

VIRTUAL CHANGE BLINDNESS AND ITS IMPACT ON MODELING HELPING
BEHAVIORS

by

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ABSTRACT

Change blindness is the failure to notice changes to visual scenes. While often studied as a perceptual phenomenon, its effects on associated behavior, particularly in virtual settings, has yet to be fully leveraged or explored. This research investigates how unnoticed changes in avatar appearance due to Change Blindness can influence the modeling and adoption of helping behaviors. The study investigates how perceived similarity to a model influences self-efficacy, identification, empathy to increase costly helping behaviors, or those which require a sacrifice of resources, time, etc. to complete. Findings indicate that, while Change Blindness did occur, there was no impact on helping behavior. This paper highlights opportunities to investigate and utilize Change Blindness in virtual settings, expanding its application beyond perceptual phenomena to behavioral change.

INDEX WORDS: change blindness, virtual, helping behaviors, social cognitive theory, self-efficacy, avatars, modeling.

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DEDICATION

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CHAPTER 1

INTRODUCTION

As more daily interactions move to strictly virtual spaces, the malleability of virtual identities has become increasingly relevant to everyday users. Scholars have argued that virtual identities have been fluid since the first email system (Dürscheid et al., 2013), wherein users were able to alter their name on their email accounts to appear as someone else. These options have only continued to proliferate, from programs such as instant messenger and Skype permitting username changes (Lo Iacono et al., 2016), to modern programs like VR Chat and Roblox which allow people to create sophisticated avatars, or virtual characters that can represent users with different voices, personalities, and appearances (Maloney, 2021).

Given the rising relevance of shifting virtual representation during social interactions, it is worth studying the underlying processes by which these shifts are detected. Human beings have incredibly complex visual systems, capable of taking in and analyzing visual data multiple times per second. However, such rapid shifts create visual blind spots, causing individuals to miss minute visual changes to a scene, such as objects moving from one side of the room to another (Masuda & Nisbett, 2006) or their color changing (Williams & Simons, 2000). These changes to a scene that go unnoticed by observers are referred to as change blindness (CB) (Simons & Levin, 1997; Simons & Rensink, 2005).

It was Grimes (1996) who established the modern structure of CB research, transitioning from rearranging letters during reading comprehension tasks (McConkie & Zola, 1979) to the detection of minor *visual* changes, such as shifts in object color, the number of objects in a scene, or what clothes a person is wearing (Simons, 2000; Simons & Rensink, 2005). CB provides a

systematic approach to explore how perceptions (or the lack thereof) of the communication process, such as sender and receiver characteristics, communication context, and mediating environment, can influence message reception and communication outcomes, core tenets of communication scholarship.

The majority of virtual CB research has examined participants' change detection of objects, looking at how CB is affected by the number of objects in a scene (2023) or the complexity of objects presented (Vasser et al., 2015). Senel et al. (2022) conducted one of the first studies of CB with virtual characters, where participants completed a Qi Gong exercise in virtual reality while their own character's and instructor's face slowly shifted. Results showed that CB occurred (i.e., the avatar's change in appearance was undetected by participants) 73% of the time with the player's avatar and 85% of the time with the instructor's avatar. This study expands on Senel (2022) and other virtual CB studies by evaluating how appearance shifts in virtual characters impact CB while simultaneously leveraging these changes to impact behavior. These findings are anticipated to guide future scholarship and practice in applying change detection principles to behavioral scenarios.

CB is also understudied in applied and behavioral contexts, as past research often examined it as a primarily perceptual phenomenon rather than examining its influence on broader interactions. Much of CB in applied settings has focused on eyewitness testimony (G. Davies & Hine, 2007; Jaeger et al., 2017; Wulff & Hyman, 2022), and the difficulty observers face when recalling specific, small details in criminals' appearances. There are outliers who examined how external decision making, such as Jones et al. (2002), who found that people who socialize with substances (alcohol and cannabis) were better at detecting changes to cannabis and alcohol-related images than non-substance-related images. The current study builds off these

approaches with an exploratory investigation of how CB influences perception of others in virtual settings.

This study applies the theoretical tenets of behavioral modeling to investigate how CB can influence associated behaviors. Modeling is a factor described in social cognitive theory (SCT; Bandura, 1991), which asserts that humans' fundamental drive for social interactions causes them to look to others for examples of what behaviors to perform and how to perform them. SCT argues that people are so socially driven that they often learn behaviors from models without needing to perform the behavior themselves (e.g., vicarious reinforcement, (Bandura et al., 1963). (Salisu & Ransom, 2014) Modeling plays a critical role in developmental socialization as early as the infant stage (John, 1999; Schunk, 1987), where parents and peers model fundamental skills such as communicating, speaking, and interacting with the world around them. Modeling is also used as a training tool in various contexts to affect behavior change where it has been associated with improved learning outcomes (Schunk, 1987), workplace performance (Guerin & Toland, 2020; Guo et al., 2011), and treating mental health disorders like PTSD (Couineau & Forbes, 2011) and phobias (Guerrin, 2012). This extensive research speaks to the value of modeling and its use in this study.

Self-efficacy can also be nurtured through modeling or vicarious experiences, emphasizing the social nature of SCT (Bandura, 1998; Bandura et al., 1963). Humans' fundamentally social nature allows us to make assumptions about the consequences of our actions through observations of others' behavior (Schunk & Usher, 2012). Particularly when models (person or persons being observed) are similar to observers, observing a model's behavior increases the observers' belief that they can perform similar behaviors and obtain similar results, strengthening self-efficacy (Bandura, 1998). Across decades of meta-analyses,

self-efficacy has been connected to attitudinal and behavior change, such as employee motivation and performance (Cherian & Jacob, 2013), academic performance, and health behaviors like quitting smoking (Gwaltney et al., 2009) to name a few.

Traditionally, modeling involved the observation of other people, but emerging technologies now enable modeling through *avatars*, or virtual characters in digital environments that are controlled by human users (K. L. Nowak & Fox, 2018). Avatars are often used in contexts where users require or want a digital representation of themselves in a virtual space, such as video games or immersive virtual environments, popularly known as virtual reality (VR) (K. L. Nowak & Fox, 2018). Avatars of all types are more common in today's media landscape than ever, with apps like VR Chat reaching peaks of 100,000 simultaneous users (*Metrics.VRchat.Community*, 2024), and Meta users creating over a billion avatars since 2019 (*Customize Your Meta Avatar With New Body Shapes, Hair and Clothing*, 2023). As people engage more frequently with and observe avatars in their daily communicative activities, scientific examination of virtual interactions on users' attitudes and behaviors both in and outside of virtual environments has risen in turn (Bombari et al., 2015; Nikolaou et al., 2022; Smith & Neff, 2018).

It is possible for viewers and users to build a sense of emotional and cognitive connection with these characters through extended use, wherein individuals begin to see the avatars as representative of themselves, a process referred to as *identification* (Birk et al., 2016; Fox & Bailenson, 2009; Green et al., 2020). Although identification was originally developed in the media psychology literature examining perceived connections between audiences and television characters (Feilitzen & Linné, 1975; Hoffner, 1996), research has shown that people build

similar connections to avatars they design and control in other modalities like video games (D. Li et al., 2013).

Identification between the user and their avatar is thought to be driven by two factors evaluated in the current study: similarity between the individual and the avatar and the avatar possessing traits the individual desires (Praetorius & Görlich, 2020; Van Looy et al., 2010a). Each factor heightens the user's sense of connection with the avatar, leading them to feel connected to their avatar's behavior and performance, and by extension causing participants to perform more behaviors they associate with that avatar (Van Looy et al., 2010a). This finding is crucial for virtual modeling, as it means that users can be incentivized to perform behaviors simply by building a relationship with the right kind of virtual character. Studies have found that identification with avatars can lead to an increase in physical exercise (Birk et al., 2016; Waddell et al., 2015; Wang et al., 2020), self-confidence (D. D. Li et al., 2013; Yee et al., 2009; Yee & Bailenson, 2007), friendliness (Praetorius & Görlich, 2021; Van Der Heide et al., 2013), to name a few.

Model-observer similarity further highlights how a connection with a character or individual, formed through identification, can influence behavioral outcomes. Similarity is often conceptualized in broad demographic categories (e.g., race, gender) or shared identities (e.g., wearing school paraphernalia to identify a common student identity (Gaesser et al., 2020; C. Kim & Harwood, 2019), but in media studies, has also been tied to personality, behavior, or life experiences (Reeves & Miller, 1978). Prior literature has shown that similarity between the observer and the model motivates modeled behavior to a greater extent than dissimilar ones in domains including education (Hoogerheide et al., 2018; Schunk, 1985), sports (Clark & Ste-Marie, 2007; Gould & Weiss, 1981), the workplace (Downes et al., 2021; Ozyilmaz et al., 2018),

and healthcare (Klassen & Klassen, 2018). This study leverages these findings through an investigation of how modeling similarity impacts behaviors.

Helping has been conceptualized as providing aid which may not necessarily be motivated by the intention to benefit the recipient (Silke et al., 2018; Van Leeuwen & Zagefka, 2017). In the right situation, individuals will sacrifice short-term benefits or resources with the chance for reciprocation, referred to as costly helping (Hein et al., 2010). Both types of helping, costly and otherwise, benefit not only the beneficiary but the helper, as helping is associated with improved mental health (Son & Padilla-Walker, 2020), greater happiness (Aknin & Whillans, 2020; Song et al., 2020; Weiss-Sidi & Riemer, 2023), and improved academic (Caprara & Cervone, 2000; Gillies, 2019) and professional (Dirk et al., 2019) performance.

Modeling has also been found to increase pro-social behaviors, such as a meta-analysis by Jung et al., (2020) which found that modeling prosocial behaviors including helping, significantly increases their frequency and performance in both the modeled and novel contexts. Comparable results were found with a meta-analysis of media and modeling, where viewing prosocial content was associated with an increase in prosocial behavior after viewing (Coyne et al., 2018). Narrowing further, studies with avatars have shown that embodying or controlling characters that perform collaborative (Dolgov et al., 2014), helpful (Rosenberg et al., 2013), or heroic (Guegan et al., 2020) actions can increase users performance of the same helping behaviors. These studies provide strong support for the relationship between modeling and behavioral outcomes and their application in the current study.

Helping behaviors are further worth investigating through the lens of CB because of how extensively they are influenced by characteristics of the beneficiary that can be visual, namely in-group identifiers. According to social identity theory (Tajfel & Turner, 1979), individuals

categorize themselves and others into ingroups (groups they identify with) and outgroups (groups they do not identify with). When individuals perceive others as members of their ingroup, often through visual identifiers such as race, gender, or shared identities (e.g. common workplace or university; (Greenwald & Pettigrew, 2014; Hein et al., 2010), they are more likely to exhibit ingroup favoritism, or a desire to benefit one's ingroup (Balliet et al., 2014). A meta-analysis of 212 studies conducted from 1963-2013 showed an increase in cooperation, including helping behavior, amongst ingroup members at the expense of out-group members (Fu et al., 2012). In-group favoritism also motivates costly helping, where individuals will endure physical pain (Greenwald & Pettigrew, 2014; Hein et al., 2010) carry heavier loads (Lee & Setoh, 2023), and expend more time in helpful tasks (McClung et al., 2017) for ingroup members but not for negatively perceived outgroup members.

Given how important visual indicators of group membership are to helping behaviors, this paper proposes that CB could disrupt these processes by shifting group identifiers in real time. CB should also play a role in model salience, as shifting model appearance between similarity to the observer may result in a congruent change in emulating the behaviors of that model. Avatars provide a meaningful way to evaluate how appearance impacts both processes, as their appearance can easily be shifted to create high levels of similarity or dissimilarity between many different observers.

While intergroup interactions have often been considered influential in performing helping behaviors, less work has been done to understand the psychological constructs underlying these behaviors (Jung et al., 2020; Penner et al., 2005). For example, through the use of Change blindness, we are able to investigate how other relevant constructs, like attention, inform intergroup helping. Secondly, while intergroup theories largely investigate identities like

race and gender as *static* constructs (Paluck et al., 2019; Pettigrew, 1998; Pettigrew et al., 2011), CB enables us to investigate them as flexible characteristics, providing concrete behavioral insight into how participants view and are influenced by different valences of group membership.

To explore these questions, the current study uses rapidly shifting avatar appearances to manipulate the level of similarity between the observer (participant) and the model (avatar). In doing so, it hopes to enhance our understanding of virtual CB, and how dynamic appearance change influences behavioral outcomes of modeling through the cultivation of self-efficacy, providing design principles for both scholars and practitioners.

CHAPTER 2

CHANGE BLINDNESS AS A PERCEPTUAL AND APPLIED PHENOMENON

When observing visual stimuli, the human eye scans the information 3-4 times a second to interpret and quickly build a mental representation of that image in the observer's mind. However, these movements are often too quick to notice every detail of a scene, and mental representations of images are often built upon initial observation regardless of later changes (Jensen et al., 2011; Simons, 2000). For these reasons, CB occurs when seemingly significant changes in visual stimuli are unnoticed by observers (Simons & Levin, 1997). This effect was first observed during reading, where experimenters found that reading ability was unaffected by rearranged or missing letters (e.g., from, 'The fLoRiDa EvErGlAdEs' to 'tHEfLORIdA eVeRgLaDeS') (McConkie & Zola, 1979). Assessing reading comprehension while making similar changes to wording, spelling, and sentence structure served as a template for the next 15 years of CB studies (Simons & Levin, 1997).

CB was then applied to visual stimuli by Grimes (1996), where large changes to images, such as swapping people's heads, went unnoticed by participants. Further experiments have employed various methods to induce CB, including saccadic movements (eye movements) (Henderson & Hollingworth, 2003; Simons & Levin, 1997), "mudsplashes" (brief visual obstructions) (O'Regan et al., 1999), and cuts or pans in films (Simons & Levin, 1997). These studies have consistently shown that without direct attention, changes, even significant ones, can be missed. For example, Simons and Levin (1998) conducted an experiment in which participants failed to notice an abrupt change in the person they were talking to (i.e., a completely different person) after a brief interruption, provided the replacement person was wearing similar clothes.

The driving mechanism of CB as illustrated by these examples is attention; it is required for observers to note the original form of the object, whether it changes, and how it changes (Jensen et al., 2011). By extension, if attention is drawn towards specific types of tasks that increase cognitive load, it will further distract observers from stimulus changes (Jensen et al., 2011). For example, participants asked to track appearing letters failed to notice when those letters change color or when images behind the letters changed (A. Hollingworth et al., 2001; A. R. Hollingworth, 2000). CB is also affected by characteristics of the task, as change is easier to detect during tasks that require less attention and are therefore less difficult, or those where information is presented more slowly (Jensen et al., 2011).

The current study's focus on behavioral outcomes merits an exploration of how CB has been applied to behavior outside the realm of strictly perceptual research. One such domain is eyewitness testimony, as witnesses are often called on to remember minute details of people, events, or scenarios and life-altering decisions for others based on that information (Jaeger et al., 2017; Nelson et al., 2011). Davies and Hine (2007) found that intentionally planning to recall burglar faces significantly increased correct identification ($M = 8.69$, $SD = 1.41$) compared to unplanned recall ($M = 6.20$, $SD = .45$). Wulff and Hyman (2022) found that, even when primed to attend closely to the theft, participants consistently made identification errors, falsely identifying a bystander as a criminal. Driving involves similarly complex visual scenes, with researchers finding that objects that require more attention (e.g., avoiding something in the road) results in less CB than objects that do not pose a direct threat (Beanland et al., 2017; Galpin et al., 2009). These studies illustrate how attention to minute changes in visual information directly effects human decision making, with the goal of the current studying being to expand on how attention affects behavior with a focus on virtual settings and applications.

The Investigation of Change Blindness in Virtual Environments

While traditional CB studies used flat, 2-d images, researchers began to turn to immersive virtual environments to understand how CB occurs in more ecologically valid settings while retaining precise experimental control (Vasser et al., 2015). Traditional CB stimuli often lack interactivity and auditory feedback, making them very distinct from the complex 3-D space humans perceive in the real world. Some studies did examine CB using real 3-D spaces, such as Marquis & Sugden (2021) who evaluated CB by swapping out confederates asking for directions on a crowded street. However, these lacked the precise control present in traditional image studies, such as people walking down the street at different times of day between participants, the time of day affecting participant visibility of the confederate, and so on.

Technologies like VR can circumvent these limitations by offering because they present the user with a 3-D space that more closely resembles the complexity of visual stimuli and their presentation (e.g., objects in the foreground and background) in real life. Further, because these scenarios are pre-programmed, they can be controlled (Triesch et al., 2003), limiting the impact of confounds inherent to applied research such as significant differences between participant experiences (Harrison & List, 2004; Roe & Just, 2009). Taken together, the virtual worlds allow for a closer examination of how attention to novel changes occurs in more ecologically valid contexts.

Researchers have begun to leverage this capability and investigate virtual CB more frequently, with findings suggesting that CB occurs in 3D environments in ways that are comparable to traditional images. For example, Martin et al. (2023) found that changing one visually simple object (e.g., a pillow) into another object within a virtual living room was easier to detect than relocating an object that is visually more complex (e.g., a potted plant). Across two

studies, Vasser et al. (2015) relocated virtual objects in non-immersive (online) and immersive (VR) 3D environments to evaluate how CB occurs in environments with 3D depth perception. Results showed that CB occurred in both settings and more often with objects in the background than in the foreground.

While these studies outline the occurrence of CB in virtual settings, a deficit of studies exploring its impact on virtual characters is noteworthy because of potential uses cases for applying CB to promote behavioral change. Virtual characters can often be customized in significant ways, which could allow them to become completely different characters that prime different attitudes and outcomes through a rapid visual shift. As supported by social identity theory, decades of research have established that group membership can positively influence behavior towards ingroup members and negatively influence behavior towards outgroup members (Tajfel et al., 1979). This phenomenon has been observed where people are willing to share more resources (Coull et al., 2001; Mulvey et al., 2014), trust more readily (Voci, 2006), be persuaded by (Mackie et al., 1990) and provide social support more readily to ingroup members (Haslam et al., 2005). When applied to modeling or group interactions, tacitly shifting ingroup appearances using CB, could be used to provide evidence for implicit bias present when favoring ingroup cognition.

