with VR.*

Twelani: *I was comfortable in the body and then I got a bit scared... I... got used to the routine.*

Herein, it is observed that participants generally recounted mixed experiences. Several participants had found the experience to be exciting and new, while others found the experience to be uncomfortable such as Lebo and Bonolo who recalled the simulation as being awkward and strange. While seemingly dichotomous, a few participants who regarded their experiences as positive overall expressed discomfort in later stages of participation, particularly Twelani and Nonnie who found their experiences soured when interacting with the other avatars. While these collated emotional perspectives provided a good overview of the overarching experience, it does not encompass the array of emotions that were experienced throughout the simulation.

For instance, six of the participants stated that when first entering the world they were uncertain. The majority of these emotions are best encapsulated by Ayanda who stated *"I think I was scared, anxious. Not really sure what would happen, how it would actually make me feel."* In and amongst these emotions participants had also voiced that they felt nervous, shocked, and awkward, hopeless, uncomfortable, perplexed, peculiar and pleasant. Interestingly, when probed about what it felt like to be in the virtual body, one participant expressed empathy towards the embodied virtual body, due to a concern that the body would be stuck or have to stay in the virtual world after the simulation was complete. This level of fear was, albeit self-directed, also echoed by Ayanda. Some of these emotions may be attributed to all participants experiencing an IVR simulation for the first time.

Thobekile: *Yeah, she was just scared. Like, will I be able to be like get out of this glass world or would I stay here forever?*

Ayanda: *Like I did (feel fearful)... Like at some point I wanted to like say stop, but I did enjoy it. It was an amazing experience, but then it's.. kind of scary as well.*

Several of these emotions were reiterated when participants described their experience of interacting with their virtual self in front of the mirror. Predominantly, participants found their first interaction with their virtual self to be strange and weird. However, a few of these individuals felt the experience became normal, easy, and enjoyable, with one participant feeling it was uncomfortable and unnatural.

Lebo: *Then also like looking in the mirror was also very, very weird because I could see my reflection or my avatar, which is me, so yeah... It became normal after like until like 10 seconds. It was very easy too... Cuz It just felt easy to do and right to do. If that makes sense.*

Thobekile: *I didn't see myself. It felt like I was looking at something else because I was trying to... look at myself but it wasn't me. It felt like there is this curtain in front of me... It was Brave and scary.*

Dikeledi: *Besides the difference in complexion, it was kinda weird. But it was fun.*

Nhelo: *It was nice. It was a very weird mirror. It was the biggest mirror I've ever seen.*

Ayanda: *I think I was anxious. Yeah, I'm going to use anxious a lot because I kept wondering what's going to happen. You know, who is going to come in?... I was excited to see everything*

else that I had to do and what was in store for me. Yeah. It was exciting and I couldn't wait to start the experience.

Nonnie: *Surreal... Interesting. It's something different I've never done. So it was interesting...*

Bonolo: *Awkward and uncomfortable. Unnatural.*

Twelani: *It was weird.*

In tandem with this, the majority of participants asserted that their ability to view the virtual world in 360 degrees made their experience enjoyable and made them feel safe. However, one participant did voice that this aspect of the experience was 'scary' as they felt *"it took me out of my comfort zone."* Similar to this, six participants felt that the feeling of being 'in' the virtual body made them feel uncomfortable and was unnatural. Nevertheless, all participants affirmed that they preferred being in their actual body as opposed to being in the virtual body. Such reasons as feeling that their actual body is happier, more liberating, and more comfortable were expressed.

Following this, Participants were asked to explore their experience of encountering the other avatars for the first time. Lebo and Thobekile had recounted feeling an indifference towards the virtual avatars. Lebo had found the avatars to be *"very robotic"* and therefore did not feel emotionally involved or part of the interaction. Thobekile, on the other hand, conveyed that they are content with others observing them. However, they engage in self-philosophy of not focusing on how such observations make them feel. Dikeledi found this interaction to be scary and uncomfortable, whilst expressing joy in being able to interact with *"different races'* other than just *"the White one."* These emotions were echoed by the remaining five participants. Emotions such as

fear, shock, nervousness, intimidation, and anticipation were paralleled in this interaction. Two participants had voiced that this anticipation stemmed from not knowing what the other avatars would do during the interaction. Participants asserted, respectively, that this anticipation made them feel out of place, unwilling to interact with the avatars, and caused discomfort in the form of *‘an increase in heart rate.’* In addition to this, a few participants linked this interaction to feelings of sadness, frustration with their actual selves not being seen and hopelessness due to the simulation feeling like a confined space.

Analogously, it is apparent that the emotional experiences of participants are variable and relatively unique to their subjective realities, despite a shared sense of nervousness. This is evident in the participants’ final recounting of the evolution of their core emotions as the simulation started and ended. Lebo and Nhelo unpacked their experience as a sense of nervousness devolved into the sensation of normalcy, relief, and comfort. Thobekile found their experience to be scary at first, due to a fear of darkness with the headset on which quickly became a feeling of acceptance coupled with enjoyment. Similarly, Dikeledi found their initial emotions to be that of nervous hesitation which became a feeling of enjoyment and upset that the experience was short-lived. Ayanda, on the other hand, expressed that they were originally excited, then anxious and finally disappointed in what she describes as a limited experience, *“I was quite disappointed because of the, the restrictions of not being able to touch the surfaces and not getting... I don't think I got the full experience. I just got the feel of it...”* Nonnie conveyed that her initial excitement gradually dissipated and was replaced by a fearful state of mind upon meeting the other avatars, which persisted till the end of the experiment. Nonnie explained that that fear became disbelief as they found themselves asking *“Did that just happen?”* Bonolo stipulated that they experienced nervousness and self-consciousness. Twelani stated that they felt a sense of nervousness which became a feeling of amazement and longing for a longer interactive experience with more avatars.

Overall, the varied displays of emotion were normalised over time. In relation to their embodiment scores, participants reported feeling and overall embodied experience. However, as mentioned, these experiences coincided with mixed emotions and sensations that would temporarily disrupt or limit the feeling of embodiment. Interestingly, discussions of empathy surrounding race did not occur, which had been observed in the findings of previous literature.

4.4.2 Realism

As shown in Table 1 above, majority of the participants scored on the high end of the embodiment scale, indicating high levels of embodiment experienced. However, the qualitative reports unfurl more varied, and in some instances, unique and nuanced experiences. Realism, in this sense, is ascribed to factors that contribute towards participants' experience of immersion. The confluence of this experience resulted in the emergence of several presiding influences. Participants explored this influence via their experience of the virtual world, their interaction with their virtual body and their experience of the virtual avatars. Albeit divergent experiences of participants, realism was unanimously described through participant notions of '*real*,' bodily experiences and environmental experiences and interactions.

Several participants asserted that their subjective experience of their virtual body was one that allowed them to feel their range of motion was unbridled in its ability to perpetuate a notion of being naturalised and fluid. These actions were regarded to closely resemble their real-life actions. Participants also stipulated that the synchronicity of the reflected actions observed in the mirror aided this sensation. Nhelo claimed that while in the virtual body, the realism achieved through synchrony, and the ability to achieve their goal-oriented tasks allowed them to feel as though "*it's*

me, but it's her also." However, this was offset by reservations expressed by a few participants. These participants stipulated that conditions in the virtual space prohibited or rather limited the expression of free bodily movement. There being, the appearance of virtual gridlines in the virtual space when approaching the boundaries of the play area, in addition to the size of the play area, and potential hazards that they may be unable to see. A number of participants further stated the appearance of the other virtual avatars in the latter half of the session contributed to further feelings of limited movement which they would otherwise not experience in the real world.

Additionally, several participants experienced moments of disembodiment, particularly when observing their own hands or body in IVR. Differences in the appearance of virtual hands compared to their own caused a sense of detachment for some users. Additionally, aspects such as avatar appearance, unrealistic movements, and the limited play area reminded participants that they were in a simulated environment rather than reality. Some described the virtual world as feeling like a "4-D avatar world," emphasizing its artificial nature.

However, this sentiment of the virtual world was not shared by all participants. Participant's opinions of the virtual environment varied greatly. For instance, Lebo, Nonnie, and Twelani reported feeling enamoured by the virtual world. Lebo, Nhelo, and Twelani expressed that the overarching IVR experience was unexpectedly realistic, particularly in one-on-one interactions and in both third and first-person perspectives. This realism extended to forgetting about being in a virtual world at times, whilst some expressed surprise at the level of immersion achieved by the technology. Dikeledi, Thobekile, Ayanda and Bonolo, on the other hand, found the environment to be '*very virtual*,' '*unreal*' and '*unnatural*.' Interestingly, the qualitatively reported experience did not always mirror the quantitative results for the embodiment questionnaire. This could reflect the degree of

complexity and uniqueness when it comes to embodiment experiences. For instance, Ayanda scored low on the embodiment questionnaire, which reflected her qualitative experience. However, this was not the case for Dikeledi, Thobekile, and Bonolo, who retrospectively scored above average to high on the embodiment scale. This discrepancy brings into question the validity and reliability of current measures in this context and would be grounds for further research.