Additionally, this technique can be used to study the impact of stereotype threat and implicit bias in real-time interactions, providing valuable data on how these phenomena affect decision-making and social interactions (Spencer et al., 2016). Rather than depending on role-playing scenarios where participants only simulate interactions (Olusegun, 2004), participants could see how their behaviors are affected by group membership in real time. For example, trainers could use the subtle appearance changes in CB paradigms to have participants interact

with someone who appears to be an outgroup member but who has shifted to an ingroup member during the interaction. This creates opportunities for learners to understand how group membership influences their behavior through actual interactions rather than through imagined examples or hypothetical interactions, a phenomenon which has led to greater transfer in other types of training (Sasaki, 1998; Toghian Chaharsoughi et al., 2014) These examples illustrate how CB could be used in behavioral change contexts.

Senel and colleagues (2022) conducted one of the few studies investigating how CB is experienced with avatars, namely when the avatar appearances are altered over time. Participants ($N= 40$) completed a Qi Gong exercise in VR, and either their instructor's avatar or their own avatar's face changed during the 10-minute manipulation. The full body of both avatars were visible to participants for the entirety of the study, with the participant's avatar being controlled by the participant's movement. Results showed that participants did not detect the avatar's facial changes in their own avatar 73% of the time and their instructor's avatar 85% of the time.

Taken together, these studies of virtual CB establish that CB occurs with significant frequency in virtual settings and that there are potential applications for utilizing CB to promote behavior change. Further, limited preexisting research also establishes that CB occurs with virtual bodies (Senel et al., 2022). Thus, we anticipate that virtual CB should occur even when using avatars in a novel context, providing a foundation for studying appearance changes in the context of modeling. Modeling and its subsequent impact on behavior is best explained using social cognitive theory.

CHAPTER 3:

THE THEORETICAL FOUNDATIONS OF MODELING

Behavioral modeling is the process by which humans learn attitudes and behaviors through the observations of others and is explained through the theoretical tenets of social cognitive theory (SCT) (Bandura, 1986). According to SCT, humans have a fundamental belief, referred to as agency, that desired outcomes are achieved as a direct result of volitional decisions and corresponding behavior (Bandura, 2001). Unlike stimulus-response models for decision making like behaviorism, SCT emphasizes the importance of cognitive assumptions that people make about the behaviors and consequences beforehand (Bandura, 1977; Schunk & Usher, 2012). The theory predicts that people will be more likely to engage in behaviors that help them accomplish a given goal if they believe their decisions can affect change rather than only relying on cause-and-effect of previous experiences (e.g., behaviorism)

Setting goals is thus a crucial part of behavior and behavior change, guiding the relationship between the individual's desire for an outcome and the behaviors that are required to achieve it, even without explicit knowledge of how to perform a desired behavior (Bandura, 2001). Children also operate under this assumption, as even without knowledge of the world they continue to explore and assess the world around them, assuming a connection between behavior and action. Goals become more concrete and motivating as people age; the intrinsic satisfaction, pride, or existential value that goal achievement brings drives meaningful behavior change like moving for a job or committing time to obtaining a degree.

As knowledge accumulates, people become better at anticipating outcomes of their actions and actively choose certain behaviors over others based on what they perceive will invite the greatest chance of goal achievement while requiring the least effort. These *outcome*

expectations further demarcate goal setting as people prefer outcomes that are specific, achievable, and temporally proximal (Bandura, 2001). For example, quitting smoking is a specific goal with a short timeline, but smokers often consider the goal too difficult to achieve (Elshatarat et al., 2016).

In the case of helping behaviors, positive affect and social rewards often set outcome expectations and serve as motivators for observers to engage in helping (Lahvis, 2017; Tamir & Hughes, 2018). Sometimes called the camaraderie effect, helping is speculated to have begun early in our evolution, where necessities like survival and gathering food hinged on cooperation with others against larger threats. Biochemical incentives for helping appear to exist amongst animals, where rats release dopamine when watching other rats consume highly palatable foods (Kashtelyan et al., 2014). Helping behavior provides more complex but equally fundamental social benefits to humans, including but not limited to early socialization, mating opportunities, and increased ability to reproduce (Lahvis, 2017; Tamir & Hughes, 2018). Helping is often seen as good or moral because helping behaviors validate preconceived notions about one's own goodness (He et al., 2014; Matherne et al., 2018; Paciello et al., 2013) and incentivize people to behave in ways that confirm these beliefs. These reward strata combine to create poignant biological and social motivations for helping others.

Based on the assertions of SCT and its relationship with helping, this study predicts that models demonstrating helping behavior will lead to an increase of helping in observers. The models will illustrate the feasibility and positive outcomes that come from helping, while also providing concrete behavioral examples of how to assist someone in need. Models providing concrete and feasible replicable behaviors, coupled with the biological and social incentives for helpers that set outcome expectations (Levine et al., 2001; Tamir & Hughes, 2018), establish that

models motivate behaviors in observers. Self-efficacy, discussed in the next section, further drives these behaviors through motivational processes.

Self-Efficacy and its Relationship to Modeling

Because decades of scholarship clearly indicates that agentic beliefs are more central to behavioral motivation than expectations of rewards and punishments, it is important to understand the cognitive mechanisms that drive behavior change. Agentic beliefs refer to a general human tendency to believe that decisions and actions can influence outcomes. However, achieving goals is often difficult, and resilience is needed to persist to achieve a desired outcome. When applying underlying agentic beliefs to specific goals, the confidence in one's perceived ability to engage in behaviors to meet an intended goal is referred to as self-efficacy (Bandura, 1977, 1989, 2010a). This section will define self-efficacy in more detail, discuss its relationship to modeling, and tie these observations to helping behavior.

Because people often avoid things that appear unachievable or difficult, self-efficacy helps strengthen the belief that people can accomplish tasks regardless of the difficulty or obstacles (Bandura, 2010a). This is directly connected to behavior change, as a meta-analysis of 19 studies and 2,3000 students observed that people who report higher self-efficacy also report greater resilience to failure (Cassidy, 2015), clarity around what goals they want to achieve, and reflect more on times when they succeeded and failed (Panadero et al., 2017). It is for this reason that scholars speculate that self-efficacy is central to task motivation but also general wellness, as self-efficacy helps people persist against the struggles of everyday life (e.g., mental health, health behaviors) (Dupéré et al., 2012; Schönfeld et al., 2016; Sheeran et al., 2016).

Fundamental to self-efficacy beliefs is that they are not only cultivated through direct experience but can be achieved through the indirect experience of events through observing

others, or vicarious experiences. Vicarious experiences refer to the tendency for people to extrapolate their own consequences of seeing other's punishment and rewards to assumptions. This was first noted by Bandura et al., (1963), who noticed that children would demonstrate requested behavior as a result of the punishments or rewards their peers received without needing to be punished or rewarded directly. Bandura (2010) further noted that children relied on self-regulation (Bandura, 2010), a cyclical process, wherein individuals constantly monitor how effective their behavior is at achieving a given goal, and then adjusting their behavior based on presuppositions about the optimal route for goal attainment (Bandura, 2001, 2010b).

Vicarious experiences, when using circumstances to demonstrate an ideal behavior, occur through modeling as described by SCT(Bandura, 2010a). Although models provide examples of how to perform behaviors, self-efficacy is required in the observer to first believe that their own actions can result in similar outcomes. This theoretical tenet is of particular interest for this study; that vicarious experiences have been found to increase self-efficacy whether presented in-person, virtually, or even through reading text or viewing images (Kantola et al., 2016; Wilde & Hsu, 2019). Outcome expectations can also influence the model's persuasiveness, as people assess not only whether the model can achieve a given outcome, but the resulting outcome that the model receives for performing the behavior (Bandura, 2010a).

Self-regulation allows individuals to make assumptions about outcome expectations without direct experience and directly contributes to self-efficacy through resisting negative emotions when failure occurs, motivating persistence towards goal achievement (Bandura, 2001, Bandura, 2010). Therefore, when observing models, people not only engage in behavioral mimicry, but also the successful cognitive strategies that appear to be represented by the modeler (Nabavi, 2012). The adoption of cognitive strategies rather than simple behaviors frequently

enables transfer, as people are not simply mimicking behaviors but understanding when and how to apply them outside of their original context. This leads to transfer, or the performance of modeled behavior in different contexts than what was demonstrated by the modeler (Fisak & Grills-Taquechel, 2007; Schunk, 1987; Taylor et al., 2005).

Findings from empirical studies suggest that behaviors modeled and demonstrated in virtual settings transfer to their real-world counterparts. Across 20 studies, Neumann and colleagues (2018) found that virtual reality training of sports performance transferred to real world sports performance (e.g. biking, golfing, weightlifting). Levac and colleagues (2019) found similar results with motor skills, such as rehabilitation for those with muscular dystrophy and cerebral palsy. In their systematic review of 46 studies, behaviors modeled in VR scenarios led to transfer to real world equivalents for 21 (46%) of examined studies. In both studies, authors cited the flexibility of VR's design flexibility and systematic control as predictors of the effect of transfer, opportunities leveraged in the current study. These results support the notion that modeling behavior in VR can lead to real world transfer, but it is important to understand how these concepts apply to helping behaviors.

CHAPTER 4: HELPING BEHAVIORS

In addition to investigating the novel area of CB in virtual contexts, this paper also investigates how detecting changes in virtual characters can influence helping behaviors. Helping can be defined as “the provision of aid through acts that may or may not be motivated by the intention to benefit the recipient” (Van Leeuwen & Zagefka, 2017). The roots of the contemporary social science perspectives on helping are often traced back to the early 20th century when McDougall (McDougall, 1910) proposed that social instincts, or fundamental motivations for behavior like hunger or companionship, were in part alleviated through their provision by others (e.g., helping). Biologists and ecologists further refined this perspective suggesting that helping behaviors evolved as a response to resource accumulation. Small cooperative groups began to share their excess resources or pool limited resources together, increasing stores of food in case of a crisis and greater protection against predators (Bshary & Bergmüller, 2008; Emlen, 1982). As previously separate groups merged, helping behaviors grew to be reciprocal, where one member of a group could provide a benefit to another in the short term with the knowledge that this would be returned in the future (Bowles & Gintis, 2013; M. A. Nowak & Roch, 2007; Rothstein & Pierotti, 1988).

Delaying the benefits or reciprocation of helping results in an upfront cost to the helper, (Lahvis, 2017), whether that be the giving of time, money, or emotional resources without an immediate benefit to the giver. This is often referred to as biological altruism (Okasha, 2020) or costly helping (Bartlett & DeSteno, 2006). Costly helping can also refer to behaviors that are not inherently helpful but become helpful when they are done in the service of another. For example, the costliness of picking up pens, a common measure of helping behaviors, derives from the

extra time given to help rather than the difficulty of the task or the cost of the pens themselves. Similarly, many helping tasks are not inherently helpful, as picking up pens is only considered helpful insofar as it derives from a request for assistance (Barclay et al., 2021).

Costly helping derives from similar biological drives as general helping, as scholars speculate that providing goods or services to others when it costs you something temporarily could actually have long term benefit (Barclay et al., 2021). Scholars proposed that, particularly in the smaller social groups in early human history, hunters helped each other catch animals to make hunting easier in the short term and to share the spoils of future hunts in the long term, resulting in mutual benefit after temporary sacrifice (Bliege Bird et al., 2012). Mutual benefit following an initial cost continues to influence modern social interactions, like professional collaboration and romantic relationships (Barclay et al., 2021) where short term benefits are (e.g. time) exchanged for long term ones (e.g. relational satisfaction, productivity).

As the definition of and motivations for helping behaviors were more precisely delineated, associated benefits also increased. On a personal level, the positive affect associated with helping behaviors is attributed to the release of endorphins, creating a sense of well-being and reduced stress (Smith, 2020). In the workplace, helping behaviors foster a collaborative and supportive environment, enhancing team cohesion and productivity (Johnson, 2021). On a broader scale, helping behaviors strengthen community bonds since they promote a culture of mutual aid and resilience, especially crucial during times of crisis or hardship (Garcia, 2022).

The population of this proposed study, students, also benefit from helping behaviors. Helping enhances student's ability to collaborate effectively on group projects (Mouw et al., 2019; Webb & Farivar, 1994; Webb & Mastergeorge, 2003) and facilitates peer learning (Getahun Abera, 2023; Kempler & Linnenbrink, 2006; Klingner & Vaughn, 2000; Walker et al.,

2011). Ultimately, the contribution of helping behaviors to student's academic achievements and future workplace success (Duan et al., 2018; Getahun Abera, 2023; Liu et al., 2020) motivated the continued investigation of helping behaviors in students investigated in the proposed study.

Results also suggest that modeling strongly influences helping behaviors. A meta-analysis of modeling and prosocial behaviors by Jung et al. (2020) of 88 studies and 25,354 participants found a moderate effect size (.45) as well as significant transfer to contexts and groups beyond the modeled scenario. Another meta-analysis of 72 studies and 17,134 participants found that prosocial media using modeling was positively associated with prosocial behavior ($r = .16$) (Coyne et al., 2018). The empirical evidence suggests that modeling helping behaviors transfers to groups and behaviors not depicted by the model, further justifying this proposed study's examination of how virtual models impact real world helping.

The theoretical models of self-efficacy clearly delineate that people who see helping behaviors modeled by similar models will be more likely to engage in helping than when they are performed by dissimilar models. Secondly, these increased behavioral outcomes are contingent upon the increase in self-efficacy gained via model observation, an assertion supported via empirical studies evaluating modeled helping behaviors. These predictions lead to the next two hypotheses:

H1: Participants will perform more helping behaviors when they perceive high similarity with the virtual model compared to when they perceive low similarity with the virtual model.

H2: Self-efficacy will positively mediate the relationship between avatar similarity and helping behaviors, such that participants in the similarity conditions will report higher self-efficacy and ultimately perform more helping behaviors than participants in the dissimilar conditions.

CHAPTER 5:

THE RELATIONSHIP OF IDENTIFICATION TO CHANGE BLINDNESS AND MODELING

While SCT traditionally studied relationships with physical others, modern technologies enable a closer examination of how similar relationships are built with avatars, digital characters or images that serve as a proxy for an individual in a digital space (K. L. Nowak & Fox, 2018). Avatars in virtual spaces have garnered attention in psychological research due to their role in facilitating social interactions and shaping individuals' self-perception and behavior (Yee & Bailenson, 2007). Studies have shown that individuals tend to invest psychological and emotional significance into their avatars, often projecting aspects of their ideal selves onto these digital representations (Nowak & Rauh, 2018). Moreover, avatars provide a means for individuals to experiment with and explore various aspects of their identity, leading to enhanced self-awareness and self-exploration (Bessièrè et al., 2007). The customization options available for avatars allow individuals to express their unique identities and preferences, fostering a sense of ownership and attachment to their virtual self-representations (Blinka et al., 2012).

These avatars, whether designed by the user or others, can be designed in such a way that viewers or players begin to form a heightened emotional or cognitive connection with a virtual character at the expense of decreased self-awareness (Cohen, 2001). This process, termed *identification*, derived from Freudian psychology's description of taking on other's traits in order to build one's own personality (D. D. Li et al., 2013). Foundational applications of the term in social psychological settings were used in self-efficacy research, where identification was defined as the extent to which people perceived themselves as similar to behavioral models (Bandura, 1969; Bandura & Huston, 1961).

As media proliferated in the ensuing decades, people were presented with greater numbers of characters with which they could build vicarious relations. The concept was initially applied to television (Feilitzen & Linné, 1975; Hoffner, 1996) where participants were asked the extent to which they shared goals with television characters; the theory has been expanded to include modalities with greater player control video games and VR (D. D. Li et al., 2013). It is this approach that is used in the current study.

Identification has various explanations (Praetorius & Görlich, 2020), but all emphasize a decrease in the individual's focus on the self and increased prioritization of the behaviors and presumed attitudes of their avatar. For example, self-perception theory (Bem, 1972) argues that people retroactively develop their attitudes and emotions towards an object or event by observing their own behavior and extrapolating what their attitudes must have been. Thus, identification occurs when users observe their avatar performing certain behaviors and then assume that their avatar's behaviors must be reflective of attitudes that would motivate similar behavior in the user (Lemenager et al., 2020; Praetorius & Görlich, 2021). In the case of helping behaviors, users would see themselves as not only capable of performing similar behaviors to the avatar, but possessing the same attitudes that also motivated the avatar to be helpful.

Scholars have also proposed the Social Identity Theory (Hornsey, 2008; Tajfel & Turner, 2004) which proposes that people have strong motivations to identify with group members that possess certain identities or traits, such as being a member of an ingroup. Through this framework, individuals see the avatar as a member of a desirable or preferred group, causing users to associate their identity with traits possessed by the avatar and, by extension, express thoughts or perform behaviors associated with that shared identity (Praetorius & Görlich, 2020). In the case of helping behaviors, individuals would see an avatar with which they identify

performing helping behaviors, see those behaviors as a desirable part of their identity, and thus be more likely to perform them.

Whatever the causal explanation, the potency of shared feelings and cognition between user and avatar has been used to promote behavior in a variety of settings, demonstrating the proteus effect (Yee & Bailenson, 2007). The proteus effect states that individuals alter their behavior to conform to what they believe to be normative for their digital self. The influence of identification in proteus effect studies has been illustrated across numerous studies (Ratan et al., 2020; Szolin et al., 2023), finding that male users acted more confident in the physical world after embodying a tall avatar in VR (Yee et al., 2009), perceived themselves as smarter in an intelligent avatar (Kocur, 2022), and increased physical activity when embodying an avatar wearing exercise clothing (Rheu et al., 2020). These studies illustrate how avatar appearance impacts identification and ensuing behavior, principles that will be utilized in the current study.

Contemporary scholarship now divides identification into two categories relevant for this study: avatars that possess ideal traits or behaviors (wishful) and avatars that appear or behave similarly to users (similarity) (D. D. Li et al., 2013; Praetorius & Görlich, 2021). The next section will explore wishful and similarity identification.

Wishful Identification

Wishful identification occurs when an “individual desires to incorporate positive traits of the identified into one’s self-concept” (D. D. Li et al., 2013 p. 258). Positive traits are contextually dependent; video game players often create avatars that possess traits that users identify as powerful or have some mechanical advantage over others at the expense of similarity to themselves (Praetorius & Görlich, 2020). On the other hand, wishful identification with traditional media characters (e.g. television) often occurs when characters are seen as attractive

(C. Kim et al., 2012), holding desirable careers (Tolbert & Drogos, 2019), or have high-status possessions (e.g., luxury cars) (Jin & Ryu, 2019).

Wishful identification can be heightened when users see themselves as similar to a given character which leads to a desire to possess non-similar, ideal characteristics. Decades of research on the importance of representation in media (D. Brooks & Hébert, 2006; Orgad, 2014; Talbot, 2007) illustrates this principle in action; where viewers who have demographic traits in common with television characters (e.g., race, gender) are motivated to acquire other traits also possessed by that character (e.g., success, intelligence, attractiveness).

Researchers have applied the concept of wishful identification using ideal avatars, virtual representations of the self that possess characteristics that users would ideally like to have in real life (Y. Kim & Sundar, 2012; Ratan et al., 2022). Research by Li, Liao, & Khoo (2013) suggests that identification with an avatar more capable and fit than the self can enhance self-efficacy and motivation in real-life exercise regimes as individuals strive to close the gap between their real and virtual selves. Kuo et al., (2016) found that participants who chose weight-reduced (ideal) avatars ate less ice cream in a taste test and were more likely to select a sugar-free drink during the experiment than those who chose a self-resembling one. While largely health and fitness-focused, these studies highlight the potential of individuals' use of ideal avatars to promote behavioral change; findings that may extend to helping behaviors.

One reason ideal avatars could impact helping behaviors is that people wish to associate themselves with desirable and moral traits (Klimt et al., 2009). Findings consistently show that people identify more with moral characters rather than evil ones (Cohen et al., 2015, 2018; Tal-Or & Cohen, 2010). This phenomenon is largely explained through moral identification, or a phenomenon where readers, players, and watchers “adopt the beliefs, goals, moral values, and

evaluative attitudes of a character” (van Krieken et al., 2017 p. 8). Given that people generally want to either act morally or be perceived as moral (Sun & Goodwin, 2020), wishful identification should occur as a result of seeing someone perform desired behavior (e.g. helping). Because helping is often identified as a moral behavior, we anticipate that participants will be motivated to identify with a helpful avatar.

Conversely, some studies have shown that ideal avatars can backfire when users focus more on their own shortcomings rather than the avatar’s strengths, thereby *decreasing* manipulation effectiveness and identification. This phenomenon is described in self-discrepancy theory, which argues that people compare their perceived actual self to an ideal self, one that possess attributes which, “from the person’s own standpoint does not match the ideal state that he or she personally hopes or wishes to attain” (Higgins, 1989 p. 322). People experience discomfort, fear, and identity threat when this gap is too large (Higgins, 1989; Strauman, 1996). In his foundational study, Higgins (1987) found that reflecting on an ideal, unachieved self triggered feelings of self-loathing, and often masked feelings of inadequacy about failure to achieve expectations under general claims of worthlessness.

These negative emotions can be further heightened through ideal avatars because the ideal avatars are a concrete expression of unmet desires and current insecurities that are presented to users in a more tangible way than imagination or reflection. For example, Ratan et al., (2022) found that participants had worse test scores after viewing an ideal avatar compared to a self-resembling one, explaining that self-efficacy decreased because the ideal avatars caused participants to view their performance goals as unobtainable. Bessiere et al., (2007) found that participants with low self-esteem rated their own attributes lower when their ideal avatar was similar to their ideal self compared to those with higher self-esteem, further showing how

exposure to ideal avatars can negatively impact the confidence necessary to achieve behavioral outcomes.

In the context of the current study, because helping behaviors are often seen as socially desirable (Lahvis, 2017), users may see their avatar performing helping behaviors as a form of idealized behavior, thus leading to heightened identification due to a desire to behave like that character. Conversely, a helpful avatar could trigger self-discrepancy, causing the participants to think more of the differences between the helpful avatar and themselves, decreasing likelihood of modeling helping. Given this uncertainty, the first research question is as follows:

RQ1: How does participants' wishful identification with their avatars influence helping behavior?

Similarity Identification

The most frequently measured type of identification is similarity identification, a type of identification where “viewers reinforce their identities and recognize themselves in that character through salient characteristics” (Cicchirillo & Appiah, 2014 p. 14). Although similarity is typically considered in the context of demographic characteristics, such as race and gender, people can perceive similarities across other character traits including personality, behavior, or life experiences (Feilitzen & Linné, 1975; Reeves & Miller, 1978).

Earlier research on similarity identification conducted with television characters established that shared sex, nationality, and social situation with the television characters (e.g, socio-economic status) increased identification amongst viewers ((Feilitzen & Linné, 1975; Reeves & Miller, 1978). As the research progressed, scholars developed more robust explanations for why similarity was so appealing to viewers, arguing that similarity leads to liking, even for mediated characters (Hoffner & Cantor, 1991), engendering a stronger

connection due to positive feelings towards the characters. Other authors have proposed that it is easier to empathize or understand someone when attributes or experiences are shared. Finally, similarity may be related to perceived realism, where characters similar to oneself are seen as more representative of real life, which can increase identification.

In this literature, similarity has been divided into multiple types (Huang et al., 2024). Objective similarity refers to shared traits (e.g., demographics, smoking status) while psychological similarity refers to shared attitudes, beliefs, or behaviors. A recent meta-analysis of 40 years of literature on similarity identification between audience and characters found that both types of similarity significantly increased identification ($g=0.19$, 95% CI [0.10, 0.28], $p<.001$), with a larger effect size attributed to psychological similarity ($k=11$, $g=0.41$) than to objective similarity ($k=37$, $g=0.13$) (Huang et al., 2024).

Unlike psychological similarity, which includes shared thoughts, feelings, or attitudes that are invisible or require an interaction to establish, observable facets of similarity (e.g., shared race, gender, professional identity) are discernable simply by looking (Braaksma et al., 2002; Krebs et al., 2019, 2021). For this reason, many avatar studies have manipulated similarity through appearance (Rheu et al., 2020; Suh et al., 2011; Van Looy et al., 2010b). As with television character identification, avatar similarity is often created through shared demographic categories (e.g., race, gender), visual indicators of shared identities such as attending the same school ((Gaesser et al., 2020; C. Kim & Harwood, 2019), or creating virtual replicas by mapping participants' faces directly onto the avatars (Fysh et al., 2022; Heyselaar et al., 2017; Suh et al., 2011).

The importance of similarity identification in the context of behavioral modeling is indicated in earlier studies with avatars. Kim and Kim (2013) found that participants experienced

more positive attitudes to a social media anti-smoking ad containing a self-resembling avatar because they viewed the consequences of smoking as more self-relevant than those who saw an ad with an ideal or no avatar. Li and Lwin (2016) found that greater identification with an avatar increased motivation to exercise during and after the experiment. A meta-analysis of avatars and fitness (Rheu et al., 2020) found that similarity to an exercising avatar increased motivation for real-world exercise compared to dissimilar avatars. These studies further confirm the value of avatar similarity identification during modeling.

Although past studies have not directly explored how similarity identification with avatars influences helping behaviors, previous studies have explored how acting out certain behaviors in the virtual world can be used to promote helping behaviors in the world. Participants who collaborated together in *Wii Sports* video games helped experimenters pick up more pens after the experiments than those who competed against one another (Dolgov et al., 2014). Rosenberg (2013) placed participants in the body of Superman to either perform helpful (find a missing child) or unhelpful (tour a virtual city) behavior. Results showed that participants who engaged in helping behaviors in the virtual world transferred the helping behavior into the real world by helping the researcher pick up more pens. These findings lead to the expectation that identification with avatars can influence helping behaviors and that those behaviors can transfer to the real world to encourage participants to help, even in dissimilar types of helping.

Similarity is also essential for building self-efficacy, as perceived similarity to the model helps observers sort through the constant stream of emulatable behaviors. When people see themselves as similar to a model, people feel that they could enact a comparable behavior and with comparable consequences (Bandura, 2001). This drives increased attention towards the model (Schunk, 1987) and has been shown to improve motivation and modeled behavior

performance in domains including education (Hoogerheide et al., 2018; Schunk, 1985) sports (Clark & Ste-Marie, 2007; Gould & Weiss, 1981) the workplace (Downes et al., 2021; Ozyilmaz et al., 2018) and medicine (Klassen & Klassen, 2018).

It is worth acknowledging the conflicting evidence about how model observer similarity influences outcomes, with more recent studies arguing that objective similarity (e.g., shared demographics) is insufficient in isolation to promote behavioral change. For example, multiple studies by Hoogerheide evaluated how shared gender between model and observer influenced learning while using video and text-based modules to teach basic electrical engineering (e.g., troubleshooting electrical circuits. (Hoogerheide et al. 2016a; Hoogerheide et al. 2016b; Hoogerheide et al. 2017; Hoogerheide et al. 2018) All results suggested that gender-matched models had no impact on test performance. Similar results were found with identification, where Cohen et al., 2018 found no difference in identification when Israeli participants were ethnically (Israeli and Spanish), and gender matched to supposed authors who wrote either a narrative (story) or non-narrative (Facebook post) describing difficulties obtaining food.

The current study circumvents these limitations in a few significant ways, namely employing multiple methods of identification and avoiding gendered behavior. Firstly, Hoogerheide et al., (2016a, 2016b, 2017, 2018) used distinctly gendered tasks (e.g., engineering), in order to evaluate competing hypothesis comparing similarity (e.g. same gender model) to task appropriateness (e.g. different gender model). Unlike these other studies, helping behaviors and the use of related behavioral models are not impacted by gender (Jung et al. 2020), simultaneously avoiding the perpetuation or use of gendered stereotypes. Finally, this study employs multiple valences of identification, using a shared or unshared student identity in addition to race and gender. Based on past research on similarity identification, this study

anticipates that multiple valences of similarity create more opportunities for users to form the emotional connection necessary for identification.

Thus, avatars seen as more similar should increase the likelihood of participants seeing themselves capable of emulating the avatar's behaviors. In the same way, a dissimilar model should result in less self-efficacy, and therefore less helping behaviors. Without the increase in perceived capability afforded by self-efficacy, vicarious learning via models will have little impact on helping behaviors (Bandura, 1998, 2010b). The current study also employs both objective and psychological similarity, creating to identify both with objective characteristics of the model (e.g race, gender, student status) and their situation by having them react to the busyness and stress of student life. Given that similarity has historically driven identification, we anticipate that people who perceive more similarity with an avatar modeling helping behaviors will identify more closely with the avatar and, by extension, perform more helping behaviors. Given this, the next hypothesis is proposed:

H3: Similarity identification will serially mediate the relationship between avatar similarity, self-efficacy, and helping behaviors, such that higher similarity identification will result in (a) higher self-efficacy and (b) more helping behaviors in the similarity conditions compared to the dissimilarity conditions.

CHAPTER 6:

EMPATHY AND ITS IMPACT ON HELPING BEHAVIORS

Empathy, often defined as understanding and sharing other's emotions through identifying oneself with another person (Hoffman, 2001) is consistently linked to helping behaviors. With its origins in a 19th century German word *Einfühlung* (Wispé, 1986), it was originally used in a more clinical context, referring to the level of accuracy with which a clinician could precisely understand and label the thoughts of their patients. The concept expanded in the 1960's to its contemporary emotional definition, which transitions the focus from emotional precision to the understanding and experience of others' emotional states particularly when others' feelings are negative (Hoffman 2008).

Empathy is thus an emotional state and cognitive process. Empathetic distress occurs when one imagines what another specific person or an imagined "average" person would feel in a similar situation (Hoffman, 2008). This imagination process is initiated through empathetic arousal, when an individual conveys their distress to another such as through verbal communication of distress, a conditioned response to the distress of another (e.g. a mother hearing her child crying), or placing oneself mentally in the situation of another (e.g. perspective-taking) (Hoffman, 2008). As empathy becomes more sophisticated, it can become metacognitive, where empathizers recognize how and when to empathize, what types of behaviors can reduce distress, and how to more accurately understand the emotions of another (Hoffman, 2008).

A final essential component of empathy is a moral component, a desire to reduce the distress of others after vicariously experiencing their situation. This moral component is also enforced by biological and cultural norms, where members of many cultures around the world

are socialized to recognize and decrease the distress of others (Cassels et al., 2010; Eisenberg, 2002; Melchers et al., 2016). Similar findings are reflected in biology and psychology, with mirror neurons enabling the cognitive processing of others' experiences (Iacoboni, 2009) and animals like elephants (R. Byrne et al., 2008), dogs (Custance & Mayer, 2012), and rats (Ben-Ami Bartal et al., 2011) showing an awareness and responsiveness to emotions of others.

Many scholars also distinguish between personal distress and empathy (Decety & Ickes, 2011). Despite similarities in behavioral manifestation, personal distress is comparable to emotional contagion, where the anguish of one person is transferred to the listener, causing them to enter a similar state of distress. When in this state of high arousal, the motivation to help is driven not by concern for the other but the reduction of one's own personal distress (Batson et al., 1987). These assertions were later verified with neurobiological studies, which found that high arousal was associated with personal distress but not with a prosocial, empathetic concern for others. For example, Batson and Shaw (1991) found that those who reported higher distress and less empathy only worked to reduce other's distress when it did not conflict with their own personal interests (Paciello et al., 2013).

Helping behaviors are a direct consequence of the moral motivation underlying empathy; they are the behavioral means by which one reacts to concern for another and attempts to reduce another's distress (Barnett et al., 1981; Betancourt, 1990; Davis et al., 1999; Mehrabian & Epstein, 1972; Paciello et al., 2013). Thus, when one feels the vicarious distress of others through empathy, people seek to engage in behaviors that could potentially reduce this distress, such as helping. Conversely, without this ability to share others' emotions, individuals would be less likely to engage in helping because there is no distress for them to reduce (Beddoe & Murphy, 2004; Gleichgerrcht & Decety, 2014).

When individuals experience appropriate levels of distress through empathy, they may be willing to overlook the upfront cost of helping in favor of the personal benefit of stress reduction. Given that empathy motivates helping independently of avatar identification or modeling effectiveness (Paciello et al., 2013), the proposed study anticipates empathy would exist on its own mediating pathway but that both pathways would in tandem strengthen helping behaviors more than either independently. Based on the logic that empathy, within reasonable limits of distress, drives helping to reduce that distress, the next hypothesis is proposed.

H4: Empathy will positively mediate the relationship between avatar similarity and helping behaviors, such that those who report higher empathy will perform more helping behaviors compared to those who report lower empathy

CHAPTER 7

SYNTHESIZING EXPECTATIONS OF CHANGE BLINDNESS OUTCOMES

CB is a logical tool for studying helping behaviors because of the influence of group identity on helping, information often conveyed with visual information in physical and virtual settings (Alvidrez & Peña, 2020; Brown et al., 2006; Ratner et al., 2014; Schubert & Otten, 2002). Social identity theory posits that individuals categorize themselves and others into ingroups (those with whom they identify) and outgroups (those with whom they do not identify). It is well-established that individuals are more inclined to exhibit ingroup favoritism, including heightened helping behavior toward ingroup members (Hornsey, 2008). Research indicates that individuals are more willing to engage in costly helping behaviors to alleviate the suffering of ingroup members, while being more hesitant or unwilling to extend the same level of assistance to outgroup members, particularly if they harbor negative perceptions of them (Hein et al., 2010). The present study, rooted in the framework of cognitive-behavioral psychology, aims to delve into this phenomenon by dynamically manipulating group membership in real-time, shedding light on the intricate interplay between ingroup/outgroup attitudes and helping behaviors.

Applying these principles of real-time avatar appearance manipulation, CB provides unique insights into how visual similarity in appearances between the model and the observer impacts outcomes. Similarity has been considered a prerequisite of model effectiveness (Bandura, 1977, 2010b; Gwaltney et al., 2009; Hoogerheide et al., 2016; Schunk, 1985) because it helps observers determine how representative the model is of their own capabilities, and thereby how similar the demonstrated consequences and actions will be to their own behavior (Mazziotta et al., 2011; Rosenthal & Bandura, n.d.). However, similarity identification is contingent upon the participant's perception that models or characters are similar to themselves

(Hoogerheide et al., 2018), whether that be in appearance, attitude, or group membership. (Krebs et al., 2019). Conversely, behavioral change as a result of a model's appearance would only occur if the appearance change is detected by observers. It is this idea of disrupting perceptual and modeling norms that motivates the current study.

CB studies argue that visual impressions of stimuli are typically formed when it is first presented (Jensen et al., 2011; Simons, 2000). This is because visual systems rely on motion to detect change, so when motion is absent (or not detected), top-down cognitive processing strategies, like reverting to the image's original appearance, are employed (Arthur, 2000; Suma et al., 2011). Thus, we predict participants in the CB conditions will base their evaluations of their avatar's similarity to themselves on its initial appearance if CB occurs, and on its final appearance if CB does not occur.

Applying this logic to modeling, we anticipate that CB will decrease modeling effectiveness if participants do not notice their avatar's transition from a dissimilar to a similar appearance. This is because participants who are blind to the avatar's change from dissimilar to similar appearance will focus on its initial appearance (dissimilar), whereas participants who notice the change will focus on the avatar's final appearance (similar). Conversely, if the avatar is changing from a similar appearance to a dissimilar appearance during the interaction, participants who experience CB will focus on the initial appearance (similar) but participants who notice the change will focus on the final appearance (dissimilar). Therefore, whether participants end up modeling the presented behavior is contingent upon their experience of CB.

H5: CB will moderate the impact of initial avatar appearance (initial similarity compared to initial dissimilarity) on identification within the similarity conditions, such that CB

will strengthen the effect of initial avatar appearance on participants' identification with their avatar compared to the dissimilarity conditions.

The occurrence of CB also leads to the prediction that participants will perceive the model in similar and similar-dissimilar change conditions as identical. Similarly, the dissimilar change should also not be detected, leading to the assertion that the dissimilar-similar change model should be perceived identically to the dissimilar model. By extension, the predicted results of perceived model similarity on helping behaviors through self-efficacy and identification should be equivalent across both similar (change, no change) dissimilar (change, no change) conditions. This leads to additional hypotheses that should only be relevant for conditions where the model changes. A theoretical model can be found in Figure 1.