Incidentally, the environment was not the only disruption of immersion for participants. Several individuals felt the presence of other avatars sometimes disrupted immersion. While some avatars were perceived as realistic, resembling characters from a game, others felt these avatars fell short of realism. Some participants indicated the aesthetic of the other avatars and the way in which they traversed the room unsettled them enough to disrupt their feeling of immersion. However, one participant, despite startlingly them, mistook avatars for real people. Albeit the opinions on the realism of the avatars were divided, there were reports of attributing autonomy and the capability of having opinions and emotions to other avatars. This highlights the immersive potential of IVR in studying interpersonal interactions in a virtual space.

Interestingly, the convergence of bodily and environmental experiences resulted in illusions. Participants expressed that the experience of interacting in the world or with their virtual avatar made them feel as though they were interacting in a simulation of previously consumed and related media. For instance, Lebo, Nhelo, Nonnie, and Twelani asserted that the experience was the same as games like Subway Surfer, and Grand Theft Auto. Furthermore, the virtual session was likened to being in a show called The Amazing World of Gumball and movies/ films in which beings reminiscent of the avatars would be hostile. This resulted in some participants being cautious of the other

avatars. Furthermore, participants expressed that being in the virtual world was like being on a different planet or in a different dimension.

Dikeledi: *It feels like I'm in Mars or something. Another planet*

Nhelo: *... I just felt like I was in a different dimension, like living in a picture.*

In other cases, Nhelo had reported that the virtual body felt lighter than their real body. Additionally, Nhelo commented that the virtual room felt 'cooler' in terms of temperature, than the original room. Nhelo expressed they began to feel as though they were wearing the same clothes (black pants and shirt) as the virtual body despite wearing a yellow a dress. Nhelo further noted that it felt as if aspects of their body had become 'smaller' to match the stature of the avatar. Thobekile reported that the virtual environment space felt 'glassy' in nature and almost void of life which made it feel like that environment could have been difficult to breathe in. On the other hand, another participant stipulated that the virtual space was a calming and meditative experience.

4.5 Theme 3: Other Awareness

Within this study, there are two external objects or others, one the participant embodies, and the other avatars present in the latter stage of the simulation. This section engages in the discourse of both these others while unpacking participant experiences of other embodiment. This is achieved through the discussion of Avatar interactions and the act of othering.

4.5.1 Avatar Interactions

Much like the projective identification, as discussed above, participants explored their diverse thoughts and feelings while interacting with the other avatars. Participants reported a mix of reactions to their interactions with the other avatars ranging from finding them to be creepy, to hostile, in-human and robotic. Dikeledi, Nhelo, Ayanda, Nonnie and Twelani stated that when the avatars walked into the room for the first time they had felt scared, however for most of them this sensation quickly dissipated. Nonnie and Twelani further regarded the avatars as intimidating at first. Additionally, Dikeledi and Bonolo regarded the avatars to be creepy. They, collectively, found the avatars unsettling due to the avatars being something that is “*supposed to be human,*” however, it did not encapsulate humanness. In line with this, both Twelani, Nonnie and Bonolo expressed that they were concerned that the avatars were going to attack them. Nonnie stated that her initial reaction was due to their exposure to media with characters resembling the avatars. Consequently, Nonnie acknowledged that they never attempted to interact with avatars due to feeling scared.

Dikeledi: *The virtual people, that's kind of creepy. More or less, that's was the one thing that I'm... OK. That scared me a bit. I was not even expecting it. You know, they look, they're in... some of... are like a human form. It's like there's someone else entering the room. It's not just you and it kind of scares you a bit. But after that you, you know you get used to it and yeah.*

Nonnie: *Okay. I think it's because I've watched a lot of films, or a lot of video games related to such things that look like these avatars. So, in my mind, I felt like when they came out, like oh my gosh, are they gonna attack me? Yeah... So my first instinct was, oh my gosh, they're gonna attack me like they do in these video games.*

Bonolo: *It was creepy... Yeah, just creepy. It's just unsettling, like seeing something that's supposed to embody a human. But it's just it doesn't feel human, and it feels like you don't*

know it's about to attack me or something. I don't know. There was a bit of like anticipation.

Again, I was thinking about the... OMG, they might attack me, even though it's not real. But I felt... I don't know. I was just waiting for them to leave.

Twelani: *OK, I got really nervous because I didn't know what.. in most movies, they fight.*

Lebo, on the other hand, found the other avatars to be robotic and 'not real.' Together with Lebo, Thobekile, Dikeledi, Ayanda and Nhelo found their attempts to interact with the other avatars to be attenuated and unreciprocated. Lebo and Bonolo stated it felt as though the other avatars were not looking at them. Finally, Dikeledi reported finding the presence of the avatars to be comforting as there were *"different races there as well. It wasn't just the White one"* as well as *"different bodies and shapes in virtual form."*

Lebo: *I don't think I felt like they were looking at me because they were just a very robotic. They just came and stood in front of me. I don't think we were interacting, like in any type of way, because I did... there was a time I tried to touch but they left.*

Nhelo: *I didn't have so much interactions. I tried to interact with some of the avatars that came, but like it seemed that their main aim was just to walk through and like, just look at me and not say anything or wave or something. I tried to wave, but like I think they are not responsive to that. So yeah. Yeah, I wish I could have. I could have had a much a real interaction. You know when I'm talking to you right now. Maybe just wave and get a wave back.*

4.5.2 Othering

Through interactions with the other avatars and the virtual other (virtual body embodied) certain biases internalisations and observations were noted by participants.

Dikeledi explained that with the other avatars present, they felt like they were the '*bigger person*' that everyone listens to as the virtual space is different from the real world. Lebo affirmed the other avatars did not move as fluidly as they felt they moved. Nhelo professed they were bitter and upset that the other avatars were unable to know and interact with them in their real body. Lebo, Dikeledi averred that the avatars were robotic, did not interact with them and therefore did not have opinions. Similarly, Thobekile and Bonolo stated that they did not think the avatars had opinions. They then asserted that if they did, their mantra was to not think about or engage in thinking about what others think. Moreover, Ayanda and Nhelo felt like the avatars had opinions. Ayanda posited this was due to the length of time they stood and stared. Nonnie vocalised they perceived the avatars as intimidating and as though they were analysing her.

Nhelo declared that they felt the taller avatars, in particular, were judging her for being short. In conjunction with this, Nhelo noted other characters came across as mean. They pointed out that a specific avatar looked at them "*like they didn't care about me.*" Nhelo had also uttered there was a tall, Black confident avatar that walked by that they "*really wanted to be.*" Likewise, Bonolo and Twelani situated their discomfort with the taller avatars. Conversely, Bonolo also stated they felt more comfortable with the shorter avatars. Finally, Nonnie posited the other avatars likely found her incompetent. They stated the other avatars were likely *thinking "does she know what she's doing here? Is she following the instructions correctly?.."*

Nhelo: *I feel like that that made me want to tap into my, my, my original body at that point to. Say OK guys. Look at me. You know her I want you to see me, but I realized that they probably see the girl in black.*

Nhelo: *Some were taller. So, I felt like they were looking at me, like okay, short girl and they would just pass, and I feel like some were mean. There's like one girl, long hair, I think she was wearing a blue shirt. She was short and she was just looking like. OK, bye. OK. I don't know how to explain it, but it didn't look like you really cared at all about me. For most of the times. I felt like I felt I felt like there was meaningless, but there were just certain characters which is that... that the tall Black girl with the afro who passed there. She was... I feel like she looked very confident, and I really wanted to be her, and I think at that moment I was like, I realized that, oh, cool. They could have just used this body. They could have just made me occupy that body. I could have just felt a little bit different than myself.*

When embodying the virtual other, participants noted differences between their virtual self and actual self. However, these were predominantly aesthetic and lived experiences.

Lebo, Thobekile, Dikeledi, and Nhelo claimed the avatar had a different skin tone to them. Thobekile noted that the avatar looked 'doll-like' or 'toyish' with long and lean hands which is in opposition to how they view themselves. Thobekile and Ayanda also stated they are comfortable and happy with their own body; however, the virtual body makes them feel as though their autonomy is hindered in the virtual space. Similarly, Nhelo considers their real body to be happier and remarked that the virtual body did not have their tattoos. Furthermore, Thobekile and Dikeledi stipulate the virtual body structure was slimmer or thinner than them. Bonolo stated the virtual body looked 'discombobulated,' inhuman and had body shape, feet, skin colour, and hair unlike their

own. Ayanda remarked that the virtual body seemed shorter than them. Likewise, Nonnie acknowledged a disparity in their skin tone and body structure and the skin tone and structure of the virtual body. Twelani found the virtual body appeared older than them and the hand and body movements were dissimilar to their own. Finally, participants held mixed opinions on whether or not the virtual arms and legs were similar to their own.

Following these considerations, several participants noted that if they had been in a virtual body that looked like their real body, their experience would have been significantly different. More specifically, participants noted that they may have felt more connected to the virtual body and, less aware of differences such as skin tone, height, and body shape. In addition to this participants stated that the experiences would not have felt so foreign to them. Twelani further iterated that in this scenario they may have likely forgotten they were using virtual reality.