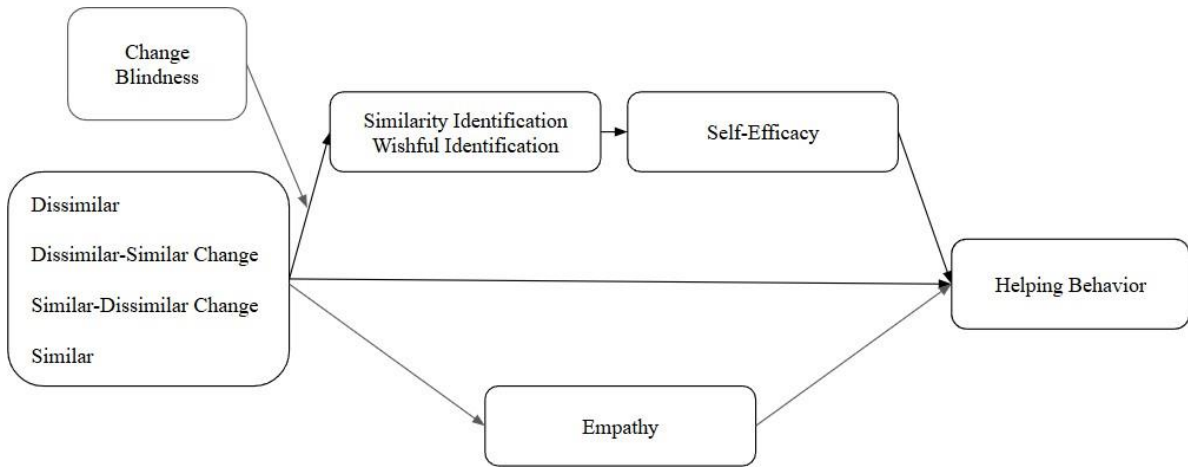
H6: There is an equivalence in self-efficacy within the (a) dissimilarity conditions and the (b) similarity conditions

H7: There is an equivalence in similarity identification within the (a) dissimilarity conditions and the (b) similarity conditions and wishful identification between the (c) dissimilarity conditions and the (d) similarity conditions

H8: There is an equivalence in helping behaviors within the (a) dissimilarity conditions and the (b) similarity conditions

Figure 1

Theoretical Model



CHAPTER 8

METHODS

Avatar Design Pilot Study

To design and select avatars for the similarity conditions, a pilot study was conducted. Participants were recruited from Mturk ($N= 710$) and completed a Qualtrics survey. After completing a consent form, participants were presented with a disclaimer that avatars cannot preserve the complexity of racial identity in the United States, and that the racial categories used in the U.S Census (e.g., White, Black) were also over simplified. This approach mirrors considerations made by other scholars who emphasize how seemingly innocuous virtual studies or data collection methods can perpetuate race perceptions and stereotypes (Hatfield et al., 2022; Nakamura, 2020; Strmic-Pawl et al., 2018).

Participants were then shown videos that depicted an elevator created in the Unity Engine. Participants viewed this elevator from a first-person perspective, simulating that they were on the elevator facing outwards towards opening doors. In each video, these doors remained closed for 5 seconds and then opened to reveal a treatment avatar which stood directly in front of participants for 10 seconds. Afterwards, participants were presented with four questions. Survey questions included evaluating the avatar's perceived race based on U.S. census categories and the certainty of the response (e.g., how confident are you in your answer, where one is not confident at all, 100 is very confident). Exact wording of questions can be found in Appendix A. After answering these questions, the avatar walked out of the elevator, and another would enter. This process repeated until 16 avatars had been viewed.

16 total avatars (8 Male presenting and 8 Female presenting) of various skin tones were created using the avatar design service, readyplayer.me (Karaarslan & Altundas, 2022).

Although slight modifications were made (e.g., changing the avatar's hair color from unnatural colors like pink and blue), the selected avatars were based on presets presented by the software. All avatars were also dressed in identical clothing, a blue button-down shirt and blue pants, where feet were not visible. Because helping behaviors are significantly influenced by shared in-group identities between the person giving help and the person receiving help (e.g., shared race, shared gender) (Borinca et al., 2021; Hein et al., 2010; Van Leeuwen & Täuber, 2010; Van Leeuwen & Zagefka, 2017; White et al., 2020) avatars representing the person receiving the help need to be designed in a way to reduce outgroup bias. Based on findings from the pilot study, two avatars were selected that received the lowest average confidence score, indicating that participants were uncertain of the racial identity of the avatar, thereby limiting the formation of potential outgroup biases for or against them. One male and one female avatar were selected from the pilot study for gender matching in the main study and can be found in Figures 2 and 3.

Figure 2

Female Presenting Racially Ambiguous Avatar

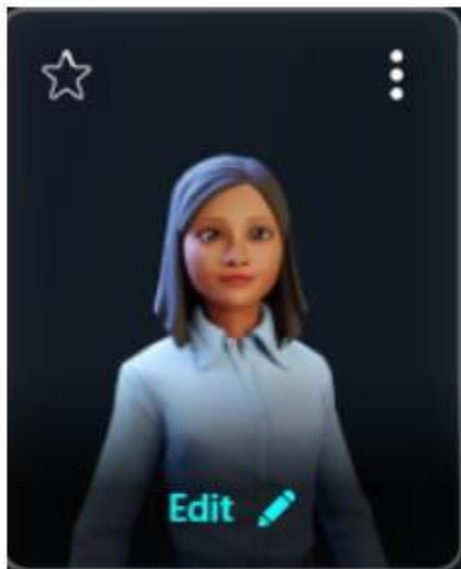
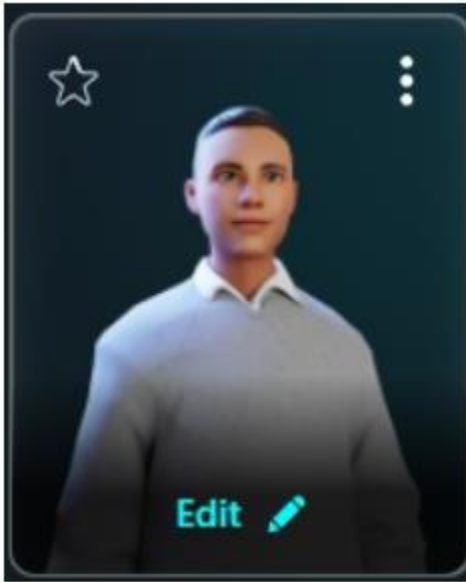


Figure 3

Male Presenting Racially Ambiguous Avatar



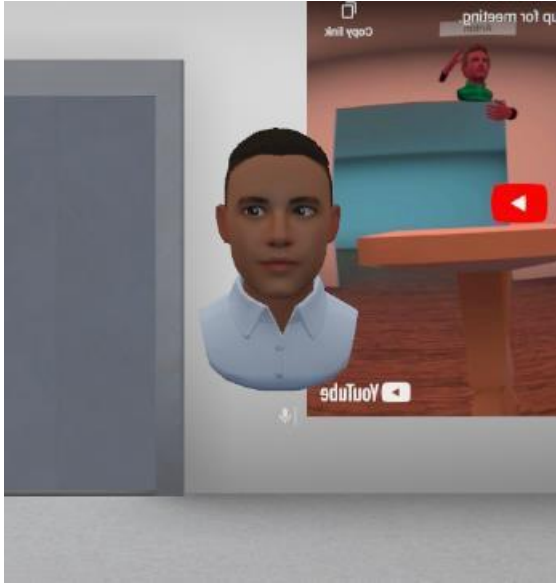
Study Design

Avatar Selection

An additional 12 avatars were selected from the pilot, one male and female presenting avatar of each racial demographic category. These were selected based on participant's rating of the avatar's perceived race, wherein the avatars with the highest confidence scores for each racial category were selected. This decision was made to avoid promoting stereotypical biases that may be activated if the new dissimilar avatar belongs to pre-existing racial categories. Controlling for potential biases in the design provides greater experimental control across the dissimilarity conditions, and is comparable with CB research examining facial change detection (Beck et al., 2001; T. N. Davies & Hoffman, 2002). Similar avatar examples can be found in figure 4.

Figure 4

Similar Avatar Example



Video Stimuli Creation

The 12 avatars alongside the single dissimilar model avatars were duplicated in a virtual social environment *conVRged* (Franzluebbbers & Johnsen, 2023) to create stimulus videos. *conVRged* is a multipurpose social VR world developed at the university that allows multiple users to interact in the same virtual space, embodied as avatars. The application is designed such that it can contain a variety of experiences, from presentation focused environments with screen-sharing, shared whiteboards, to games such as chess, checkers, remote-controlled cars, and a playground. The system consists of several separate environments for each target application. An elevator is used to travel between different rooms in VR space, with the buttons in the elevator used to select a target environment. While *conVRged* is used within our research group, its design mimics aspects of several commercial applications, such as VR Chat, Rec Room, or Horizon Workrooms (Franzluebbbers & Johnsen, 2023). Due to the design of this environment, these avatars only show the avatar's head, top of the torso, and hands, with the hands detached from the user's body (Karaarslan & Altundas, 2022).

This footage was synthesized into 4 possible conditions, with parenthetical comments noting how the conditions will be referred to throughout the manuscript: Model is dissimilar to observer and model's appearance does not change (Condition 1, Dissimilar-No Change), Model is dissimilar to observer but becomes similar (Condition 2, Dissimilar-Similar), Model is similar to observer but becomes dissimilar (Condition 3, Similar-Dissimilar), and Model is similar to observer and model's appearance does not change (Condition 4, Similar-No Change). A full list of the 14 recorded videos (6 male-presenting avatars for each racial category, 6 female-presenting avatars for each racial category, and 2 dissimilar avatar videos) were used as can be found in Appendix B.

In the Dissimilar-to-Similar and Dissimilar conditions (1 and 2), the dissimilar avatar was an avatar template, with no facial features (e.g., eyes, hair) and a randomized skin color that is physically impossible for humans to possess naturally, leading to a total of 13 model avatars used. To prevent biases towards helping outgroup members, two videos were created for the interaction with the participant's dissimilar avatar to have the gender of the beneficiary match the participant, which led to a total of 14 videos being used for the No-Change conditions. The dissimilar avatar can be found in figure 5.

Figure: 5

Dissimilar Avatar Example



To create video footage for conditions containing similarity footage (2, 3, and 4), the gender/race matching avatar was rapidly swapped to the dissimilar avatar in the Similar-Dissimilar Change conditions. For the Dissimilar-Similar conditions, the process was reversed, where the participants first saw the dissimilar/stock avatar, which then swapped to an avatar of similar gender/race. The swap occurred at the same time point for both conditions, half-way through the model demonstrating the helping behavior. This time point was selected due to its similarity to CB studies employing changes to real people, where the changes to the confederates occurred approximately halfway through the interaction (Marquis et al., 2021; Simons & Levin, 1998).

The need to combine footage from the 14 different base videos in different orders led to a total of 42 videos being created. For example, the White Female avatar footage was used in three videos: a No change condition video, a Similar-to-Dissimilar change video, and a Dissimilar-to-Similar change video. A full list of videos created and what videos were synthesized to create the CB videos can be found in Appendix C. Finally, a list of possible

videos shown to participants based on their permutations of selected race and gender can be found in Appendix D.

Design and Participants

The study employed four experimental conditions in a between-subjects design. A total of 273 participants were recruited from a large southeastern university for extra credit and completed part 1 of the survey. A total of 173 participants completed the second part of the survey to receive extra credit. Of that total, 28 cases were removed due to a technical issue where videos were not displayed to participants, reducing the total to 144. Thirty-five participants were assigned to condition 1 (No Change, Similar model), 35 were assigned to condition 2, 37 were assigned to condition 3 and 37 were assigned to condition four with 30 identifying as male (21%) and 114 as female (79%). Regarding racial identification, 114 participants identified as white (79%), eight (6%) identified as Black, 12 (8%) identified as Asian, 9 (6%) identified as Hispanic, and one (<1%) as Middle Eastern.

Procedure

Pre-Experiment

Participants were first sent an online questionnaire with demographic questions, the self-efficacy questionnaire (see measures), moral expectancy questionnaire, and distractor questions regarding daily social media use.

Experiment

Participants received a second link three days after the pre-experiment survey. The Qualtrics link contained a video of the modeled helping behavior carried out by the treatment avatar, as well as the post-questionnaire. Regardless of condition, these videos consisted of four parts: the presentation of a cover story, an avatar interacting with aspects of the virtual

environment alone, interaction with a new avatar who made a helping request, and engagement in the helping behavior by the first avatar. For conditions where the avatar was race and gender matched to participants (i.e., similar avatar), the cover story stated that the participant was a UGA Computer Science Major working to complete a group project before a presentation happening the next day. In dissimilar conditions, the avatar was a third-party beta tester assisting a virtual reality start-up. This approach ensured that the participant was an outgroup member both in the clip (a third-party contributor rather than a team member) and in real life (a beta tester rather than a student). This information was presented to the participant at the beginning of the video via text on a black background.

In both condition types (similar and dissimilar), the participant was told the model was troubleshooting the environment to ensure it was working correctly. Secondly, they were told their contributions were valuable because programmers can sometimes miss minute details, so the input from a third party who had not viewed the virtual space before could help catch undetected errors. To further reinforce the cover story and have them attend to the model, participants were told to watch the model closely to report glitches they saw after the video.

Interacting with various aspects of a virtual space is a common method for troubleshooting virtual spaces (Curlin et al., 2022; Liang, 2010) and justified why the participant would see the model perform seemingly mundane tasks. This troubleshooting portion consisted of three 40-second clips, taking a total of two minutes, with the participant's model (avatar) marked as "DEV". In the first clip, the model appeared to troubleshoot a play space in *conVRged*, picking up chess pieces and placing them back down again, and placing pieces on top of one another. The model avatar also tested a remote-control car, using the remote to move the car around. In the second clip, they were in an auditorium troubleshooting the podium as well as

the physics of a basketball. In the final clip, the model could be seen interacting with a chessboard, ensuring the physics of the pieces worked correctly. Pictures of each clip can be found in Figures 7, 8, and 9.

Figure 6

Troubleshooting Clip 1 with Checkers

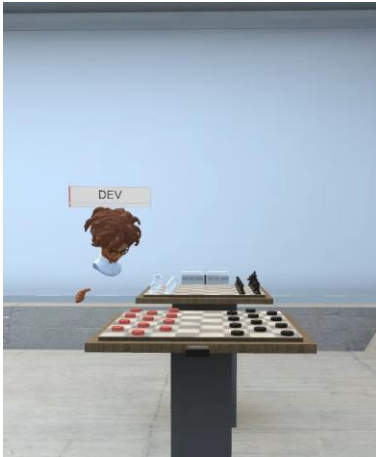


Figure 7

Troubleshooting Clip 2 with the Basketball



Figure 8

Troubleshooting Clip 3 with Chess Pieces



Prior to each clip, participants were presented with text explaining what they were about to see and further justifying the cover story. For example, prior to seeing the checkerboard troubleshooting, participants were presented with the following narrative: “The developer will go into the playroom and will play checkers by themselves. They will find a weird bug where the pieces keep disappearing, but they will fix it quickly.” Similar text was presented before each clip, and each text window was displayed to participants for 7.5 seconds.

After viewing these activities for two minutes, the model entered the conference room where they encountered the beneficiary avatar, the racially ambiguous avatar selected during the pilot study. The interaction was fully voiced using ttsmp3.com, with a stock male-sounding voice and a stock female-sounding voice used for the gender-matched beneficiary avatars. Using text prior to the interaction and voiced lines during the interaction, the beneficiary avatar was presented as either another UGA student (similarity conditions) or a TogethVR employee (dissimilarity conditions).

While this study was interested in the influence of ingroup and outgroup attitudes, the study chose to avoid racial intergroup interactions due the potential for perpetuating bias. Past

studies on virtual embodiment, or having people embody avatars of different races used to improve intergroup attitudes or decrease racial bias, has received criticism recently for depicting a shallow or superficial version of outgroup members. By definition, these short, simulated interactions cannot depict the complexity of intergroup interactions (Nakamura, 2020), and can decrease the perceived need for real, systemic change (Dixon et al., 2010; Kaiser et al., 2013). Further, studies that depict members of other racial identities can reinforce negative biases if not explicitly designed to reduce them or inform participants of how those biases impact their perception (Behm-Morawitz, 2017; Hawkins et al., 2021) Thus, out of a desire to not reinforce or engender preexisting stereotypes, and to explicitly focus on helping behaviors as the outcome variable of interest, this study chose to use an avatar pilot participants had identified as ambiguous.

In both similar and dissimilar conditions, this avatar verbally explained that they were happy the model agreed to help them because they did not have time to troubleshoot prior to their showcase of the environment the next day. They then demonstrated how to troubleshoot the brainstorming task: creating a block, connecting it with arrows, and typing words onto the block. They then told the participant to complete the same task on their own, thanked them for helping one last time, and left the scene. The beneficiary avatar repeated their gratitude for the model's assistance to emphasize the helpful nature of the task. The model then troubleshooted the environment, repeating the behaviors verbally and physically described by the beneficiary. The model troubleshooted the brainstorming task for 90 seconds, longer than previous clips, to mimic the longer time required to assist the beneficiary in a costly task. After this, the avatar closed the brainstorming task and the video ended.

The brainstorming task was designed based on literature evaluating mental models, or the visualization of the relationship between ideas shared by others (Kaba et al., 2016; O'Connor et al., 2004; Van den Bossche et al., 2011). Troubleshooting a brainstorming task was selected based on assertions that helping behaviors transfer across groups and tasks (Jung, 2020), so modeled helping in the virtual environment should promote it during the behavioral manipulation. Secondly, brainstorming is an unfamiliar, more complex task that requires more effort (e.g. higher cost) (Barclay et al., 2021; Vekaria et al., 2017) the brainstorming task has multiple moving parts (e.g. boxes, arrows), making the troubleshooting aspect believable. A screenshot of the interaction before the brainstorming task and the conference room space can be found in figure 9. A full script of the virtual scenarios for the similar conditions can be found in Appendix E, and the dissimilarity conditions' script can be found in Appendix F.

Figure: 9

Interaction Before Troubleshooting Task



Post-Experiment

After viewing the video with the treatment for the respective experimental condition, an arrow appeared in the Qualtrics interface allowing participants to move onto the next portion. Participants were informed that the experimenter was working with a lab assistant to design laboratory protocols and wanted to ensure they were easily understandable to someone not as familiar with the task. To evaluate optional, costly helping (Barclay et al., 2021), participants were informed that this portion was optional, and that their grade and credit would be unaffected by their decision.

The helping manipulation drew from literature on spontaneous helping behaviors (e.g., picking up pens) where participants provided help in unplanned scenarios that were seemingly

unrelated to previous tasks (Dolgov et al., 2014; Levine et al., 2001; Rosenberg et al., 2013; Scisco et al., 2019). Editing as a helping behavior was selected because it is a common behavior for students of any discipline (Ebadi & Rahimi, 2017; Fajri et al., 2015; Mawlawi Diab, 2010), setting a goal that participants should perceive as achievable (Bandura, 2010). Conversely, editing a laboratory protocol was a sufficiently uncommon behavior for the intended sample, ensuring that participants had similar levels of knowledge about the topic. A lab protocol for a nonexistent study was used to ensure that participants had similarly low levels of knowledge of the topic. The text participants edited can be found in Appendix G. Conducting this study via Qualtrics decreased the likelihood of experimenter effects, as participants tend to feel more obligated to acquiesce to experimenter requests when they are physically present (De Quidt et al., 2019).

After reading the message, participants were able to move onto the next screen where they could select either to edit the lab protocol (i.e., engage in helping behavior) or continue to complete the final survey. The lab protocol was linked to a Microsoft Word Online document unique to each participant that could track participant edits. Participants who clicked the Word Online link were sent there directly, whereas those who clicked continue were taken to the final survey, debrief, and dismissal. If participants chose to edit the document, they were instructed to return to Qualtrics when they were done, which then directed them to the same survey, debrief, and dismissal procedure described above. In case participants misclicked, there was a link to return to the Word document on the page of the survey prior to the debrief.

Measures: Pre-Survey Only

Social Media Use. For the pre-questionnaire, the distractor questions about social media use were drawn from the ESM Social Media Use Questionnaire (E-SMUQ), a validated 10-item

measure (Beyens et al., 2021) asking about daily social media use on 3 platforms: Snapchat, WhatsApp, and Instagram (e.g. how much time do you spend viewing Snaps on Instagram. For each question, participants were asked to enter their time in minutes (e.g., 5 minutes).

Demographic questions were also asked during the pre-survey to distract participants from the race and gender matching that would occur with their avatar. In addition to race and gender, participants were asked about their education, current employment, and marital status.

Measures: Pre-Survey and Post-Survey

Self-Efficacy. Following best practices in using self-efficacy to evaluate specific competencies (Muris, 2001), a pre-post measure of self-efficacy was used, drawing from a modified version of the General self-efficacy Scale (Chen et al., 2001). This survey contained eight 7-point Likert scale questions (1 = strongly disagree; 7 = strongly agree) about general self-efficacy (e.g., “I will be able to achieve most of the goals that I set for myself”). People who already reported high self-efficacy tend to find vicarious experiences less impactful, as this means they already possess the capabilities to achieve the outcomes presented by the models (Elshatarat et al., 2016; Hoogerheide et al., 2018). Thus, a pre-post assessment of self-efficacy was used to account for any significant changes in self-efficacy, controlling baseline measures of self-efficacy. The measure was found to be reliable ($\alpha = 0.87$).

Behavioral Intention for Helping. To complement the assessment of helping behaviors, intentions to engage in helping behaviors were also measured via a pre-post survey using the prosocial behavioral intentions scale (Baumsteiger & Siegel, 2019). The scale consists of four Likert scale items (e.g., “How likely are you to assist a stranger with a small task?”) from 1 (Definitely would not do this) to 7 (Definitely would do this). The measure was found to be reliable ($\alpha = 0.77$).

Measures: Post Survey Only

Change Blindness. Drawing from traditional change blindness approaches (G. Davies & Hine, 2007; T. N. Davies & Hoffman, 2002; Nelson et al., 2011), participants in the change conditions were presented with images of the similar avatar and the dissimilar avatar. To assess whether participants detected any changes in the avatars in their respective experimental conditions, a binary measure was used where participants were asked to select one of the two images that represented how their avatar looked at the end of the experiment. Choice order was randomized for participants, but were coded with a 1 for similar avatars and 2 for dissimilar avatars. This response was then compared to condition, where a 1 (similar avatar) was the correct answer for conditions 1 (Similar-No Change) and 3 (Dissimilar-Similar), but the incorrect answer for conditions 2 (Similar-Dissimilar) and 4 (Dissimilar-No Change). We determined that change blindness occurred when participants answered incorrectly for the change conditions (2 and 3).

Perceived Similarity. Perceived similarity was evaluated using modified questions from McCrosky's (1975) attitude homophily subscale of the perceived homophily scale, which contains eight 7-point Likert-Type Scale questions with different anchors depending on the question (e.g., On a scale from 1-7, please rate the avatar's resemblance to you, where 1= doesn't resemble you and 7 = resembles you). The measure was found to be reliable ($\alpha = 0.83$).

Helping Behaviors. Drawing from past quantitative measures of non-binary helping behaviors (Dolgov et al., 2014; Rosenberg et al., 2013), helping behaviors were measured by coding the number of total editing incidents (where higher frequency of edits = more helping) and the time spent (where more time spent on the editing task before clicking on the next Qualtrics page = greater helping). Time was measured in seconds.

Identification. Similarity identification and wishful identification were measured using a modified version of the Player-Identification Scale (PIS), which integrates both wishful and similarity identification questions (Van Looy et al., 2010a). The similarity subscale consists of six 7-point Likert scale items (1 = Strongly Disagree; 7 = Strongly Agree). Sample items included, “The avatar I watched is like me in many ways.” The wishful identification subscale contains five 7-point Likert scale items (1 = Strongly Disagree; 7 = Strongly Agree). Sample items included, “The avatar I watched has characteristics that I would like to have.” Both the similarity ($\alpha = 0.93$) and wishful identification ($\alpha = 0.90$) measures were found to be reliable.

Empathy. Empathy was measured using the Basic Empathy Scale for adults (BES-A) (Carré et al., 2013; Jolliffe & Farrington, 2006), a 19-question measure with 3 subscales containing: seven cognitive empathy questions (e.g., “I can understand my friend’s happiness when she/he does well at something”), six emotional contagion questions (e.g., “After being with a friend who is sad about something, I usually feel sad”), and six emotional disconnection questions (e.g., “My friends’ emotions don’t affect me much”). All questions were measured on 7-point Likert scales (1 = Strongly Disagree; 7 = Strongly Agree). The overall scale was found to be reliable ($\alpha = 0.84$)

Moral Identification. To control for preexisting attitudes towards helping, the Moral Identification scale (Aquino & Reed, 2002) was used, which assesses how much a person bases their identity on their moral values, beliefs, and behavior. This approach has been used to evaluate the importance of helping behaviors to individuals, as helping is often seen as a moral or socially beneficial action (He et al., 2014; Matherne et al., 2018; Paciello et al., 2013). The scale consists of five 7-point Likert scale items (1 = Strongly Disagree; 7 = Strongly Agree). Sample items included, “Being someone who has these characteristics is an important part of

who I am”. The measure was found to be reliable ($\alpha = 0.71$). A full list of questions can be found in Appendix H.

CHAPTER 9

RESULTS

The relationship between avatar appearance and helping behaviors (H1) was investigated using an ANOVA with Similarity versus Dissimilarity condition as the IV and Helping Behaviors as the DV. It was expected that participants in the similarity and similarity-dissimilarity conditions would perform more helping behaviors than those in the dissimilarity and dissimilarity-similarity conditions. The results were not significant, with condition having no significant effect on editing time $F(3, 104) = 0.87, p = .35$. Due to the lower number of participants who edited documents ($n=4$), edits made was not analyzed. Full results can be found in Table 2.

The mediating relationship of self-efficacy on helping behaviors (H2) was investigated using model 4 of Hayes PROCESS macro V3.5 in SPSS Version 26 (Preacher & Hayes, 2004). The condition (e.g., Similar- No Change, Similar- Dissimilar, Dissimilar-Similar, Dissimilar-No Change) served as the independent variable, helping behaviors as the dependent variable, and self-efficacy as the mediator. This approach is supported by logic from Hayes and Preacher (2014), who argue that dummy coding can be used for mediation models without sequential variables because, “Regardless of the system used for coding groups, the relative total effects are equal to the sum of the corresponding relative direct and indirect effects” (p. 256). The coding scheme can be found in Table 1. Condition 1 (Dissimilar-No Change) served as the reference group.

Table 1*Multicategorical Indicator Coding*

Condition	Dummy Code 1	Dummy Code 2	Dummy Code 3
Dissimilar-No Change	0	0	0
Dissimilar-No Change Versus Dissimilar-Similar -x1	1	0	0
Dissimilar-No Change Versus Similar-Dissimilar -x2	0	1	0
Dissimilar-No Change Versus Similar-No Change-x3	0	0	1

The overall model was not significant with $F(2, 103) = 0.62, p = .54$. The analysis showed that self-efficacy was not significantly affected by condition, with beta values and p-values as follows: Dissimilar-No Change to Dissimilar-Similar (X1): $b = 0.19, p = .30$; Dissimilar-No Change to Similar-Dissimilar (X2): $b = 0.06, p = .74$; Dissimilar-No Change to Similar-No Change (X3): $b = 0.08, p = .63$. Pre-self-efficacy was significantly associated with self-efficacy, indicating that pre-self-efficacy scores strongly predicted post-self-efficacy scores ($b = 0.51, p < .001$). Editing time was also not significantly affected by self-efficacy with $b = 0.71, p = .99$. The direct effects of condition on editing time were not significant for any comparisons: Dissimilar-No Change to Dissimilar-Similar (X1): $b = -36.75, p = .74$; Dissimilar-No Change to Similar-Dissimilar (X2): $b = -112.86, p = .29$; Dissimilar-No Change to Similar-No Change (X3): $b = -71.08, p = .49$. The indirect effects of condition on editing time through self-efficacy were also not significant: Dissimilar-No Change to Dissimilar-Similar (X1): $b = 7.07, CI [-22.59, 63.09]$; Dissimilar-No Change to Similar-Dissimilar (X2): $b = 2.13, CI [-13.46,$

29.47]; Dissimilar-No Change to Similar-No Change (X3): $b = 3.12$, CI [-13.68, 30.45]. H2 was not supported. Full results can be found in Table 3.

The relationship between wishful identification and helping behaviors (RQ1) was investigated using a regression, with wishful Identification as the IV and Editing time as the DV. The overall model was not significant $F(1,126) = 0.52$, $p = .37$ revealing that wishful identification did not significantly impact helping behavior.

The serial mediation relationship of Condition (IV) through similarity identification (M1) and Self-efficacy (M2) to helping behaviors (DV) (H3) was investigated using Model 6 of Hayes PROCESS macro V3.5 in SPSS. The overall model was investigated for fit, and all analyses used 5,000 bootstrapped samples to estimate confidence intervals. The overall model predicting Similarity Identification from Condition was significant, $F(3, 102) = 4.03$, $p < .01$. A closer analysis revealed that the similarity identification was significantly higher in the Similar-Dissimilar Condition compared to the Dissimilar-No Change Condition (when comparing the Dissimilar-No Change condition to the Similar-Dissimilar Condition (X2): $b = 0.85$, $p = .01$). When comparing the Dissimilar-No Change condition to the Dissimilar-Similar condition (X1) ($b = -0.26$, $p = .46$) and when comparing the Dissimilar-No Change condition to the Similar-No Change condition (X3) ($b = 0.36$, $p = .28$) were not significant. The overall model predicting self-efficacy from Condition and Similarity Identification was not significant, $F(4, 101) = 1.30$, $p = .28$, indicating that self-efficacy was unaffected by condition for when comparing the dissimilar-no change condition to the dissimilar-similar condition (X1) ($b = 0.04$, $p = .86$), when comparing the Dissimilar-No Change condition to the Similar-Dissimilar Condition (X2) ($b = 0.12$, $p = .58$), or when comparing the Dissimilar-No Change condition to the similar-No Change condition (X3) ($b = 0.06$, $p = .75$). Unexpectedly, there was a significant negative indirect effect

of Similarity on self-efficacy, such that those who reported higher similarity identification reported lower self-efficacy ($b = -.13, p = .04$). The overall model predicting Editing Time from Condition serially mediated through Similarity Identification and self-efficacy was not significant, $F(5, 100) = 0.37, p = .87$, indicating that Editing Time was unaffected by condition for when comparing the dissimilar-no change condition to the dissimilar-similar condition (X1) ($b = -33.92, p = .75$), when comparing the Dissimilar-No Change condition to the Similar-Dissimilar Condition (X2) ($b = -97.86, p = .36$), or when comparing the Dissimilar-No Change condition to the similar-No Change condition (X3) ($b = -61.54, p = .55$), and was unaffected by Similarity Identification ($b = -11.23, p = .73$) or self-efficacy ($b = 31.90, p = .54$). H3 was not supported. Full results can be found in Table 4.

The mediating relationship of empathy on helping behaviors (H4) was investigated using Model 4 of Hayes' PROCESS macro V3.5 in SPSS (Preacher & Hayes, 2004), with condition as the independent variable, helping behaviors as the dependent variable, and empathy as the mediator. The overall model was assessed for fit, utilizing 5,000 bootstrapped samples for confidence interval estimation. The model predicting Empathy from Condition was not significant, $F(3, 102) = 1.42, p = .24$. Condition did not significantly affect empathy when comparing the dissimilar-no change condition to the dissimilar-similar condition (X1) ($b = -0.07, p = .58$), the dissimilar-no change condition to the similar-dissimilar condition (X2) ($b = -0.17, p = .14$), or the dissimilar-no change condition to the similar-no change condition (X3) ($b = 0.00, p = .98$). However, moral identification was a significant predictor of empathy ($b = 0.30, p < .001$). Additionally, the overall model predicting Editing Time from Condition through Empathy was not significant, $F(4, 101) = 0.29, p = .88$. Editing Time was unaffected by condition when comparing the dissimilar-no change condition to the dissimilar-similar condition (X1) ($b = -$

28.03, $p = .79$), when comparing the dissimilar-no change condition to the similar-dissimilar condition (X2) ($b = -106.49$, $p = .31$), and when comparing the dissimilar-no change condition to the similar-no change condition (X3) ($b = -60.61$, $p = .56$). The direct effect of condition on editing time and the indirect effect of condition on editing time through empathy were also not significant across all comparisons. The indirect effects of condition on editing time through empathy were: Dissimilar-No Change to Dissimilar-Similar (X1): $b = -0.20$, CI [-16.53, 20.33]; Dissimilar-No Change to Similar-Dissimilar (X2): $b = -0.52$, CI [-25.24, 29.70]; Dissimilar-No Change to Similar-No Change (X3): $b = 0.01$, CI [-14.97, 16.70]. H4 was not supported. Full results can be found in Table 5.

The moderating relationship of change blindness between Similarity/Dissimilarity conditions on identification (H5) was investigated using Model 1 of Hayes' PROCESS macro V3.5 in SPSS, with Similarity/Dissimilarity Conditions as the independent variable (IV), Similarity Identification as the dependent variable (DV), and the occurrence of change blindness as the moderator. The overall model was assessed for fit, utilizing 5,000 bootstrapped samples to estimate confidence intervals. The model predicting Similarity Identification from Condition and CB occurrence was significant, $F(3, 102) = 3.56$, $p = .02$, $R^2 = .09$, $MSE = 1.42$, indicating that similarity identification was higher in the Similar-Dissimilar condition compared to the No Change condition ($b = .58$, $p = .04$). However, the interaction between the occurrence of change blindness and the Similarity/Dissimilarity condition was not significant, R^2 change = .01, $F(1, 102) = .70$, $p = .40$, suggesting that the occurrence of change blindness had no impact on similarity identification. Full results can be found in Table 6.

Equivalence tests for Hypotheses H6, H7, and H8 were conducted using the Independent Samples Equivalence Test package in SPSS. Equivalence testing is used when it is predicted that

conditions will be significantly similar to one another (e.g., not significantly different). Thus, the null hypothesis predicts that the score falls outside of established equivalence bounds, typically evaluated at $\Delta L = -.1, -.3, -.5$ and $\Delta U = .1, .3, .5$. A significant test indicates a score within those bounds. It was predicted that change blindness would be undetected, and thus that there would be an equivalence within the similarity conditions and the dissimilarity conditions in self-efficacy, helping behaviors, and similarity identification.

Amongst the similarity conditions, the result was not significant for self-efficacy (H6a) $t(142) = 2.763, p = .719, d = 0.30$. However, results were significant for similarity identification (H7a) $t(142) = .29, p = .040, d = 0.30$; wishful identification (H7c) $t(142) = .64, p = .002, d = 0.50$; editing time (H8a) $t(142) = .84, p = .011, d = 0.50$. These results indicate that, when comparing similar- no change to the similar-dissimilar condition for each measure other than self-efficacy (H6a), scores were statistically equivalent and not significantly different (Lakens et al., 2018).

For the dissimilarity conditions, all hypotheses were significant including self-efficacy (H6b) $t(142) = -0.25, p = .002, d = 0.50$; similarity identification (H7a) $t(142) = .29, p = .040, d = 0.30$; similarity identification (H7b) $t(142) = -1.21, p = .014, d = 0.50$; wishful identification (H7c) $t(142) = .64, p = .002, d = 0.50$; wishful identification (H7d) $t(142) = -1.21, p = .014, d = 0.50$; and editing time (H8b) $t(142) = -0.25, p = .002, d = 0.50$. As with the similarity conditions, Findings indicate that the self-efficacy in the dissimilarity conditions, similarity identification, wishful identification, and editing time did not significantly differ when comparing scores in the dissimilar-no change condition to those in the dissimilar-similar condition. Within both the similarity and dissimilarity conditions, findings can further be divided between small (.5) and medium (.3) effect sizes according to Cohen's classification of effect sizes (Sullivan & Feinn,

2012). This further suggests that change blindness occurred, as these variables should differ were the change in the model detected. Full results can be found in Table 7.

Exploratory Analysis

To further investigate whether CB occurred independent of helping behaviors, a Chi-Square Test of Independence was used to evaluate the occurrence of Change Blindness across conditions. Due to a technical issue, 43 participants were not asked whether change blindness occurred, leaving 111 participants who were presented this question. Results suggested a significant difference between groups $\chi^2 (N=111)= 24.123, p <.001$. Residual testing revealed that participants correctly identified the appearance of their avatar 100% of the time when its appearance did not change, but only 45% of the time when its appearance changed. Chi square test results can be found in Table 8, and Residuals can be found in Table 9.