4.6 Comparison of Quantitative and Qualitative Results

It should be noted that all participants, had not interacted with IVR before the simulation. This is not reflective of their living standards measure either. Most participants fall into the moderate access to wealth and most access to wealth categories in the living standards measures (See Table 5 below). This prevalence of negative emotions (fear, nervousness, uncertainty, uneasiness, etc.) is likely due to participants' lack of experience with IVR and their exposure to similar events in media and games that represented similar contexts in a '*scary*' light. This is consolidated by a few participants who wished to experience the simulation again as it would be different now that they know what to expect of an IVR simulation.

TABLE 5

LIVING STANDARD MEASURE SCORES

Code	Living Standards Measure Results (Max score = 10)
	Rating
P1: Lebo	Level 10 (Low)
P2: Thobekile	Level 9 (High)
P3: Dikeledi	Level 7 (Low)
P4: Nhelo	Level 9 (High)
P5: Ayanda	Level 7 (High)
P6: Nonnie	Level 8 (High)
P7: Bonolo	Level 7 (High)
P8: Twelani	Level 8 (High)

Self-esteem in comparison to embodiment scores does not necessarily indicate a correlation. However, in comparison to how participants compared themselves to their avatars and recounted their experiences within the virtual bodies, showed a small relationship with self-esteem scores. For example, a few participants with above-average embodiment and self-esteem (See Table 6 below) mentioned they prefer their own body more (*"I love being in my body"*), finding the virtual body to be *'unnatural'* and discombobulated. While other participants with markedly lower self-esteem such as Nhelo, mentioned *"I took a break from my body. That was really exciting because sometimes I fantasise about it..."*. However, this is not true for all individuals in this sample. Interestingly, Lebo and Ayanda who have mentioned the identity of *'coconut'* and *'oreo'* respectively, scored normal self-esteem scores and above-average embodiment scores. Additionally, Dikeledi and Nhelo, who both scored low on their self-esteem scores expressed that the avatars are lighter or thinner than themselves (*"it was thin and I'm not..."*; *"even my body weight was much lighter..."*). Similarly, Nonnie remarked that they felt the avatars believed she was incompetent, *"does she know what she's doing here? Is she following the instructions correctly or something like*

that.” While not necessarily indicative of self-esteem scores, it does showcase the potential of helping unpack related thoughts and issues in the field of psychology, similar to echo Summer’s et al., (2021) assertion of the capability of IVR usage in assessing and treating dysmorphia. However, A larger population would be required to make a definitive claim regarding the association between embodiment and self-esteem scores.

TABLE 6

FINAL EMBODIMENT SCORES

Code	Rosenberg Results (Max score =30)		Final Embodiment Scores (Max score =7)	
	Score	Rating	Score	Rating
P1: Lebo	21	Normal	4.4	Above average
P2: Thobekile	17	Normal	5	Above average
P3: Dikeledi	12	Low	6.3	Very High
P4: Nhelo	13	Low	5.2	Above average
P5: Ayanda	18	Normal	3.1	Below Average
P6: Nonnie	8	Low	4.4	Above average
P7: Bonolo	28	High	6.6	Very High
P8: Twelani	23	Normal	5.8	High

4.7 Conclusion

In essence, this social-affective interaction emphasises the uniqueness of participant experiences at various stages of interaction in the IVR session. It also consolidates the need to look at both qualitative and quantitative results to get a fuller understanding of participant experiences of embodiment.

Chapter 5 : Discussion and Conclusion

5.1 Discussion

5.1.1 Summary

This study aimed to explore subjective experiences of immersive virtual reality when embodying an avatar of another race group in a sample of Black-identifying female participants. Thematic analysis of semi-structured interviews of eight participants identified three core themes, specifically: (1) self-awareness ; (2) embodiment experiences; and (3) other awareness. This study aimed to explore the subjective experiences of self and other embodiment, body ownership in virtual reality, and develop an interview schedule.

As expected, one of the main themes reported by participants centred around the self, particularly the minimal self, including body agency and body ownership as well as embodiment and disembodiment experiences (Ahn et al., 2013; Duval & Wicklund, 1972; Seghezzi et al., 2019). This is in line with how philosophers have defined and described the minimal self, as a reflection of experiences of selfhood and sensory information (Gallagher, 2000). Similarly, the prevalence of emotion-based interactions was anticipated following Gall et al. (2021) who proved emotional processing increases when high embodiment is experienced. However, a unique contribution of this study was to explore the subjective experience of feelings of embodiment using IVR drawing on a diverse sample and the mixed and unique realities arising from the South African context, which resulted in rich descriptions of experiencing virtual reality for the first time and notions of hybrid identity (i.e. the “coconut effect”). It is such discussions and results that will be further unpacked in the discussion section below. Further, the results of this study highlight the benefit of drawing on qualitative methods in experimental IVR research, in addition to gold-standard psychometric

methods, which provide greater depth and meaning to participant experiences and therefore complement quantitative reports.

5.1.2 Bodily and IVR Experiences

This study found that there was a consortium of sensations felt by participants which are aligned to their senses of agency and ownership while inhabiting the virtual body (Haggard et al., 2002). In this regard, while dealing with a limited sample, participant responses stressed the variability within each of these sensations. Ergo, the extent to which participants reported feeling embodied, ownership, agency and responsiveness using the avatar embodiment measure, are not explicitly reflected in their qualitative experiences (See Table 4 in Chapter 3). Instead, they show a spectrum upon which these sensations may be felt. For instance, some participants in this study reported feeling a high level of agency in the embodiment questionnaire. However, these participants reported qualitatively diverse and different feelings regarding this overall sense of body agency. Specifically, participants reported they felt they were limited in their autonomy due to restrictions. For example, Nhelo, Ayanda, Nonnie and Bonolo stated (respectively) that their movement was limited due to '*grid lines*', being worried about 'bumping into things' as a result of limited space and feeling as though '*it was like a job to move*'. Consequently, in looking at the results of this study, when participants began to expand on their feelings of virtual embodiment, participants reported additional ideas of what would be needed to enhance embodiment in the simulation. For example, participants stated the Avatars looked '*doll-like*', were '*in-human*', '*robotic*' or '*creepy*' in the way that they moved and had limited interaction with them. Thus, participants indicated aspects of realism, space and interaction that, if addressed, could enhance feelings of immersion and embodiment. Future studies using a larger sample size will help ground these exploratory results. Furthermore, the qualitative reports added richer and complementary data to support the overall feeling of embodiment to include a sense of excitement or even apprehension in

some cases. Taken together, these results support the proposal of integrating more qualitative methods into experimental studies on embodiment and self-experiences, to provide more phenomenologically rich data.

Making use of a third-person perspective (i.e., the mirror) to view the virtual body, together with moving the virtual body in synchrony with their own, is considered a gold standard approach eliciting an embodiment experience drawing on multisensory integration (Debarba et al., 2015; Peck et al., 2013; Peck & Gonzalez-Franco, 2018; Peck & Gonzalez-Franco, 2021; Slater et al., 2009; Slater et al., 2010; Tsakiris, 2017). Interestingly in this study, using qualitative reports, participants found the mirror interactions helpful to varying degrees. They had mixed reports on viewing their virtual body in the mirror and seeing the other virtual avatars in the mirror personal interactions to help or hinder their ability to feel embodied. In comparison, as described in Chapter 3, most participants scored above average for embodiment and aesthetic embodiment. However, the third-person interactions (interaction away from the mirror with observable parts of the virtual body) allowed most participants to not focus on the aesthetic differences but rather focus on the speed of movements, synchrony of actions and goal-orientated behaviours that mirrored their own. This interaction specifically, in tandem with interacting with the environment away from the mirror, is what majority of the participants felt made them feel embodied.

Similar to the above, Slater et al. (2009) found that when participants move their '*real*' body and at the same time get visual feedback that the virtual body is moving in tandem with theirs, a sense of ownership could be felt. Analogously, Swinkels et al. (2022) reported that participants have the ability to aid in their ability to experience a full-body illusion and embodiment through their own movements and positions. Further, Heersmink (2020) and Serino et al. (2018) posit that an

individual's sense of self, body ownership and body schema can become flexible (plastic) with body illusion experiments such as the rubber hand illusion (despite aesthetic differences). Moreover, Slater et al. (2009) assert the effectiveness of the visuo-motor synchrony experiments (utilised in this study) in deducing sensations of embodiment and proprioceptive drift as opposed to other methods (visuo-tactile synchrony and computer interface-based experiments), which are deemed less effective. Therefore, our qualitative reports of these multisensory experiences of movement are generally aligned with the results of experimental studies, with the aesthetic differences emerging as a less important factor.

Interestingly, as stated above, participants experienced sensations of being in different dimensions, gaming worlds or feeling cooler or lighter. This is what Slater et al. (2009) refer to as plausibility and place illusions. Plausibility illusions are the illusion that events happening in IVR are real and relate personally to the individual using the equipment (Slater et al., 2009). Place illusions, on the other hand, create the strong illusion of being in a specific place despite the sure knowledge that they were not there (Slater et al., 2009). While intriguing and not reported (to the researcher's knowledge) within full embodiment IVR studies, similar instances have been reported in studies dealing with rubber hand and related rubber hand illusion experiments (Rohde et al., 2013; Crivelli et al., 2023). Additionally, such reported changes in body temperature were noted by Kocur et al. (2022).