CHAPTER 10

Discussion

The present investigation sought to develop a deeper understanding of how change blindness occurs in virtual environments and to apply those principles to behavioral modeling, evaluating how models of different appearances impacted the performance of helping behavior. The results showed that participants were significantly more likely to incorrectly identify their avatar's appearance in the change conditions (2 and 3) than the no change conditions (1 and 4). Results also showed that there was an equivalency in self-efficacy, identification, and helping behaviors between the similarity and dissimilarity condition, further verifying the occurrence of CB. While none of the variables of interest (identification, self-efficacy, empathy) were significantly related to helping behaviors, indirect effects showed that similarity identification was associated with more similar avatars. Interestingly, self-efficacy decreased after the manipulation.

The Occurrence of Change Blindness in Virtual Settings

Based on the increased detection of CB in the similar conditions and results of the equivalence tests, the change blindness manipulation was successful. The effect size of the majority of equivalency tests speaks to the strength of the occurrence of change blindness in virtual settings. However, results should be interpreted cautiously given the underpowered nature of the study.

Although not studied as frequently as it was two decades ago, this study demonstrates merit for investigating CB and its theoretical advancement in virtual settings. Due to customizability, avatar appearances can be manipulated more easily and dramatically than with traditional confederates. For example, CB studies that measured the occurrence of CB after

swapping confederates were limited to studying if participants recognized that the confederate was a completely different person. Avatars can be used to control more minute aspects of the avatar (e.g., eyes, nose shape, arm length, etc.) or create more significant changes (e.g., what was used in his study) than are possible in real life. Scholars interested in the perceptual components of CB may leverage the plasticity of avatar appearance to evaluate dramatic or nuanced changes in future studies to assess their impact on communication processes and outcomes.

Equivalency measures are also a novel method for investigating CB that could overcome some limitations of existing measures. CB measures tend to be inconsistent but are primarily based on self-reports, ranging from recall (e.g., what was the appearance at the end of the experiment (G. Davies & Hine, 2007; Simons & Ambinder, 2005) to direct questions (e.g., did you notice that an appearance change took place? (Marquis et al., 2021; Simons et al., 2002) (Simons et al., 2002). Further, many of our equivalency measures asked about participant states rather than traits, avoiding the limitation of needing to remember the avatar's appearance after the manipulation. Future studies could use this method in other contexts with behavioral or attitudinal outcomes to potentially assess CB with greater precision.

Self-Efficacy and Helping Behaviors

Self-efficacy was overall not found to significantly influence helping behaviors, and even had a negative relationship with similarity identification. This might have been due to the measurement of self-efficacy used, a general measure of self-efficacy (GSE) rather than one tailored to the specific skill being measured (e.g., helping behaviors). While the GSE has been used in various experiments to evaluate SE for decades (Chen et al., 2001; Coyne et al., 2018; Yenen & Çarkit, 2023), other scholars have created scales customized to assess SE in their specific domain of interest (Brady, 2011; Kang et al., 2021; Peng, 2008). A measure of SE

customized to helping behaviors could strengthen its assessment capability because questions would only inquire about SE changes expected because of the manipulation.

Further, because self-efficacy is a subjective feeling of capability to perform a given task it does not always align with their actual performance, an observation made periodically throughout the literature. Self-efficacy can even lead to overconfidence and decreased performance (Schmidt & DeShon, 2009), such as Vancouver et al, (2002), where participants who reported higher self-efficacy after one game of mastermind had worse performance on a second game. Similarly, other studies have found that people's overestimations of their abilities are more likely when considering general topics, and more accurate or underestimated when they are more specific (Fuchs et al., 2019). For example, Tashma et al., (2019) found that self-efficacy was overestimated when considering broad academic subjects but under-estimated for specific assignments (e.g., papers, exams).

Due to the use of a general, a-contextual self-efficacy measure, people could have overestimated their self-efficacy, while it decreased when actually presented with the experimental scenario. This is supported by research outside self-efficacy about people's tendency to overestimate their abilities (e.g. the Dunning-Kruger effect (Dunning, 2011)), particularly when they are ignorant of what the task actually entails. Thus, the greater identification that was predicted to the strength of the modeling manipulation could have also increased participant's focus on the difference between their initial, broad self-efficacy and the self-efficacy required to perform specific behaviors.

The lack of increase in self-efficacy between pre-and post-measures also calls into question if the scenario was designed appropriately to elicit an increase in self-efficacy. Behavioral change as a result of modeling is more likely when desired behaviors are perceived as

feasible, brief, and have associated rewards (Bandura, 2010a). The current scenario potentially lacked all three of these motivators.

Because all participants were students in the school of journalism and may be unfamiliar with IT troubleshooting and testing, the helping behavior demonstrated by the avatar appears too difficult or unfamiliar. Given that unfamiliarity can increase perceived task difficulty (Bandura, 2010a; Bouffard-Bouchard, 1990; Kelley et al., 2015), participants lack of familiarity with troubleshooting may have decreased the self-efficacy gain from model observation, ultimately decreasing helping behavior performance.

Self-efficacy research, specifically self-regulation, argues that observers do not only emulate behaviors, but presumed attitudes and motivations of the model (Bandura, 1991, 2010a). This is a reason why findings from modeling studies often transfer and serve as motivation for the current study (Fisak & Grills-Taquechel, 2007; Schunk, 1987; Taylor et al., 2005). An important component of self-regulation is goal directedness- that individuals must be able to interpret the model's through the presumed goals before they are able to translate said goals into a measure of effectiveness for their own behavior (Nabavi, 2012).

Participant's lack of familiarity with IT Troubleshooting may have made it more difficult to determine that their actions were helpful, thus reducing their ability to infer model attitudes for the purpose of helping during the behavioral measure. Many helping behavior studies use manipulations like picking up pens that clearly require the helper to assist the beneficiary, clearly illustrating an increase in self-efficacy and transfer of helping behavior to different settings (Johnson, 2012; Levine et al., 2001; Rosenberg et al., 2013). Although the beneficiary verbally acknowledged that the model's behavior was helpful, the fact that the participants were being

helpful might not have been clear to participants, decreasing SE gained because of the experiment.

Conversely, self-efficacy is most useful when tasks are perceived as difficult and SE helps participants overcome a challenge (Bandura, 2010a; Elshatarat et al., 2016; Wood & Bandura, 1989). It is possible participants, who were unfamiliar with what makes IT tasks easy or more difficult, did not see what the helpful avatar did (e.g., troubleshooting) as difficult enough to merit the cultivation of self-efficacy, further decreasing transfer. Future studies looking at the impact of CB on helping behavior may consider the ease of the behavior that participants are being asked to perform.

Finally, this study featured no rewards beyond praise from the beneficiary, which might be insufficient to motivate self-efficacy and associated behavior. Rewards provide tangible incentives for performance beyond intrinsic motivation for performing a desired behavior, while behaviors without rewards can decrease motivation to complete difficult tasks, working hard for no perceivable gain (Bandura, 1991). Past studies also show that greater rewards increase self-efficacy more than lesser rewards (Malik et al., 2015; Schunk, 1983; Stirin Tzur et al., 2016), and that tangible, concrete wards (objects, money) are often greater motivators for behavioral change than intangible ones (praise) (Kelly et al., 2017; Yoon et al., 2015).

For example, Stirin Tzur et al., (2016) found across three studies, that self-efficacy was higher when rewards were offered to top performers rather than to everyone. Their findings were further affected by task difficulty, as providing rewards only to top performers was speculated to further decrease self-efficacy when the task was difficult. Thus, the lack of more tangible, short-term incentives in this study, while an inherent part of costly helping (Hein et al., 2010), could have disincentivized participants from completing an entirely optional helping behavior task.

Future research design scenarios that incorporate more tangible benefits such as extra credit for students or reciprocal reward offerings from the beneficiary (e.g., offering help on future projects, studying help, etc.) to make the rewards more concrete.

Empathy and Helping Behaviors

Empathy did not significantly mediate the relationship between behavioral intentions to help or help behaviors which merits further exploration. Empathy promotes helping when helpers experience a vicarious sense of the beneficiary's distress and work to reduce it (Batson et al., 1987; Cuff et al., 2016), an effect enhanced when helpers have shared experiences with the beneficiary (Kerem et al., 2001). Given that they were journalism students, it is possible that participants focused more on the unfamiliar nature of a troubleshooting task rather than the shared nature of group projects and collaborative work.

Studies from narrative transportation theory also suggest that emotional responses to narratives including empathy increase when verisimilitude is high, or that the story is perceived as real (Van Laer et al., 2014). This realness is enhanced when there is narrative consistency and that the narrative follows identifiable rules, lacking plot holes and events happen as users expect according to those rules (Bal et al., 2011). Further, verisimilitude promotes stronger emotional responses to characters in those stories, as characters perceived as more realistic more easily enable participants to feel the character's imagined emotions and react more strongly in turn (Kuiken et al., 2004).

Considering the narrative presented to participants, a lack of verisimilitude could in part explain the lack of empathy. For example, the narrative was framed as a troubleshooting scenario, and participants were then asked to list what glitches they saw in the video in an open-ended question. While this was intended to be a throwaway question and was not thematically

coded, some participants noted in their response that they did not see any glitches. Further, there were no visual indicators in the virtual space that it belonged to either UGA or the hypothetical startup. Visual indicators, such as logos, could be used to strengthen ingroup or outgroup identity (Hackel et al., 2014), while more obvious “glitches” could be programmed into the scenario to ensure the narrative was consistent. Perhaps due to these design limitations, group membership was not sufficiently salient following the manipulation.

The fact that empathy did not significantly differ between conditions also suggests that the objective and psychological similarity manipulations were weaker than expected. The relationship between group membership and empathy is well documented (Hein et al., 2010; Levine et al., 2001; Stürmer et al., 2006) leading to the assumption that empathy should have differed across conditions even if the behavioral outcomes were not supported. While objective similarity (e.g., demographics) was presented throughout the manipulation via the model’s appearance, psychological similarity was only referenced via text at the beginning of the scenario and the beneficiary avatar’s dialogue. Future research could illustrate the delayed gratification inherent to costly helping more clearly, better incentivizing transfer in participants.

Theoretical Implications for Group Membership

In addition to the methodological observations, it is worth exploring the impact of these nonsignificant findings and how CB informs our understanding of group membership. CB illustrates that that perceptual processes influence group membership and corresponding behaviors. Identity Salience, which argues that identities are organized into hierarchies and then used based on their perceived relevance to the situation, explains the psychological processes underlying social categorization (Callero, 1985; Stryker & Serpe, 1982, 1994). While these studies establish influence behavior in specific contexts, little research has clarified the role that

perception plays informing this salience. The nonsignificance of model appearance on helping behavior suggest that CB can be used to manipulate intergroup perception in real-time without altering participant's perception of shared values or traits (e.g. psychological similarity).

The insignificant findings suggest that intergroup perception could be less fixed than traditionally thought. Theories like intergroup Contact largely relied on building relationships to overcome traditional differences in fixed demographic groups. Findings from the current study suggest that even intergroup perception of demographics is not static, and that perception plays a role in how people evaluate and determine intergroup differences. These findings go beyond salient by suggesting that a perceptual process must be conducted in order to determine demographic and identity (e.g. student) differences. Well, this is largely self-explanatory, the nonsignificant findings represents an important possibility for understanding how people interpret demographic information.

The non-significant results of this study also adhere to previous research which asserts that demographic categories constitute only a portion of group identification. Foundational research conducted from the 1970's to the 1990's (D. Byrne, 1997; D. Byrne et al., 1971; Tsui & Gutek, 1999) suggested that shared demographic information increased the perception of shared values and traits, ultimately increasing workplace outcomes such as improved training retention. More modern real-world (Mansoor et al., 2019; Xuhua et al., 2015) and virtual (Hoogerheide et al. 2016a; Hoogerheide et al. 2016b; Hoogerheide et al. 2017; Hoogerheide et al. 2018) suggest that demographics only play a minor role in behavioral change. The current study aligns with this approach, suggesting that a complex understanding of identity salience is needed in studies that examine demographic differences.

Decades of research also suggest that group boundaries are permeable and fluctuate based on tasks, members, etc (Armenta et al., 2017; Ellemers et al., 1988, 1990). Once again, change blindness provides an opportunity to study permeability in ways that groups are traditionally fixed. The results from the current study suggest that these demographic categories had no impact on behavioral outcomes, further providing insight into how and when people attribute significance to demographic or intergroup information in group settings. Digital settings like the ones used in this study provide opportunities to study how group permeability is affected by a variety of categories,

Limitations

There are multiple limitations to consider. Firstly, it is worth noting that this experiment was underpowered. While the change blindness effect was strong enough to be captured, even without the recommended number of participants, it is also possible that the experimental design was effective and future research could evaluate this with larger participant pools.

There were also limitations in the measures used. The empathy measure used was a trait evaluation of empathy rather than a state. While the measure is validated and widely used throughout the literature, empathy for the interactive partner might have better assessed the scenario's effectiveness. Data on group membership salience was also not collected, making it more difficult to interpret the limited findings related to empathy.

Due to the lack of significance of helping behaviors, the study's reliance on mediation limited its ability to detect other significant findings. While investigatory analyses and direct effects provided insight into significant relationships outside of those presented in hypotheses, the theoretical presuppositions of the study were contingent upon significant mediation models.

Hypotheses and statistical tests more capable of investigating constructs of interest, such as those used in the investigatory analyses, should be leveraged by future researchers

The study was also affected by design limitations, specifically using a predesigned scenario rather than one custom tailored to the current experiment which could be done in few ways. The narrative used to encourage the behavioral outcome of interest could also be tailored to a given sample. While the narrative used to establish similarity described computer science students, the sample exclusively consisted of journalism students. Computer science students are a logical choice for manipulations involving technology and programming and aligned with the programming limitations of the experiment. A future version of this study could involve more extensive programming to depict scenarios specifically relevant to the evaluated sample. In the case of journalism students, the manipulation could be precise enough to depict specific classes that all students would have taken and even use avatars that precisely represent professors of those classes. These examples could benefit virtual modeling scenarios by establishing more valences of similarity. Programming limitations also prevented the use of virtual information in the visual space that could better distinguish between conditions and make the scenario appear more realistic.

The final consideration in terms of manipulation is user testing. The scenario and script were evaluated by committee members and other graduate students to ensure that the text describing each clip clearly described each scenario beforehand, and that the scenario justified the need for help. However, no user testing was conducted with the specific sample evaluated, that of undergraduate journalism students, which could have increased the ability of researchers to design a scenario relevant for our sample. Given the importance of similarity in modeling

scenarios, future research should more extensively test manipulations with their intended audience to ensure the scenario sufficiently depicts and motivates behaviors of interest.

Conclusion

The current study set out to investigate the occurrence of change blindness in virtual environments, an understudied and increasingly relevant area for researchers as virtual interactions become more and more common. Secondly, it sought to investigate how those changes influence modeled helping behaviors, using shifting avatar appearances to make the virtual model more closely resemble the viewer in hopes of increasing their confidence (e.g., self-efficacy) in helping others.

Aligning with previous studies, change blindness did occur, and is one of the few studies investigating how change blindness occurs with virtual characters, a result was also supported using equivalency measures. Similarity identification was in the Similarity-Dissimilarity condition, suggesting that objective similarity does inform viewer perception of similarity. However, this finding only occurred in one of the two similarity condition aligns with mixed results found in previous studies.

Ultimately, there was no impact of either mediators or conditions on helping behavior. However, exploratory analysis suggests that the expected relationships between empathy, identification, and homophily occurred as expected. While the experiment was underpowered, future scholars interested in using changing virtual models could also employ more rigorous methods to promote in-group salience, design an experiment specifically for the intended audience, and more heavily emphasize psychological similarity. Understanding how to leverage different technologies' capabilities to promote behavior change, as well as how perception

influences the likelihood of that change, remain important questions for our increasingly digital world.

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APPENDICES

Appendix A

Pilot Study Questionnaire

Please select the best response: from your perspective, what race does this avatar appear to be?

White: e.g., German, Irish ancestry, English, Polish, French, etc.

Hispanic, Latinx, or Spanish Origin: e.g., Mexican, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian, etc.

Black: e.g., African American, Jamaican, Haitian, Nigerian, Ethiopian, Somalian, etc.

Asian: e.g., Chinese, Filipino, Asian Indian, Vietnamese, Korean, Japanese, et al.

Middle Eastern or North African: e.g., Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian, et al.

Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.

Please select how certain you are in your answer. Please use your best judgment where 0 = uncertain, 100 = very certain

Appendix B

Original Video Stimuli

Stimulus	Avatar Race	Avatar Sex
1	White: e.g., German, Irish ancestry, English, Polish, French	female
2	White: e.g., German, Irish ancestry, English, Polish, French	male
3	Hispanic, Latinx, or Spanish Origin: e.g., Mexican, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian, etc.	female
4	Hispanic, Latinx, or Spanish Origin: e.g., Mexican, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian, etc.	male
5	Hispanic, Latinx, or Spanish Origin: e.g., Mexican, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian, etc.	female
6	Hispanic, Latinx, or Spanish Origin: e.g., Mexican, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian, etc.	male
7	Hispanic, Latinx, or Spanish Origin: e.g., Mexican, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian, etc.	female
8	Hispanic, Latinx, or Spanish Origin: e.g., Mexican, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian, etc.	male
9	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.	female
10	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.	male
11	Middle Eastern or North African: e.g., Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian, et al.	female
12	Middle Eastern or North African: e.g.,	male

Lebanese, Iranian, Egyptian, Syrian,
Moroccan, Algerian, et al.