It was found that participants who experienced strong embodiment experiences in the Rohde et al. (2013) and Crivelli et al. (2023) studies experienced a cooling of the hand temperature. Worth noting, is that while stronger embodiment was experienced for the individuals with colder temperatures, this higher embodiment was not reported for the participants who

claimed they felt colder when in the virtual body. Similarly, as with Serino et al. (2018), no notable differences in embodiment scores (higher embodiment in younger participants) were noted when comparing participant embodiment scores and the ages of participants. However, this discrepancy could also be due to additional factors such as the virtual body being a different race than the participant.

There was an exception with plausibility illusions. Lebo reported feeling the world was glassy and felt difficult to breathe in, scoring an above-average embodiment score. In addition to this, those individuals that experienced place illusions (Lebo, Nhelo, Nonnie, and Twelani) had, overall, reported average to above-average embodiment. Furthermore, despite reporting sensations similar to proprioception, Ayanda (as mentioned) scored low on body ownership which is consistent with Rohde's et al. (2011), assertion that proprioception and body ownership are governed by different mechanisms.

Unexpectedly, all participants reported no experience with IVR. This is in contrast with participants' scores in the categories of moderate and most access to wealth on the LSM. This likely indicates a digital divide in access to such experiences or technologies (Kumm et al., 2022; Ndulu et al., 2022). Nevertheless, when access was given to these technologies through the current study, the lack of previous exposure made no difference, with most participants reporting that they enjoyed and were excited by the IVR simulation.

5.1.3 Biases, Internalisations and Identity

As with previous literature utilising IVR embodiment experiences, associated topics around internalisation and biases arose (Peck et al., 2013; Peck & Gonzalez-Franco, 2018; Peck & Gonzalez-

Franco, 2021; Slater et al., 2009; Slater et al., 2010). However, the results did not coverage with the expressions of empathy, as stipulated in a few of the prior studies (Peck et al., 2013; Peck & Gonzalez-Franco, 2018; Peck & Gonzalez-Franco, 2021; Serino et al., 2018). Instead, most descriptions of these interactions were devoid of empathetic discourse towards an individual of another race. Instead, these experiences with the other avatars and the virtual self culminated in rhetoric regarding the focus on the physical differences between the participants and their avatars. More specifically, participants would engage in a comparison of their body and presence in a given room to that of the virtual body, rather than focusing on the skin colour of the avatar. The discussion thereof seemed to offer an internal lens into the way in which individuals conceptualise themselves in similar spaces.

The above discourse appeared to echo Summer's et al. (2021) correspondence of the potential IVR has in creating space for discussing issues surrounding body dysmorphia, in terms of focusing on physical dimensions other than skin colour. However, as previous studies (Banakou et al., 2016; Chen et al., 2021; Peck et al., 2013; Peck & Gonzalez-Franco, 2018; Peck & Gonzalez-Franco, 2021; Schulze et al., 2019) focused on unconscious racial bias as measured by the Implicit Association test (Pennington et al., 2023), it is possible that there was not a conscious reflection of aspects of race in the actual qualitative interview of this study, but there were implicit processes occurring that cannot be captured by the interview process.

Interestingly, the discourse surrounding the Black or African identity for some participants harked back to the contemporary literature on Identity, Black Identity and Black consciousness (Du Bois, 2018; Easthope, 1998; Fanon, 1952; Lewes, 1879). Steve Biko (2002) propagated the Black Consciousness movement in an attempt to reverse the mentality surrounding Black people and

encourage the notion that 'Black is beautiful' and be proud of their culture, and identity (Ojo-Ade, 1981). Evident throughout the interviews is the iteration of participants stating that they *are 'Black and proud of it..'*

However as mentioned above, some participants noted that they are often identified as being a 'coconut' or 'oreo' due to not feeling like or being told they did not fit within 'norms' of what is expected of a Black individual due to certain backgrounds, or mannerisms etc. This indicates the existence of a hybrid identity that exists amongst some individuals within the Black community. Homi Bhabha iterates that this hybridity entails an individual who possesses two or more biological, ethnic, and cultural identities (Easthope, 1998). This sense of hybridity is similarly referred to by a concept known as double consciousness. This identity is splintered and resultant of prior racial oppression. It engages in a concept called double thought which involves trying to maintain the original identity whilst adhering to the expected norms of the dominant group (Lewes, 1879). Both Du Bois (2018), and Frantz Fanon (1952) have noted the occurrence of similar phenomena. Fanon (1952) argues that a form of this culminates in what he dubs as a 'Neurosis of Blackness'. That is the persistence of the oppressive power, which continues to affect the consciousness of the Black Identity may percolate into individuals attempting to dress, behave and look like oppressive power. While it might not be indicative of a "Neurosis of Blackness," it does indicate that there is a preconceived societal notion of what is Black and what is not, which is in itself a form of self and othering. Interestingly, the final embodiment scores of the participants identifying as these categories (Oreo or Coconut) were comparatively lower than other participants.

In addition to the above, a few participants noted that during their IVR experience, they began to identify as light-skinned despite acknowledging the avatar did not share an identity with

them as it lacked the aspects that coincided with their Black and African identifying identities. In addition to this, some of the participants reported the virtual body's mind and their mind were thinking the same things, were orientated towards achieving the same goals and shared mostly the same personalities. One participant even noted they experienced a hybrid identity as they felt like they were 'two people at once'. While this is congruent with Heersmink (2020), Serino et al. (2018), Slater et al. (2009) and Swinkels et al. (2022), Bian et al. (2015) and McCreery et al. (2012) found that individual's attitude, perceptions and behaviours were not the same as the virtual self or persona. However, these deviations could be the result of role adoption of the participant's personally created character, while the IVR character did not have a role and was pre-created for participants to use (McCreery et al., 2012).

Similarly natured and structured experiments to the main study investigated implicit racial bias (Banakou et al., 2016; Chen et al., 2021; Peck et al., 2013; Schulze et al., 2019). As such, it was expected that race as a bias may appear as a topic brought up by participants. However, this was not the case. Instead, the biases that were presented were towards the other avatars not looking or moving as realistic as the embodied virtual body, discomfort in the presence of taller avatars, comfort in the presence of shorter avatars, and some participants believing the other avatars judged them for being short or incompetent.

5.1.4 Embodied Cognition Theoretical Framework

As previously mentioned, embodied cognition is dependent on and is effectively influenced by our experiences in our bodies such as those achieved through motor processes, sensory systems, and interactions with the environment (Borghi & Carauna, 2015). In addition to this, the kind of body an organism possesses influences cognition (Borghi & Carauna, 2015). In this study, participants

reported that their interactions within the environment helped them feel as though they were embodied within the virtual body which was achieved through visuo-motor synchrony. Furthermore, some participants reported interacting (moving) in the virtual body allowed them to feel as though it was their own to an extent, with some participants reporting they began to feel “*smaller*,” “*lighter or light-skinned*.” The above findings, as mentioned prior, are consistent with the assertions of Heersmink (2020), Serino et al. (2018), Slater et al. (2009) and Swinkels et al. (2022). However, despite some aspects of the environment and body aiding in a feeling of embodiment or ownership, such as the synchronous movements, participants stipulated they did not always feel embodied. It was reported that some elements of their interaction made them conscious that they were not embodied within the virtual body such as awareness of the available space in real life, ‘*cartoony*’ or ‘*unreal*’ looking avatars and environments. However if this could be remedied with a larger play area and perhaps a more realistic simulation and avatars, participants noted they may have more easily been “absorbed” by the simulation. This highlights the need for realistic virtual environments and interactions to obtain an embodied experience.

In lieu of the above, there exists a disparity between quantitative and qualitative data as there is a lack of juxtaposition between the two accounts of embodiment. This brings into question if participants are truly feeling fully embodied or rather experiencing embodiment on a partial physical, emotional and cognitive level (ie., participants feel as though they are in partial control of the body, present, etc.). Furthermore, if participants are experiencing embodiment, based on the qualitative account this sense of embodiment is not consistent throughout the experience. However, the measure used to elucidate embodiment scores suggests overall embodiment. These parallel narratives suggest that embodiment is fundamentally more complex. More specifically, it is possible to feel overall embodied whilst still experiencing moments of disembodiment. Moreover, the requirements and extent to which an individual experiences Embodied Cognition and finds the IVR

simulation realistic may be unique to individual narratives, interactions, expectations and prior experiences with similar technologies or related media or entertainment.

5.1.5 Emotional States

As mentioned above, participants displayed an array of emotions when interacting in the IVR space. Of these, emotions such as being scared, nervous, and anxious were most common. As previously mentioned, participants expressed that these negative emotions were the result of prior exposure or no exposure to IVR and related experiences. In addition to this, most participants found their original negative emotions began to dissipate as they became accustomed to the IVR environment and the sequences of events within it. Furthermore, participants situated that these emotions may be different if they had to experience the simulation again. To the researcher's knowledge, the limited literature on qualitative experiences has not engaged in unpacking the emotional experiences of the participants, nor have they expressed the familiarity participants have with IVR. Furthermore, as discussed above, the high emotional process in relation to high embodiment scores can be observed in the findings of this report, which is in concord with Gall et al. (2021) findings. Gall et al. (2021) noted the higher the embodiment experience of an individual, the more emotional processing they would engage in. This is in line with the final embodiment scores of participants, as they have all obtained an average to high embodiment score. However, the participants' engagement with emotional discourse remained relatively similar to one another. A larger sample size would be required in order to discern if the emotion talk varies in tandem with embodiment scores and to elucidate the existence of similar findings amongst the populous and within the South African context.

In relation to their embodiment scores, participants reported feeling and overall embodied experience. However, as mentioned, these experiences coincided with mixed emotions and sensations that would temporarily disrupt or limit the feeling of embodiment. This suggests that despite an overall sense of embodiment, these experiences are unique, personal, and not always consistent throughout the IVR experience. Additionally, it suggests emotional states have the capacity to contribute to feelings of disembodiment. A larger sample would be required to discern if this would have an influence on consequent embodiment scores.

Interestingly, discussions of empathy and race did not occur, which had been observed in the findings of previous literature (Barbot & Kaufman, 2020). This study did not intend to use the IVR to generate empathy, following the caution of Banakou et al. (2016) and Sora-Domenjó (2022). However, discussions of race and empathy were expected due to this study being based on Peck et al. (2013) which aimed to explore if implicit racial bias can be reduced by embodying a body of a different race from your own, using IVR. However, there was no rhetoric on empathy brought up by participants of this study. The only exception was a participant who was concerned that the virtual body would be stuck or have to stay in the VR environment forever, once the simulation was complete. As mentioned above this could have been due to the fear, joy, excitement and nervousness that participants experienced when interacting with IVR for the first or how realistic they found the simulation. However, the researcher believes that such deviations are also subject to the diverse, mixed and unique realities arising from the South African context, in addition to the age of the participants. Most of the participants (aged 19-33) are considered “Born Free” or have been born and grew up in post-apartheid (ended 1994-31 years ago) South Africa which focused more on tolerance, acceptance and equal treatment of individuals of all races (British Broadcasting Corporation, 2014). However, a larger and wider age range sample would be needed to confirm if such findings are applicable.

5.1.6 The Interview Schedule

As mentioned by Pyasik et al. (2022), most studies in this field of research are quantitative-driven. However, there are some studies that also utilise qualitative data collection methods such as Harth et al. (2020), Spangenberg et al. (2022) and Ventura et al. (2018). In tandem with Spangenberg et al. (2022), participants in this study gave a self-reflective, first-person account of their experience. Despite methods of conducting embodiment simulations being different, accounts of experiences in this study and in Harth et al. (2020), and Spangenberg et al. (2022) papers, revealed that participants experienced unique and subjective interactions as well as changes in body and self-other perceptions.

Following the completion of the data collection, the schedule underwent further changes. Other than the changes made during the pilot stage of the interview (See Chapter 3), several of the questions were split into parts to encourage participants to talk about various aspects of their experience. For instance, when addressing realism, participants were asked to report on interaction with themselves, the environment and the other avatars or participants were asked to address feelings and thoughts about certain aspects of the simulation separately.

In a similar vein, participants were also asked to express some of their thoughts and feelings about the interaction processes in the simulation. This caused participants to be more open about their emotional experiences throughout the interaction. Further, participants became more open about the way controlling the virtual body and interacting with the other avatars made them feel. This allowed for more opportunities to probe them about their individual experiences. Additionally, questions were added to encourage participants to talk about identity, personality, behaviours, and interactions in front of the virtual mirror. This enabled the researcher to engage in rich discussions

about the real self, the virtual self and othering experiences with the participants. As per the elicitation technique (described above), questions regarding moving as the virtual avatar and the sensation of being in the virtual body were added. This allowed the researcher to draw out discussions around proprioceptive drift, unconscious experiences, and self-awareness. Finally an explanation of how the elicitation technique works was added to account for participants not understanding the reason for referring back to certain aspects of their interaction and being considered they may not be answering correctly.

5.1.7 Participant Feedback

As described in the methods, the participants were also asked to provide general feedback on the experience, as using IVR in a low-to-middle-income country context is still a new method (Botha et al., 2023). Here a suitable number of the participants reported that they felt the simulation was too short and that there were not enough avatars. Participants felt the other avatars were robotic and wished they could have more of an interaction with them such as being able to speak, wave, or have the avatars orient themselves towards them. Participants also stipulated that they did not expect to feel anything (emotion) during the simulation, and did not expect the simulation to feel as real as it did. Additionally, voiced that they were concerned about bumping into objects in the 'real world' and were less inclined to move as a result. Furthermore, participants were concerned that the experience would have been 'weird and uncomfortable,' but reported a positive experience in the end. Finally, despite having the lowest embodiment scores, a participant reported that the simulation was perfectly executed. Overall, these descriptive results suggest that despite previous research on notions such as the 'digital divide' (Ndulu et al., 2022) and a growing expertise in virtual reality methods in experimental settings in contexts such as South Africa (Gilpin et al., 2021), this study provides further evidence for the feasibility of virtual reality research in low-resource contexts like South Africa.

5.2 Strengths, Limitations and Future Directions for Research

To the best of our knowledge, this is the first study in the literature to draw on a group of Black-identifying participants who embody an avatar of another race group (i.e., light-skinned avatars; see Higgins et al., 2024). As argued by other South African teams, (Botha et al., 2023; Gilpin et al., 2021; Higgins et al., 2024; Matshabane, 2021), there is a need to increase diversity, inclusion, and equity in virtual methods studies for local and international impact. This current study contributes to this growing need and call. Furthermore, although VR methods are growing in contexts like South Africa (e.g., Botha et al., 2023; Gilpin et al., 2021; Matshabane, 2021), using immersive VR by creating a full-body illusion (see Blanke & Metzinger, 2009) has not been conducted in the South African Context, which is a further strength of this research. Furthermore, although there has been a rapid increase in the use of IVR methods to study embodiment (Banakou et al., 2016; Chen et al., 2021; Peck et al., 2013; Peck & Gonzalez-Franco, 2021; Schulze et al., 2019), only a handful of studies have drawn on qualitative methods to unpack the subjective experiences of participants. This exploratory study acts as a pilot study for future research to draw on additional qualitative methods to enhance our understanding of these rich phenomena.

Additionally, this report engaged with reliable, appropriate, and valid data collection methods. In addition to this, these data collection methods and techniques were thoroughly and rigorously documented. The researcher engaged in the thorough unpacking of findings and discussions. Such findings and discussions further included alternative explanations, which were applicable. Throughout this report, the researcher has consistently addressed biases, limitations, implications, and future avenues for research. An elevated level of transparency and replicability and replicability was ensured through thick descriptions, audit trails, reflexivity, and aspects of the data collection tool being made publicly available, as mentioned prior. Moreover, the researcher partook

in triangulation, crystallisation, regular peer, participant and supervisor discussions and findings examinations, as mentioned above.

While there are strengths to the study there were several limitations. One such limitation is the small sample size. The study included only eight participants, which might still be considered as an adequate number to achieve data saturation (Fusch & Ness, 2015), however, a larger sample size may have revealed further insights. However, due to the technical nature of the IVR simulation, including a larger number of participants was beyond the scope of this current research report. Additionally, the original study aimed to also recruit a sample of White-identifying participants who embodied a dark-skinned (i.e., Black) avatar, as in previous studies (Peck et al., 2013). However, unfortunately, only a very small number of White-identifying participants responded to the various calls for participants. Therefore, a further limitation of this study was not having a comparison group. Nevertheless, this also speaks to wider challenges in the South African context in conducting research around race and racism (Durrheim, 2024; Gonzalez-Sobrinio & Hughey, 2014).

In terms of the IVR simulation, there were a few limitations also observed. Virtual reality is still a developing science (Slater, & Sanchez-Vives, 2016), and the avatars and environment used might have lacked adequate dashes of realism (Weber et al., 2021), as noted by some of the participant interviews. For example, in some cases, participants claimed that this aesthetic made them uneasy and less inclined to interact with them. Participants also stated that they felt, the other avatars would look past them and therefore felt that there was not much interaction happening between them. Participants have also not engaged in discussions surrounding race and empathy, as expected by previous research. This unexpected outcome may have been a result of several factors such as this being the first time most of the participants have experienced Immersive Virtual Reality:

aspects affecting embodiment and realism such as the limited space, appearance of gridlines and the 'doll-like' or 'cartoony' impression of the other avatars and the virtual body. Further than this, the Interview schedules focused on how the participants felt in response to their interaction with the other avatars and what the other avatars thought of them as opposed to explicitly asking them about interactions with the different races. However, it should be noted that this was done in an effort to not prime answers and allow such topics to emerge naturally in the interview with the participants.

Future studies can not only attempt to enhance the realism of the virtual world and avatars but also the social interactions taking place. Additionally, the IVR world was built as a basic simulation that tried to exclude the influence of any external factors. Therefore a basic warehouse room was used. However, in line with increasing the diversity of the avatars and participants used in IVR research, the IVR environment could also be more ecologically valid in future studies, but using more local South African scenes (e.g., a university setting, a village or township context). Furthermore, future studies could also draw on focus group methods to discuss the general IVR experience in a group setting, rather than using only individual interviews.