13

N/A (dissimilar)

N/A
(dissimilar)

Appendix C

Created Video Stimuli

Condition	Stimuli Used	Sex	Original Appearance	Final Appearance
Similar	1	Female	White: e.g., German, Irish ancestry, English, Polish, French	White: e.g., German, Irish ancestry, English, Polish, French
Similar-Dissimilar	1,13	Female	White: e.g., German, Irish ancestry, English, Polish, French	Dissimilar
Dissimilar-Similar	13,1	Female	Dissimilar	White: e.g., German, Irish ancestry, English, Polish, French
Similar	3	Female	Hispanic, Latinx, or Spanish Origin: e.g., Mexican, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian, etc.	Hispanic, Latinx, or Spanish Origin: e.g., Mexican, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian, etc.
Similar-Dissimilar	3,13	Female	Hispanic, Latinx, or Spanish Origin: e.g., Mexican, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian, etc.	Dissimilar
Dissimilar-Similar	13,3	Female	Dissimilar	Hispanic, Latinx, or Spanish Origin: e.g., Mexican, Puerto Rican, Cuban, Salvadoran,

				Dominican, Colombian, etc.
Similar	5	Female	Black: e.g., African American, Jamaican, Haitian, Nigerian, Ethiopian, Somalian, etc.	Black: e.g., African American, Jamaican, Haitian, Nigerian, Ethiopian, Somalian, etc.
Similar- Dissimilar	5,13	Female	Black: e.g., African American, Jamaican, Haitian, Nigerian, Ethiopian, Somalian, etc.	Dissimilar
Dissimilar- Similar	13,5	Female	Dissimilar	Black: e.g., African American, Jamaican, Haitian, Nigerian, Ethiopian, Somalian, etc.
Similar	7	Female	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.
Similar- Dissimilar	7,13	Female	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.	Dissimilar
Dissimilar- Similar	13,7	Female	Dissimilar	Indigenous: e.g., Inuit, Native

				American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.
Similar	9	Female	Middle Eastern or North African: e.g., Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian, et al.	Middle Eastern or North African: e.g., Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian, et al.
Similar-Dissimilar	9,13	Female	Middle Eastern or North African: e.g., Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian, et al.	Dissimilar
Dissimilar-Similar	13,9	Female	Dissimilar	Middle Eastern or North African: e.g., Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian, et al.
Similar	11	Female	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.
Similar-Dissimilar	11,13	Female	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.	Dissimilar

Dissimilar-Similar	13,11	Female	Dissimilar	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.
Similar	2	Male	White: e.g., German, Irish ancestry, English, Polish, French	White: e.g., German, Irish ancestry, English, Polish, French
Similar-Dissimilar	2,13	Male	White: e.g., German, Irish ancestry, English, Polish, French	Dissimilar
Dissimilar-Similar	13,2	Male	Dissimilar	White: e.g., German, Irish ancestry, English, Polish, French
Similar	4	Male	Hispanic, Latinx, or Spanish Origin: e.g., Mexican, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian, etc.	Hispanic, Latinx, or Spanish Origin: e.g., Mexican, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian, etc.
Similar-Dissimilar	4,13	Male	Hispanic, Latinx, or Spanish Origin: e.g., Mexican, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian, etc.	Dissimilar
Dissimilar-Similar	13,4	Male	Dissimilar	Hispanic, Latinx, or Spanish Origin: e.g., Mexican, Puerto

				Rican, Cuban, Salvadoran, Dominican, Colombian, etc.
Similar	6	Male	Black: e.g., African American, Jamaican, Haitian, Nigerian, Ethiopian, Somalian, etc.	Black: e.g., African American, Jamaican, Haitian, Nigerian, Ethiopian, Somalian, etc.
Similar- Dissimilar	6,13	Male	Black: e.g., African American, Jamaican, Haitian, Nigerian, Ethiopian, Somalian, etc.	Dissimilar
Dissimilar- Similar	13,6	Male	Dissimilar	Black: e.g., African American, Jamaican, Haitian, Nigerian, Ethiopian, Somalian, etc.
Similar	8	Male	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.
Similar- Dissimilar	8,13	Male	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.	Dissimilar

Dissimilar-Similar	13,8	Male	Dissimilar	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.
Similar	10	Male	Middle Eastern or North African: e.g., Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian, et al.	Middle Eastern or North African: e.g., Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian, et al.
Similar-Dissimilar	10,13	Male	Middle Eastern or North African: e.g., Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian, et al.	Dissimilar
Dissimilar-Similar	13,10	Male	Dissimilar	Middle Eastern or North African: e.g., Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian, et al.
Similar	12	Male	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.
Similar-Dissimilar	12,13	Male	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian,	Dissimilar

			Pacific Islander, Samoan, etc.	
Dissimilar- Similar	13,12	Male	Dissimilar	Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Pacific Islander, Samoan, etc.
Dissimilar	13		Dissimilar	Dissimilar

Appendix D

Video Assignment by Race and Gender Selection

Participant Racial Identification	Participant Gender	Condition Possibilities
White: e.g., German, Irish ancestry, English, Polish, French	male	1. W-M-D-S 2. W-M-NC 3. W-M-S-D 4. Diss-M-NC
White: e.g., German, Irish ancestry, English, Polish, French	female	1. W-F-D-S 2. W-F-NC 3. W-F-S-D 4. Diss-F-NC
Hispanic: e.g., Latinx, or Spanish Origin: e.g., Mexican, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian	female	1. H-F-D-S 2. H-F-NC 3. H-F-S-D 4. Diss-F-NC
Hispanic e.g., Latinx, or Spanish Origin: e.g., Mexican, Puerto Rican, Cuban, Salvadoran, Dominican, Colombian	male	1. H-M-D-S 2. H-M-NC 3. H-M-S-D 4. Diss-M-NC
Black: e.g., African American, Jamaican, Haitian, Nigerian, Ethiopian, Somalian	female	1. B-F-D-S 2. B-F-NC 3. B-F-S-D 4. Diss-F-NC
Black: e.g., African American, Jamaican, Haitian, Nigerian, Ethiopian, Somalian	male	1. B-M-NC 2. B-M-S-D 3. B-M-D-S 4. Diss-M-NC
Asian: e.g., Chinese, Filipino, Asian Indian, Vietnamese, Korean, Japanese	female	1. A-F-D-S 2. A-F-NC 3. A-F-S-D 4. Diss-F-NC
Asian: e.g., Chinese, Filipino, Asian Indian, Vietnamese, Korean, Japanese	male	1. A-M-D-S 2. A-M-NC 3. A-M-S-D 4. Diss-M-NC

Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Samoan	female	1. I-F-D-S 2. I-F-NC 3. I-F-S-D 4. Diss-F-NC
Indigenous: e.g., Inuit, Native American (e.g., Lakota, Sioux), Māori, Mayan, Native Hawaiian, Samoan	male	1. I-M-D-S 2. I-M-NC 3. I-M-S-D 4. Diss-M-NC
Middle Eastern or North African: e.g., Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian	female	1. M-F-D-S 2. M-F-NC 3. M-F-S-D 4. Diss-F-NC
Middle Eastern or North African: e.g., Lebanese, Iranian, Egyptian, Syrian, Moroccan, Algerian	male	1. M-M-D-S 2. M-M-NC 3. M-M-S-D 4. Diss-M-NC
Prefer not to say	Non-binary	1. Diss-F-NC 2. Diss-M-NC
Other (please specify)	Non-binary	1. Diss-F-NC 2. Diss-M-NC
Prefer not to say	Other (please specify)	1. Diss-F-NC 2. Diss-M-NC
Other (please specify)	Other (please specify)	1. Diss-F-NC 2. Diss-M-NC
Prefer not to say	Prefer not to say	1. Diss-F-NC 2. Diss-M-NC
Other (please specify)	Prefer not to say	1. Diss-F-NC 2. Diss-M-NC

Appendix E

Text and Subtitles Displayed during Similarity Conditions

Introduction

You are about to watch a video of a developer troubleshooting an environment in real-time

They are a CS MAJor at UGA finalizing a group project right before leaving for class

Before Viewing Clip 1

The developer will go into the playroom and will play checkers by themselves. They will find a weird bug where the pieces keep disappearing, but they will fix it quickly

Before Viewing Clip 2

Then they will move to a big virtual auditorium and will bounce a basketball around.

The ball won't bounce right at first, so they will change some settings, and then it will work just like a real ball.

Before Viewing Clip 3

After that, they will go up high into the sky to play chess

The chess pieces will be moving awkwardly, so they will make some tweaks, and soon the pieces will move smoothly.

Before Viewing the Helping Scenario

Just as they are about to leave another room, they will meet another developer who is stuck on a problem but has to rush to class

The first developer will agree to help and will start working on troubleshooting the new problem right away.

Dialogue spoken by beneficiary avatar

Thank you so much for agreeing to help me. I know you have to run but I didn't think I was going to be able to get this done by myself

So we have alumni coming to look at lab projects and we were planning to show off this room as a collaborative space. but I haven't had time to troubleshoot the most recent update. It should be working but it would be great to have another pair of eyes on it before tomorrow.

All you need to do is make sure that these podiums work and that the brainstorming task works correctly.

All you'll need to do is create some boxes with that button there and connect them with arrows with the button in the corner to show how they're connected. You don't actually need to come up with good ideas or anything, just test the functions.

Try to test out every function too. Like making the arrows longer or shorter, coloring the boxes. Everything you can think of. Just in case somebody tries the same thing tomorrow.

I've got to go to class but thanks again. It's super helpful.

Appendix F

Text and Subtitles Displayed during Dissimilarity Conditions

Introduction

You are about to watch a video of a beta tester troubleshooting an environment in real time.

They work at TOGETHVR, a startup virtual reality collaboration platform.

They were recruited to beta test the environment but are not an employee.

Before Viewing Clip 1

The developer will go into the playroom and will play checkers by themselves. They will find a weird bug where the pieces keep disappearing, but they will fix it quickly

Before Viewing Clip 2

Then they will move to a big virtual auditorium and will bounce a basketball around.

The ball won't bounce right at first, so they will change some settings, and then it will work just like a real ball

Before Viewing Clip 3

After that, they will go up high into the sky to play chess.

The chess pieces will be moving awkwardly, so they will make some tweaks, and soon the pieces will move smoothly.

Before Viewing the Helping Scenario

Just as they are about to leave another room, they will meet an employee of TOGETHVR who is stuck on a problem but has to rush to a meeting

The beta tester will agree to help and will start working on troubleshooting the new problem right away.

Dialogue spoken by beneficiary avatar

I'm so happy I ran into someone else. I know you're just here to beta test but I didn't think I was going to be able to get this done by myself

So we have a meeting with our CTO tomorrow and wanted to show off this collaborative space specifically but I haven't had time to troubleshoot the most recent update. It should be working but it would be great to have another pair of eyes on it before tomorrow.

All you need to do is make sure that these podiums work and that the brainstorming task works correctly.

All you'll need to do is create some boxes with that button there and connect them with arrows with the button in the corner to show how they're connected. You don't actually need to come up with good ideas or anything, just test the functions.

Try to test out every function too. Like making the arrows longer or shorter, coloring the boxes. Everything you can think of. Just in case somebody tries the same thing tomorrow.

I've got to go to my meeting but thanks again. It's super helpful.

Appendix G

Laboratory Protocol Edited by Participants

Editing Instructions

If you would like to participate, I would like for you to look for the following issues

1. grammar- look for typo/spelling errors etc. Things that you would edit in any other essay for class
2. clarity- when you look at the document, are the instructions clear? would you know what to do just by reading this document? This is where your input would be extra helpful
3. If you choose to edit the lab protocol, you will see boxes that look like the one below. These boxes are examples of what the research assistant will say out loud. Do the sentences in the boxes sound like something you or other people would actually say?

The protocol begins on the next page

Proximity in Virtual Reality

Basic details of being a research assistant

- The experiment will be hold in Room **135B**, of the Building
- Use RESEARCHER SCHEDULE Google Sheet for shifts
- Make sure you are signed up on good days to use the lab on the lab calendar, and that participants are signed up in those slots if you want to make sure people will come
- At your desk, you will have access to a computer that you will use for making a record of the participants who are entering and leaving (using the Participant Log Google Sheet).
- Pull up the pilot survey (link found here)

You are now looking at the home screen of the spatial app. Spaces and then practice Brainstorming

EXPERIMENTAL CONDITION

BEFORE PARTICIPANTS ARRIVE...

1. SETING UP PARTICIPANT SURVEY COMPUTER:
 - . The computer 135B, used study, should all times. In case restarts forced login, here information:
 - . Find called "PROXIMITY SURVEY" desktop Chrome bookmark.
 - . If find, link.
2. On computer, out "FOR RESEARCHER ONLY" (participant ID & condition).
 - . Click. You see page "Research ID." Leave open browser window COVID form.
 - . You need confirm participants. Can open log on phone desktop need be

2. SETTING UP EXPERIMENT

3. In Oculus Headset, application Convrged.

ONCE THE PARTICIPANT ARRIVES...

1. Greet the participant in the hallway and adhere to COVID-19 protocol
 - . *Hi, you here for the Collaboration study?*
 - . *Great, what's your name and UGA email so that I can make sure you get credit for participating?*
2. After completion of the screening questionnaire, bring participants to the respective room (check participant log for which room they need to be in)
 - . Administer hand sanitizer immediately upon entering the room.
 - . Put on gloves.
 - . Explain cleaning procedures done on headsets and other surfaces:



This is an example of a box that contain what the researcher will say out loud

Verify and fill out participants' information in the Participant Log Google Sheet ([link](#))

1. Participants ID and conditions are pre-assigned in the log. Add the participant information to the next available empty cells.


2. Verify and fill out name and UGA email (make sure they match with their SONA sign ups).
3. e.g., When a participant arrives, ask them their name and UGA email address. Check if they match with SONA sign ups. Type these into the Participant Log. Then, in the ARRIVED column, mark the time (e.g., 10:30am).

Sign into spatial


- Open the tab for spatial.io
- At the top of the page click the picture with a name at the top. Then select Edit Profile
- NON ANONYMOUS CONDITION
 - Change your name to your first name only.
 - Then click the moving avatar in the background.
 - When you see a screen that says create 3D avatar, click the picture icon to let it take a picture of you.
 - Select a gender that matches yours.
 - On the next screen, using the icon that looks like a rain drop, select a skin tone that matches yours. When you're done, Looks good.
- ANONYMOUS CONDITION
 - Change the name of the participant to Room Number

ADMINISTERING HEADSET

1. Give instructions about controllers BEFORE they put on the headset by demonstrating the procedure using other controllers for your own.

	<p>“You will grab these controllers like this here.. Please don’t click anything yet, as you will practice soon.</p>
---	--

0. Instruct them to put on the headset.
 . Demonstrate the procedure using another Vive headset other than your own:


	<p>“I will be standing 6 feet away from you and show you how to put on the headset using my own headset at the same time.</p> <p>Place the goggles over your eyes and rotate the knob behind your head to tighten in that your head is nice and snug and comfy within the headset.</p> <p>You may also tighten the Velcro strap on top of your head and pull until the headset sits comfortably. You should be able to rotate your head without the headset falling off or moving around.”</p>
---	--

- Take the blue controllers out of the magnetic charging station and hand them to the participant
- Go into the hallway and give instructions from your computer on zoom so that instructions can be given to all participants at once.


Sign into spatial

0	You are now looking at the home screen of the spatial app. Spaces and then practice Brainstorming
---	---


VR CONDITION TRAINING

0.		<p>You are now looking at the beginning</p> <p>There are a blue circle below your feet. Please stay in there</p> <p>You can move around by using either the left or right control sticks you can push it left or right or forward to move in that direction..</p> <p>The movement can feel a little quick but you will adjust.</p> <p>Let me know when you have</p>
----	---	---

- Once the participant practices moving

0.		<p>You can also select objects in the environment with the triggers under your pointer fingers. You can move an object towards you by moving the control stick towards you while holding the trigger. You can move an object away from you by moving the control stick away from you. Try doing that now.</p>
----	---	---


- Once the participant notifies you

0.		<p>We're going to practice brainstorming with an exercise. Look around this virtual space. What do you see? What do you notice in it? We're going to write it down</p> <p>First of all let's make categories of what you see in the room. For example, there is a couch in the room so that could be considered furniture or tree could be considered a decoration. Try making one category and one item in that category now using two different stick notes.</p>
----	---	--

Click on a sticky note/ or colored square by just tapping the trigger and clicking edit. Edit will appear over the top right corner and clicking edit. To write a note, you can draw, speak or type it using different icon.

Try putting one observation on one note and then placing it in the air near you. Do not paste it on the board where you got the notes from. Try making a few notes of different items.

If you get disoriented, just use the to where you were.

0.  Great. Now, are any ideas related to other ideas? For example, If you wrote “furniture” you could list chair, couch, and then draw arrow to them. If you wrote decoration, you could then list tree and drawn arrow to it

To place an arrow, hit the flat button touching the bend in your thumb on the left controller. This is the menu button.

click the middle blue button with a plus sign that says content and the red arrow. If you have ideas that you think go together, try do this now

You can rotate the arrow by moving the arrow close to you with the control stick, grabbing it by moving your , and then rotating your hand.

“Great. Thanks for practicing. Do you have any other questions? We’re going to apply those skills and begin the study now.

To begin phase one, please click the button halfway up your thumb, and click the arrow pointing left and

Back at the main menu click team -> Room Marked with your room number, time, and date.

You all will be in separate virtual spaces for right now, so make sure you aren’t together with anyone else. Let me know when you’re there.

BEGIN THE EXPERIENCE

Before we begin, click the flat button on the RIGHT controller under your thumb to open the oculus menu, click share, and then record video. Click yes to approve

Today you’re going to be brainstorming about the future of transportation. What it will look like, what will change from now, and how people will get from place to place in the future.

As you come up with ideas, please place them in the virtual space as we practiced. Please put ideas *you think* are related together by using arrows. If you don't do this the study won't work

There is no right or wrong answer, and anything you think is worth including is worth putting down on a note. We are looking for as many ideas as possible.

I have placed extra arrows and sticky notes on the wall in front of you for you to use. If you run out, you can make copies by clicking them and clicking the button in the lower right.

I will be walking in and out of the different rooms to make sure no one is having any problems and you'll be doing this for 10 minutes.

PHASE 1

AFTER 10 MINUTES

0. At 10 minutes- stop the participants

0 "Finish whatever idea you are writing then please let me know.

We will be moving on to the next phase. Click the button halfway up your thumb on either controller and click the left arrow to exit the room. Back in the main screen, under teams click the room labelled group with your time and date. The next phase will start when we are all together

Go into the group room PC and click the three dots- export content.

Once everyone has arrived

1. 

You will now be brainstorming on the same topic together. While you cannot look at the information in the other room, please feel free to recall any ideas you had written up and share them with the group.