With the growth of entertainment towards more immersive experiences, the lived experience in this study facilitates the need to understand the impact of immersive virtual reality experiences on self and other perceptions as well as mental wellness. As this study focused primarily on Black-identifying individuals, further research could be conducted to include embodiment experiences of other raced individuals (such as Indian, Asian, and Mixed individuals in the South African Context) in a body different from their own to provide a comparative analysis of experiences. Further research could also be conducted through longitudinal means to establish if there is a

change in these lived experiences over time. Another direction, in this context, could also include a questionnaire on mood to explore if embodiment experiences are affected by mood. Due to similar findings as Summers et al. (2021), related research could also utilise the expertise of psychologists to gain insight into utilising immersive virtual reality to address mental wellness issues such as insecurities and body dysmorphia. Additionally, later investigations could be conducted on children's perceptions of race, and body ownership in virtual bodies different from their own, with the aim of unpacking these experiences in relation to older individuals. Here, research could also explore how children perceive colour and race compared to older individuals. This could also explore how these perceptions develop or change over time. Similarly, research could cross-compare perceptions and experiences of different age or generation groups, following the example of Serino et al. (2018).

Moreover, future research could further the exploration of the association between self-esteem and embodiment scores. Additionally, the discrepancy between embodiment scores and what is explored qualitatively, calls into question the validity and reliability of current methods of exploring embodiment in studies of this nature. As such a more integrated and critical explanation can provide deeper insights into such findings, which is grounds for future investigations. Finally, a future avenue for research may present itself in unpacking how experiences of marginalisation ('Oreo' or 'Coconut effect' as it presents itself in this study) shape participants' relationships to the embodied avatar.

5.3 Reflexivity: The Research Process

When the data collection and analysis portion of the research process commenced, I was a bit hesitant and nervous when engaging with the participants and the interview process. Albeit being a postgraduate student, my honours and final postgraduate year occurred during the COVID pandemic. Degrees had a big focus on research. Since we were required to collect data, my data was collected in compliance with COVID guidelines. Consequently, my experience with conducting data collection for qualitative data was limited to online interactions. I was unsure if I was prepared or had the necessary skill set to conduct the interviews in person. However, with the piloting of the interview schedules, and the more interviews I conducted, I became more confident in my ability to interview participants.

The recruitment process was staggered as there did not seem to be an initial interest in this particular study. However, there was a steady flow after a while, despite a few cancellations and 'no-shows'. During the interview process, I remember being hyper-aware of my position as a researcher. I remember acknowledging that I am an Indian male researcher interviewing female Black-identifying participants. I tried to ensure that I remained sensitive and respectful of these differences in both my interaction and analysis of participants. Furthermore, my awareness of my 'maleness' and that we live in a country wrought with issues surrounding gender-based violence and injustices to women prompted me to take additional steps to make the participants feel more comfortable. I would book rooms for interviews across the hall from the lab where my female supervisors and colleagues conducted a portion of the testing. I gave participants the ability to choose their preferred seating in the interview room. In addition to this participants were asked if they were alright with closing the door and allowed to leave it open, if they felt more comfortable this way. Moreover, I would always place the keys to the room within view of the participant, on a desk with the other tools and documents needed for the interview, between the participant and me.

I was quite excited and anxious about conducting interviews with a schedule that I had created. While this schedule was based on aspects of the avatar embodiment questionnaire and similar instruments, as mentioned above. I had a small fear that the schedule would not elicit data around existing topics, themes, and contexts of the report. Fortunately, the pilot stage allowed the opportunity to refine the interview schedule. Interestingly, my initial fear came true, however in a positive light. I found that aspects of the data did not coincide with some prior findings. In this case, empathy and race were not brought up. Albeit there was a focus on the more corporeal and incorporeal sensations participants experienced. Additionally, other themes began to emerge surrounding identity, hybridity, self-image, self-esteem, and body image that were particularly interesting. However, I felt unequipped to further explore these facets and notions as it was bordering on sensitive topics. In light of the above, I found myself perplexed by the data analysis process. It coincided with rigours engagement with the data to generate themes fitting of data that certain unique aspects from what I observed in previous literature. While writing these themes previous literature assisted, however could not entirely guide the structure of the emergent themes.

5.4 Conclusion

Overall, this exploratory study provided the first qualitative accounts of using IVR with a sample of Black-identifying female participants to explore subjective experiences of embodiment of the virtual body of another race group. The results of this study highlight the importance of including qualitative methods to complement traditional questionnaire-based methods in IVR research, to provide more nuanced insights into phenomenologically rich concepts such as self and other awareness. This study also showed the basic feasibility of using IVR methods in under-resourced contexts like South Africa. Further, it highlighted the 'digital divide' (i.e., first-time experiences with

IVR), place illusions, plausibility illusions, and hybrid racial identities (i.e., the “coconut effect”), resulting from the diverse South African context.

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Appendix A. Demographic Questionnaire

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Demographic Questionnaire

Name: _____

Surname: _____

Age: _____

Date of Birth:

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Ethnicity: ☐ Black-Identifying ☐ White-Identifying ☐ Coloured-Identifying

☐ Indian-Identifying ☐ Other

Gender: ☐ Male ☐ Female ☐ Other

Home Language: _____

Question	Answer	
1. I have the following in my household		
TV Set	True	False
Swimming Pool	True	False
DVD Player	True	False
M-Net/ Dstv subscription	True	False
Air conditioner	True	False
Computer/Laptop	True	False
Vacuum cleaner/ floor polisher	True	False
Dishwashing machine	True	False

Washing machine	True	False
Tumble dryer	True	False
Home Telephone (excluding cell)	True	False
Fridge/ freezer (combination)	True	False
Electric stove	True	False
Microwave oven	True	False
Built-in Kitchen sink	True	False
3 or more cell phones in the household	True	False
2 cell phones in the household	True	False
Home theatre system	True	False
2. I have the following amenities in my home or on the plot:		
Tap water in house/on plot	True	False
Hot running water from a geyser	True	False
Flush toilet in/outside house	True	False
3. There is a motor vehicle in our household	True	False
4. I am a city dweller	True	False
5. I live in a house, cluster, or townhouse	True	False
6. I live in a rural area outside Gauteng	True	False
7. There is no radio or only one radio (including car radios) in my household	True	False
8. There are no domestic workers or household helpers in the household (both live-in & part-time)	True	False

Appendix B. Rosenberg Self Esteem Scale (RSE)

Rosenberg Self-Esteem Scale (RSE)

Please record the appropriate answer for each item, depending on whether you strongly agree, agree, disagree, or strongly disagree with it.

1 = Strongly agree 2 = Agree 3 = Disagree 4 = Strongly disagree

- _____ 1. On the whole, I am satisfied with myself.
- _____ 2. At times I think I am no good at all.
- _____ 3. I feel that I have a number of good qualities.
- _____ 4. I am able to do things as well as most other people.
- _____ 5. I feel I do not have much to be proud of.
- _____ 6. I certainly feel useless at times.
- _____ 7. I feel that I'm a person of worth.
- _____ 8. I wish I could have more respect for myself.
- _____ 9. All in all, I am inclined to think that I am a failure.
- _____ 10. I take a positive attitude toward myself.

RSE scale is a 10 items scale developed by Morris Rosenberg to measure self-esteem.

Scoring: Scores are calculated as follows:

For items 1, 2, 4, 6, and 7:

Strongly agree = 3

Agree = 2

Disagree = 1

Strongly disagree = 0

For items 3, 5, 8, 9, and 10 (which are reversed in valence):

Strongly agree = 0

Agree = 1

Disagree = 2

Strongly disagree = 3

The scale ranges from 0-30. Scores between 15 and 25 are within normal range; scores below 15 suggest low self-esteem.

Important: Please note that this self-assessment tool is for reference and screening purpose only, it is not for diagnostic purpose.

Appendix C. Avatar Embodiment Questionnaire

Participant ID _____

Condition _____

Please select your level of agreement with the following statements:

“During the experiment, there were moments in which...

References in the questionnaire to body would need to be updated if only a body part is being explored. Blank spaces _____ depend on the experiment. Questions 14-16 can refer to the feet in touch with the virtual floor, if there are no further tactile stimuli this interpretation is preferable to removing the touch questions. }

Q1. I felt out of my body”

<i>never</i>	<i>almost never</i>	<i>rarely</i>	<i>half of the time</i>	<i>often</i>	<i>most of the time</i>	<i>always</i>
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Q2. I felt as if my (real) body were drifting toward the virtual body or as if the virtual body were drifting toward my (real) body”

<i>never</i>	<i>almost never</i>	<i>rarely</i>	<i>half of the time</i>	<i>often</i>	<i>most of the time</i>	<i>always</i>
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Q3. I felt as if the movements of the virtual body were influencing my own movements”

<i>never</i>	<i>almost never</i>	<i>rarely</i>	<i>half of the time</i>	<i>often</i>	<i>most of the time</i>	<i>always</i>
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Q4. It felt as if my (real) body were turning into an ‘avatar’ body”

<i>never</i>	<i>almost never</i>	<i>rarely</i>	<i>half of the time</i>	<i>often</i>	<i>most of the time</i>	<i>always</i>
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Q5. At some point, it felt as if my real body was starting to take on the posture or shape of the virtual body that I saw”

<i>never</i>	<i>almost never</i>	<i>rarely</i>	<i>half of the time</i>	<i>often</i>	<i>most of the time</i>	<i>always</i>
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Q6. I felt like I was wearing different clothes from when I came to the laboratory”

<i>never</i>	<i>almost never</i>	<i>rarely</i>	<i>half of the time</i>	<i>often</i>	<i>most of the time</i>	<i>always</i>
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Q7. I felt as if my body had changed”

<i>never</i>	<i>almost never</i>	<i>rarely</i>	<i>half of the time</i>	<i>often</i>	<i>most of the time</i>	<i>always</i>
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Q8. I felt a _____ sensation in my body when I saw _____”

<i>never</i>	<i>almost never</i>	<i>rarely</i>	<i>half of the time</i>	<i>often</i>	<i>most of the time</i>	<i>always</i>
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Q9. I felt that my own body could be affected by _____”

<i>never</i>	<i>almost never</i>	<i>rarely</i>	<i>half of the time</i>	<i>often</i>	<i>most of the time</i>	<i>always</i>
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Q10. I felt as if the virtual body was my body”

<i>never</i>	<i>almost never</i>	<i>rarely</i>	<i>half of the time</i>	<i>often</i>	<i>most of the time</i>	<i>always</i>
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Q11. At some point, it felt that the virtual body resembled my own (real) body, in terms of shape, skin tone or other visual features.”

<i>never</i>	<i>almost never</i>	<i>rarely</i>	<i>half of the time</i>	<i>often</i>	<i>most of the time</i>	<i>always</i>
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Q12. I felt as if my body was located where I saw the virtual body”

<i>never</i>	<i>almost</i>	<i>rarely</i>	<i>half of the</i>	<i>often</i>	most of	always
	<i>never</i>		<i>time</i>		the time	
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Q13. I felt like I could control the virtual body as if it was my own body”

<i>never</i>	<i>almost</i>	<i>rarely</i>	<i>half of the</i>	<i>often</i>	most of	always
	<i>never</i>		<i>time</i>		the time	
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Q14. It seemed as if I felt the touch of the floor in the location where I saw the virtual feet touched”

<i>never</i>	<i>almost</i>	<i>rarely</i>	<i>half of the</i>	<i>often</i>	most of	always
	<i>never</i>		<i>time</i>		the time	
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Q15. It seemed as if the touch I felt was caused by the floor touching the virtual feet”

<i>never</i>	<i>almost</i>	<i>rarely</i>	<i>half of the</i>	<i>often</i>	most of	always
	<i>never</i>		<i>time</i>		the time	
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Q16. It seemed as if my feet were touching the virtual floor”

<i>never</i>	<i>almost</i>	<i>rarely</i>	<i>half of the</i>	<i>often</i>	most of	always
	<i>never</i>		<i>time</i>		the time	
(-3)	(-2)	(-1)	(0)	(1)	(2)	(3)

Appendix D. Interview Schedule

The Interview Contract: Defining the framework, objective, and confidentiality of the interview

Make sure to ***greet the participant***. Allow them time to get comfortable and ask any questions they need to regarding the interview process.

Notify participants of the aim of your study and the purpose of the interview and the types of questions it aims to address (e.g., This study ***aims to develop a phenomenological interview schedule*** for immersive virtual reality experiences. The purpose of this interview is ***to gather information about your subjective experience*** of the virtual reality world and the embodiment of a virtual body).

Explain that ***the study will use repetitive questioning*** to understand their experience in depth.

Remind them that their role is voluntary, and they may withdraw from the study should they feel it necessary. ***Explain steps that will be taken to address confidentiality***. If required, affirm roles in the interview process. When the participant is done asking questions and content to continue, begin asking questions. ***May I confirm that you agree to be recorded and understand what you have consented to?***

Commencing the Interview

If you feel comfortable to start, I would like you to take a step back with me to when you first entered the virtual reality simulation.

Evocation state: Exploring Bodily Sensations

Work with the participants to help encourage them to engage in introspection surrounding their experience.

Visual Introspection

Q1: How was your virtual reality experience with the experiment today?

❖ **Elaborative Prompt:** In what way?

Q2: Could you walk me through some of your thoughts and feelings while interacting in the VR world?

Q3: Thinking back could you describe what you saw when you first entered the VR world?

❖ **Prompt:** What was it like being in that scene?

❖ **Elaborative Prompt:** How so?

❖ **Prompt:** How did you find the realism/ quality of the world, and what makes you say that?

❖ **Transitional Prompt:** While still thinking about what you could see, I want you to start to focus on the sensations of your body.

Kinesics Introspection

Q1: Could you describe where your virtual body was in the VR world?

Q2: How did this make you feel in relation to your real body?

❖ **Elaborative Prompt:** What makes you say this?

Q3: What was it like moving and interacting in the VR world?

❖ **Elaborative Prompt:** Can you explore this a bit more for me?

Diachronic structure: Exploring experience over time

Explore the sequence of events with participants. Can prompt with phrases like “What did you do then?” / “How did you know x?/.” Can use the following questions to guide, however, the focus should be on eliciting sequential introspective experience.

Example questions:

1. You said you saw x when you were in the virtual world. Can you walk me through what happened when the experiment started?

2. What did you do during the experiment?
3. What did you do then?
4. What were you thinking while doing this?
5. Can you describe how it made you feel?
6. You said saw x; did you interact with x?

Synchronic Structure: Deeping Understanding of Experience

Attempt to exploring the following themes in detail with the participant.

Virtual World

1. You mentioned that this was an x experience for you. What have your experiences with VR been?
2. Could you describe how it was being in the VR world?
3. What was it like having a 360 degree experience of the world?
 - ***Elaborative Prompt:*** What makes you say this?
 - ***Elaborative Prompt:*** What was it about the world that made it feel realistic?
 - ***Elaborative Prompt:*** What made it seem unrealistic?
 - ***Elaborative Prompt:*** Did you feel like you could interact with the items in the virtual environment?
 - ***Elaborative Prompt:*** Did you feel you could move freely?
4. What were your feelings towards being in the VR world?

Embodiment

Presence

1. Could you explore your sensation of being in the virtual body?
2. Did you feel connected to your virtual body?
 - ***Elaborative Prompt:*** What makes you say that?
3. Would you say you felt like you were in the virtual body?
 - ***Elaborative Prompt:*** How did you know this?

Similarity

1. At any point did you feel similar or different to your virtual bodies (in the sense that you felt represented or misrepresented in the virtual body)?
 - ***Elaborative Prompt:*** Would you mind explaining these instances?
2. Which body did you feel most aligned with?
 - ***Elaborative Prompt:*** Why do you feel that way?

3. If you had an exact virtual body replica of yourself that you got to experience in the VR world, how do you think your experience would differ?

Ownership

When you were in the virtual body, did the body feel like your own?

- **Elaborative Prompt:** How did you know this?

Mirror Experiences and Race

1. How would you identify in terms of ethnicity?

Elaborative Prompt: Would you say you always feel aligned with this?

Elaborative Prompt: Would you mind elaborating?

2. How does this differ from how others identify you?
3. What was it like looking in the mirror?
4. What was it like seeing and interacting with yourself in front of a mirror?
 1. What was it like looking down at your virtual arms and body?"
 2. How did these compare?
 3. What was it like when the virtual bodies came into the room?
 4. How did you feel when the other virtual bodies stopped to look at you?
 5. Did this differ depending on the virtual body?
 6. Do you think they had opinions of you?
 - **Elaborative Prompt:** How do you know that?
7. Was this dependent on which virtual body came in?

Identification with Virtual body

1. What was it like being in the virtual body?
2. Would you say you related to the virtual body bodies?
 - **Elaborative Prompt:** What makes you feel that way?
3. How did this experience compare to being in your own body?
4. How did your identity as the virtual body compare with your own?
 - **Elaborative Prompt:** What makes you feel that way?

Concluding the interview

Once questions are finished, thank them again for participation. Ask if there are anything further questions about the study, participation, or interview. Stipulate that they may contact the

individuals on the information sheet if they have any further concerns regarding the data collection/interview process

1. What were you thinking and feeling before engaging in the study as opposed to after it ended?
2. How did you feel returning to your own body?
3. Do you think your experience with VR has influenced your experience today?
 - ***Elaborative Prompt:*** How so?
4. Is there anything else you would like to add about your virtual reality experience?

Appendix E. Initial Interview Schedule

Introduction to the Interview Process

Make sure to greet the participant. Allow them time to get comfortable and ask any questions they need to regarding the interview process. Remind them that their role is voluntary, and they may withdraw from the study should they feel it necessary. Explain steps that will be taken to address confidentiality. If required, affirm roles in the interview process. When the participant is done asking questions and content to continue, begin asking questions.