Keep these in mind while you work (1) Come up with as many ideas as you can (2) Do not criticize one another's ideas (3) Free-wheel and share wild ideas (4) Expand and elaborate on existing ideas

Discuss any ideas you want to share with your team, and team members feel free to share your opinions on those ideas as they come up. Discuss as much as needed without any regard for the idea quality. We want quantity over quality here. Once everyone agrees on it, please place the idea in the virtual space with a sticky note.


Sort the ideas you did in the same way as before, by connecting related ideas with an arrow.


I will be in the virtual space with you in case you have questions. You will be working on this for 15 minutes.

Go into everyone's room on PC and click the three dots- export content. Save these in SMM -> Data Collection Materials -> Cognitive Map with the title Time_Date_Room_Group

PHASE 2


1. At 15 minutes- stop the participants

0.		Finish whatever you all are working on as soon as you can as we'll be moving onto the last phase
----	---	--

0.		<p>For the final part of this study, you will be returning to your original brainstorming room. To do this, click the button halfway up your thumb, click the arrow pointing to leave, and then select the room with your room number on it.</p> <p>I want you to update your original brainstorming document with ideas that you learned from your team mates. How were their ideas bad? How are yours better? What can be done to improve?</p> <p>Take this time now to edit your original document on your own without talking to me or anyone else.</p> <p>You can't view the original document even if you wanted to, but think back to what you saw, and make any changes you want to your brainstorming document now. You'll have at least 10 minutes to do this.</p>
----	---	--

PHASE 3

1. After 10 minutes- stop everythingg

0.		<p>Now that you're done, please save the file by clicking the button in the lower corner of the screen and click. At the end of the file name, include your room in the save file, and put 2 right after that</p> <p>For example:</p> <p>Let me know whenafn finish edits edits and you can start the survey.</p>
----	---	---

Go into everyone's room on PC and click the three dots- export content. Save these in SMM -> Data Collection Materials -> Cognitive Map with the title Time_Date_Room_SoloBS2

END OF EXPERIENCE AND POST-EXPERIENCE SURVEY

1. Once the participant finishes crossing the third phase, please let them know the experience is completed and it is time to complete the survey.



“Alright, the experiment is now complete, so you can remove the headset if you are ready to not wear it anymore. We have one more part to complete before you leave so let me know when we can transition to the final step as it would be very helpful and easy.

- . Direct them to the survey computer in their respective room so that they may complete the survey.
- . Make sure you input participant ID and condition prior to the participant completing the survey.
- . Ask them to complete the survey, and then tell them there will be a short debriefing after the survey.



Let me know when you're all done

0. Once participants finish, have them all gather in room 135A where you will complete the debriefing phase



“All done with the survey? Great!”

POST-GAME DEBRIEF

1. Ask questions about their questions
2. Thank the participant for their time

AFTER THE PARTICIPANT LEAVES

1. In the Participant Log, record that the participant has completed the study. Provide credit in SONA.
 2. Once a participant has left, go to their survey computer and restart the survey for the next participant (making sure to enter the next participant's ID and condition).
 3. Connect the charger outside the headset.
 4. Finally, use the sanitizer wipes to sanitize the computer, VR headset, and survey computer **BEFORE EACH PARTICIPANT**.
 5. Also sanitize the electrodes and straps.
0. At the end of each day:
 - . Move the data file (video) from the day to the google Folder
 - . Log out and shut out each computer.
 - . Throw your trash and leave the room looking nice and fresh⁷⁶[45
 - . Turn off the lights and close the door

Appendix H

Study Questionnaire

Pre-Study Questionnaire

Demographics

1. What is your age?

2. What is your gender or how do you identify?

- Male
- Female
- Non-binary/third gender
- Prefer not to say
- Other (please specify): _____

3. What is your Ethnicity/Race or how do you identify?

- Caucasian/White
- African American/Black
- Hispanic/Latino
- Asian/Pacific Islander
- Native American/Alaska Native
- Mixed ethnicity
- Other (please specify): _____
- Prefer not to say

4. What is your Marital Status:

- Single
- Married
- Divorced
- Separated
- Widowed
- Domestic partnership
- Prefer not to say

5. What is your highest level of education completed?

- Less than high school
- High school graduate
- Some college/Associate's degree
- Bachelor's degree
- Master's degree
- Doctorate or professional degree

6. What is your employment Status?

- Employed full-time
- Employed part-time
- Unemployed
- Student
- Retired
- Homemaker
- Other (please specify): _____

7. What is your household income?

- Under \$25,000
- \$25,000 - \$49,999
- \$50,000 - \$74,999
- \$75,000 - \$99,999
- \$100,000 - \$149,999
- \$150,000 or more
- Prefer not to say

E-SMUQ

Use of Instagram

“How much time in the past hour have you spent...”

1. “sending direct messages on Instagram”
2. “viewing direct messages on Instagram”
3. “viewing posts/stories of others on Instagram”

Use of Snapchat

“How much time in the past hour have you spent...”

4. “sending snaps on Snapchat”
5. “viewing snaps on Snapchat”
6. “viewing stories of others on Snapchat”

7. “sending direct messages on Snapchat”
 8. “viewing direct messages on Snapchat”
- Use of WhatsApp*
- “How much time in the past hour have you spent...”
9. “sending messages on WhatsApp”
 10. “reading messages on WhatsApp”

Post Study Questionnaire

Change Detection

Please select the image that most closely resembles the appearance of your avatar at the end of the experiment

Perceived Homophily

On a scale from 1-7, please answer the following Questions.

The avatar that I saw in the study and saw the world from their perspective:

1. Looks Similar to me -> Looks different than me (RC)
2. Different size than I am -> Same size I am
3. Appearance like mine -> Appearance unlike mine (RC)
4. Doesn't resemble me -> Resembles me
5. Doesn't think like me -> Thinks like me
6. Behaves like me -> Doesn't behave like me (RC)
7. Similar to me -> Different from me
8. Unlike me -> like me (RC)

Prosocial Behavioral Intention Scale

Imagine that you encounter the following opportunities to help others. Please indicate how willing you would be to perform each behavior from 1 (Definitely would not do this) to 7

(Definitely would do this). If you are more likely to complete one task (e.g., help a stranger find a key) than another (e.g., help a stranger find a missing pet), please respond to the task that you would be more likely to perform.*

1. Comfort someone I know after they experience a hardship
2. Help a stranger find something they lost, like their key or a pet
3. Help care for a sick friend or relative
4. Assist a stranger with a small task (e.g., help carry groceries, watch their things while they use the restroom)

Identification

Please answer the questions about the avatar you watched perform the task.

Similarity Identification

The avatar I watched is like me in many ways

The avatar I watched resembles me

I identify with the avatar I watched

The avatar I watched is an extension of myself

The avatar I watched is similar to me

I resemble the avatar I watched

Wishful Identification

If I could become like my the avatar I watched, I would

I would like to be more like The avatar I watched

The avatar I watched is an example to me

The avatar I watched is better me

The avatar I watched has characteristics that I would like to have

Moral Identification

“It would make me feel good to be a person who is helpful

“Being someone who is helpful is an important part of who I am

“I would be ashamed to be a person who is helpful (RC)

“Being helpful is not really important to me (RC)

“I strongly desire to be helpful

self-efficacy

I will be able to achieve most of the goals that I set for myself

When facing difficult tasks, I am certain that I will accomplish them.

In general, I think that I can obtain outcomes that are important to me.

I believe I can succeed at most any endeavor to which I set my mind.

I will be able to successfully overcome many challenges.

I am confident that I can perform effectively on many different tasks.

Compared to other people, I can do most tasks very well.

Even when things are tough, I can perform quite well

Empathy

1. My friends' emotions don't affect me much. (RC)

2. After being with a friend who is sad about something, I usually feel sad.

3. I can understand my friend's happiness when she/he does well at something.

4. I get frightened when I watch characters in a good scary movie.

5. I get caught up in other people's feelings easily.

6. I find it hard to know when my friends are frightened. (RC)

7. I don't become sad when I see other people crying. (RC)

8. Other people's feelings don't bother me at all. (RC)
9. When someone is feeling 'down' I can usually understand how they feel.
10. I can usually work out when my friends are scared.
11. I often become sad when watching sad things on TV or in films.
12. I can often understand how people are feeling even before they tell me.
13. Seeing a person who has been angered has no effect on my feelings. (RC)
14. I can usually work out when people are cheerful.
15. I tend to feel scared when I am with friends who are afraid.
16. I can usually realize quickly when a friend is angry.
17. I often get swept up in my friends' feelings.
18. My friend's unhappiness doesn't make me feel anything. (RC)
19. I am not usually aware of my friends' feelings. (RC)
20. I have trouble figuring out when my friends are happy(RC)

Tables

Table 2

ANOVA Results Comparing Helping Behavior Between Similarity and Dissimilarity Conditions

Source	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	108,146.21	1	108,146.21	0.87	0.35
Within Groups	12,944,752.41	104	124,468.77		
Total	13,052,898.63	105			

Table 3*Regression results for Self-Efficacy as a Mediator on Helping Behaviors*

	b	SE	Bootstrap 95% CI		p
			Lower	Upper	
<i>Self-Efficacy</i>					
X ₁ → Self-Efficacy	0.19	0.18	-0.17	0.56	0.30
X ₂ → Self-Efficacy	0.06	0.18	-0.29	0.41	0.74
X ₃ → Self-Efficacy	0.08	0.17	-0.26	0.43	0.63
Pre Self-Efficacy	0.51	0.08	0.35	0.67	0.00
<i>Helping Behaviors</i>					
X ₁ → Helping Behaviors	-36.75	109.39	-253.98	180.48	0.74
X ₂ → Helping Behaviors	-112.86	104.95	-321.28	95.55	0.29
X ₃ → Helping Behaviors	-71.08	103.12	-275.85	133.69	0.49
Pre-Self Efficacy	36.80	61.25	-84.84	158.43	0.55
Self-Efficacy	0.71	56.44	-111.38	112.80	0.99
<i>Direct Effects</i>					
Condition → Editing Time	Effect	bSE	BootLLCI	BootULCI	p
X ₁ → Helping Behavior	-36.75	109.39	-253.98	180.48	0.74
X ₂ → Helping Behaviors	-112.86	104.95	-321.28	95.55	0.29
X ₃ → Helping Behaviors	-71.08	103.12	-275.85	133.69	0.49
<i>Indirect Effects</i>					
Condition → Self-Efficacy → Editing Time	Effect	bSE	BootLLCI	BootULCI	
X ₁ → Helping Behaviors	7.07	21.26	-22.59	63.09	
X ₂ → Helping Behaviors	2.13	9.94	-13.46	29.47	
X ₃ → Helping Behaviors	3.12	10.53	-13.68	30.45	

Notes: X₁ = Dissimilar-No Change vs. Dissimilar- Similar X₂ = Dissimilar-No Change vs. Similar-Dissimilar, X₃ = Dissimilar-No Change vs. Similar-No Change ; SE = standard error; CI = confidence interval. Bootstrap resampling = 5000. *** p < .001 ** p < .01 * p < .05

Table 4*Regression results for the Serial Mediation of Similarity Identification and Self-Efficacy on**Helping Behaviors*

	b	SE	Bootstrap 95% CI		p
			Lower	Upper	
<i>Similarity Identification</i>					
X ₁ → Self-Efficacy	-0.26	0.34	-0.94	0.43	0.46
X ₂ → Self-Efficacy	0.85	0.33	0.19	1.51	0.01
X ₃ → Self-Efficacy	0.36	0.33	-0.29	1.01	0.28
<i>Self-Efficacy</i>					
X ₁ → Self-Efficacy	0.04	0.21	-0.38	0.46	0.86
X ₂ → Self-Efficacy	0.12	0.21	-0.30	0.54	0.58
X ₃ → Self-Efficacy	0.06	0.20	-0.34	0.46	0.75
Similarity Identification	-0.13	0.06	-0.25	-0.01	0.04
<i>Helping Behaviors</i>					
X ₁ → Helping Behaviors	-33.92	107.16	-246.69	178.86	0.75
X ₂ → Helping Behaviors	-97.86	106.90	-310.11	114.39	0.36
X ₃ → Helping Behaviors	-61.54	102.02	-264.11	141.03	0.55
Similarity Identification	-11.23	32.34	-75.45	53.99	0.73
Self-Efficacy	31.90	51.80	-70.96	134.76	0.54
Direct Effects					
	Effect	bSE	BootLLCI	BootULCI	p
Condition → Editing Time					
X ₁ → Helping Behavior	-33.92	107.16	-246.69	178.86	0.75
X ₂ → Helping Behaviors	-97.86	106.90	-310.11	114.39	0.36
X ₃ → Helping Behaviors	-61.54	102.02	-264.11	141.03	0.55

Indirect Effects

Condition → Similarity Identification →
Editing Time

X ₁ → Helping Behaviors	2.88	8.04	-6.41	24.33
X ₂ → Helping Behaviors	-9.51	11.06	-34.36	9.54
X ₃ → Helping Behaviors	-4.02	7.42	-22.66	7.91

Condition → Self-Efficacy → Editing Time

X ₁ → Helping Behaviors	1.21	15.81	-30.88	37.69
X ₂ → Helping Behaviors	3.75	13.02	-18.68	36.77
X ₃ → Helping Behaviors	2.02	11.61	-21.84	28.70

Condition → Similarity Identification → Self-
Efficacy → Editing Time

X ₁ → Helping Behaviors	1.07	3.58	-5.60	9.53
X ₂ → Helping Behaviors	-3.53	8.33	-24.92	7.63
X ₃ → Helping Behaviors	-1.49	4.80	-14.54	4.41

Notes: X₁ = Dissimilar-No Change vs. Dissimilar- Similar X₂ = Dissimilar-No Change vs. Similar-Dissimilar, X₃ = Dissimilar-No Change vs. Similar-No Change ; *SE* = standard error; *CI* = confidence interval. Bootstrap resampling = 5000. *** $p < .001$ ** $p < .01$ * $p < .05$

Table 5*Regression results for Empathy as a Mediator*

	b	SE	Bootstrap 95% CI		p
			Lower	Upper	
<i>Empathy</i>					
X ₁ → Empathy	-0.07	0.12	-0.30	0.17	0.58
X ₂ → Empathy	-0.17	0.11	-0.39	0.06	0.14
X ₃ → Empathy	0.00	0.11	-0.22	0.23	0.98
Moral Identification	0.30	0.05	0.19	0.41	0.00
<i>Helping Behaviors</i>					
X ₁ → Helping Behaviors	-28.03	107.34	-241.17	185.10	0.79
X ₂ → Helping Behaviors	-106.49	104.78	-314.54	101.56	0.31
X ₃ → Helping Behaviors	-60.61	103.06	-265.24	144.01	0.56
Moral Identification	3.10	93.48	-182.51	188.70	0.97
Empathy	-13.71	56.74	-126.37	98.94	0.81
<i>Direct Effects</i>					
Condition → Editing Time	Effect	bSE	BootLLCI	BootULCI	p
X ₁ → Helping Behavior	-28.03	107.34	-241.17	185.10	0.79
X ₂ → Helping Behaviors	-106.49	104.78	-314.54	101.56	0.31
X ₃ → Helping Behaviors	-60.61	103.06	-265.24	144.01	0.56
<i>Indirect Effects</i>					
Condition → Empathy → Editing Time	Effect	bSE	BootLLCI	BootULCI	
X ₁ → Helping Behaviors	-0.20	8.38	-16.53	20.33	
X ₂ → Helping Behaviors	-0.52	12.63	-25.24	29.70	
X ₃ → Helping Behaviors	0.01	7.14	-14.97	16.70	

Notes: X₁ = Dissimilar-No Change vs. Dissimilar- Similar X₂ = Dissimilar-No Change vs. Similar-Dissimilar, X₃ = Dissimilar-No Change vs. Similar-No Change ; SE = standard error; CI = confidence interval. Bootstrap resampling = 5000. *** p < .001 ** p < .01 * p < .05

Table 6*Regression Table for Change Blindness as a Moderator between Similarity/Dissimilarity**Conditions and Similarity Identification*

Predictor	b	SE	t	p	Lower CI	Upper CI
Similarity/Dissimilarity (X)	0.58	0.28	2.07	0.04	0.02	1.13
CB Occurrence (W)	-0.47	0.79	-0.59	0.56	-2.04	1.10
Interaction (X*W)	0.42	0.50	0.84	0.40	-0.57	1.41

Table 7*Equivalence Test Results for Self-Efficacy, Empathy, Similarity Identification, and Wishful**Identification*

Hypothesis	Outcome Variable	Comparison	t(142)	p	d
H6a	Self-efficacy	Similar	2.63	.719	0.30
H6b	Self-efficacy	Dissimilar	-0.25	<.01**	0.50
H7a	Similarity Identification	Similar	.29	.040*	0.30
H7b	Similarity Identification	Dissimilar	-1.21	.014*	0.50
H7c	Wishful Identification	Similar	-.34	<.01**	0.50
H7d	Wishful Identification	Dissimilar	.62	<.01**	0.50
H8a	Editing Time	Similar	.84	.011*	0.50
H8b	Editing Time	Dissimilar	-0.25	<.01**	0.50

Note: Equivalence bounds $\Delta L = -0.30$ and $\Delta U = 0.30$. Scores within these bounds indicate no significant difference between conditions.

Table 8*Chi-Squared Test Comparing Occurrence of CB Across Conditions*

Test	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	47.117	3	.000
Likelihood Ratio	60.155	3	.000
Linear-by-Linear Association	0.019	1	.889
N of Valid Cases	122		

Table 9*Chi-Square Residuals Evaluating the Occurrence of CB Across Conditions*

Avatar Appearance Correct	Condition 1 (Dissimilar-No Change)	Condition 2 (Dissimilar-Similar)	Condition 2 (Similar-Dissimilar)	Condition 4 (Similar-No Change)
Count	31	15	12	31
% within Condition	100.00%	48.40%	41.40%	100.00%
% within CB Occurrence	34.80%	16.90%	13.50%	34.80%
Residual	8.4	-7.6	-9.2	8.4
Standardized Residual	1.8	-1.6	-2	1.8
Adjusted Residual	3.9	-3.6	-4.4	3.9
Count	0	16	17	0
% within Condition	0.00%	51.60%	58.60%	0.00%
% within CB Occurrence	0.00%	48.50%	51.50%	0.00%