Questions

Q1: How would you identify in terms of ethnicity?

Prompt: Would you say you always feel aligned with this?

Prompt: Would you mind elaborating?

Q2: How was your experience in virtual reality in this experiment?

Prompt: Could you walk me through some of your thoughts and feelings while interacting in the VR world?

Q3: What were you thinking and feeling before engaging in the study?

Q4: Did you feel connected to your avatar (e.g., virtual body)?

Probing Question: Would you say you felt present in the avatars and the virtual world?

Prompt: What makes you say that? / Would you mind exploring that for me?

Q5: Could you describe your experience of being in the virtual body?

Prompt: How similar did you feel to your avatars?

Prompt: How different did you feel from your avatars?

Prompt: How was your experience being in each avatar?

Q6: What was it like being in the avatar?

Probing question: How did this experience compare to being in your own body?

Prompt: Did you feel like it was your own body?

Q7: At any point did you feel aligned or misaligned with your virtual bodies?

Probing Question: Would you mind explaining these instances?

Probing Question: Which body did you feel most aligned with?

Q8: What was it like seeing and interacting with yourself in front of a mirror?

Q9: If you had an exact avatar replica of yourself that you got to experience in the VR world, how do you think your experience with the other avatars would differ comparatively?

Prompt: Please elaborate.

Q10: Did you identify with your virtual body?

Prompt: Please elaborate.

Q11: Would you say you felt embodied?

Probe: Please elaborate.

Q12: Is there anything else you would like to add about your virtual reality experience?

Concluding the Interview Process

Round up the discussion. Ask if there is anything further questions. Stipulate that they may contact the individuals on the information sheet if they have any further concerns regarding the data collection/interview process. Ask if they would like to hear the findings of the study if they are interested. Finally, thank them for participation in the study.

Appendix F. Information Sheet

Information Sheet

Good day, we are conducting a study entitled: *Exploring the phenomenology of self and other embodiment of the virtual self-using immersive virtual reality*. We wish to invite you to participate in this research as you meet the criteria of being a healthy individual with normal or corrected to normal vision without the need for glasses as well as not suffering from epilepsy and having no family history of epilepsy. Before you decide to continue, it is important for you to understand why this study is being done and what it involves. Kindly read the following information sheet and discuss anything that is unclear or if you require further information. Take this opportunity to decide whether or not you wish to participate in this study.

Purpose of the Study: This study aims to use Immersive Virtual Reality (IVR) in order to produce a sense of body ownership in healthy participants from different ethnicities and investigate perceptual components of embodiment and the virtual self.

What is Immersive Virtual Reality (IVR)?: IVR uses computer technology to enable users to experience and interact with a simulated environment. Headsets (helmets, goggles, or headpieces) are used to display images of a computer-generated world, which creates an immersive experience with a three-dimensional stereoscopic view. Position trackers embedded in the headset sense the position and orientation of the user and transmit this information to a computer, which updates the images for

display in real-time. Together the technologies can create real/believable experiences and give users that they have “stepped inside” a virtual environment.

What Participation Involves?: If you wish to take part in this study, you will be asked to complete a consent form, a demographic questionnaire, and an interview. You will then be asked to take part in the IVR section of the study, which involves wearing a head-mounted display for approximately 10 minutes, embodying an avatar, and interacting in a virtual world. Finally, you will be asked to complete a questionnaire and Interview, which will be audio recorded, after the virtual reality scenario to explore your feelings of embodiment and your virtual self. It is important to note that since this study involves a researcher-administered questionnaire and interview, tests and IVR scenario face-to-face interactions between the participants and the researcher will take place. Therefore, complete anonymity cannot be guaranteed. However, measures will be taken to ensure confidentiality, such as limiting access to those involved in this study (i.e., the researcher and research assistants). The research procedure will take approximately 45-60 minutes.

Risks and Benefits of the Study: Participation is not anticipated to have risks, however, please take the following into consideration when deciding whether or not to participate in this study. Individuals have reported experiencing some degree of nausea when using virtual reality systems. Some studies have provided evidence to suggest that using head-mounted displays might result in vision disturbances afterwards. While we are unaware of any long-term IVR studies, existing studies usually do testing after about 30 minutes, which shows that this effect is occasionally still present after this period.

Additional side effects have also been reported, such as 'flashbacks.' Finally, like any type of video equipment, there is a possibility that an epileptic episode can be induced. For example, epileptic episodes have been reported for computer video games. Therefore, we would like to stress that you are not obliged to participate in this study and can withdraw at any point without a given reason.

You can also opt to not answer any particular question and there will be no negative consequences if you choose to do so. All data collected and information of individuals who have been excluded or withdrawn voluntarily will in default be disregarded and destroyed. It is important to note that some of the matters of interest in this research can be considered as sensitive, such as ethnicity. Therefore, should you feel distressed as a result of this study you may receive free counselling by contacting the South African Depression and Anxiety Group: 011 262 6396.

Research Outcomes: Our will be used to compile a research report, which will be available and accessible in the library of the University of the Witwatersrand and on the World Wide Web. Additionally, the findings from this study eventually may be published in a scientific journal as well as reported at scientific meetings.

Concerns and Enquiries: Should you have any concerns, complaints, enquiries or require clarification or further information about this research please do not hesitate to contact Dr Sahba Besharati, sahba.besharati@wits.ac.za

Appendix G. Informed Consent Form

Informed Consent Form

I, _____ hereby confirm that I have read and understand the information provided in the information sheet in relation to the research entitled: Exploring the phenomenology of self and other embodiment of the virtual self-using immersive virtual reality. I have adequately been informed about the research procedures, and what participation involves and have been given sufficient time to consider whether or not to participate in this study. I also understand that:

- My participation is completely voluntary.
- I may withdraw from the research at any time with no negative
- consequences for me.
- My research data will be kept anonymous, and my participation will be treated with confidentiality.
- No anticipated risks are associated with participation in this study –I have been given a number for free counselling services if I experience any distress that may be elicited by this study

Declaration by Participant

I hereby consent to take part in this study Participant's name:

Signature:

Date:

Appendix H. Examples of Baked Goods for Participants



Appendix I. Ethics Certificate (Main Study)



R48 Dr S Besharati, et al

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL) CLEARANCE CERTIFICATE NO. M211139

NAME: Dr S Besharati, et al
(Principal Investigator)

DEPARTMENT: Department of Psychology
School of Human and Community Development
University

PROJECT TITLE: Embodiment using immersive virtual reality and the
reduction of cross-cultural bias

DATE CONSIDERED: 2021/11/28

DECISION: Approved unconditionally

CONDITIONS:

NOTE: If contact information regarding student study participants is required,
please contact the Registrar's office - <Nicolsen.Potgieter@wits.ac.za>

SUPERVISOR: Not applicable

APPROVED BY: 
Dr CB Penny, Chairperson, HREC (Medical)

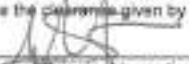
DATE OF APPROVAL: 2022/08/22

This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and ONE COPY returned to the Research Office secretariat on the 3rd floor, Philip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to submit details to the Committee. I agree to submit a yearly progress report. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in November and therefore reports and re-certification will be due in the month of November each year. Unreported changes to the study may invalidate the clearance given by the HREC (Medical).


Signature of Principal Investigator

26/08/2022

Date

Appendix J. Ethics Clearance Certificate (This Study)



SCHOOL OF HUMAN AND COMMUNITY DEVELOPMENT ETHICS COMMITTEE **CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)**

CLEARANCE CERTIFICATE

PROTOCOL NUMBER: MAPSYC/23/01

PROJECT TITLE:

Exploring the phenomenology of self and other embodiment of the virtual self, using Immersive virtual reality.

INVESTIGATOR

Ajodhya Sachin (2579505)

SCHOOL/DEPARTMENT OF INVESTIGATOR

SHCD/Psychology

DATE CONSIDERED

14 June 2023

DECISION OF THE COMMITTEE

Approved unconditionally

RISK LEVEL

Minimal Risk

EXPIRY DATE

31 December 2025

ISSUE DATE OF CERTIFICATE

03 June 2023

CHAIRPERSON


(Dr Aline Ferreira Correia)

cc: Dr Sahba Besharati (Supervisor)

DECLARATION OF INVESTIGATOR

To be completed in duplicate and ONE COPY returned to the Chairperson of the School/Department ethics committee.

I/we fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure be contemplated from the research procedure as approved, I/we undertake to submit an amendment of the protocol to the Committee.

Signature



Date

2023 / 08 / 01

Appendix K. Ethics Training Certificate



Zertifikat Certificat Certificado Certificate

Promouvoir les plus hauts standards éthiques dans la protection des participants à la recherche biomédicale
Promoting the highest ethical standards in the protection of biomedical research participants

Certificat de formation - Training Certificate

Ce document atteste que - this document certifies that

Sachin Ajodhya

a complété avec succès - has successfully completed

Introduction to Research Ethics

du programme de formation TRREE en évaluation éthique de la recherche
of the TRREE training programme in research ethics evaluation

Release Date: 2023/04/06
CID : MPH/MC/eth/3


Professeur Dominique Sprumont
Coordinateur TRREE Coordinator

APPROVED BY
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