# Self-Representations in Immersive Virtual Environments[1]

JEREMY N. BAILENSON[2]
*Department of Communication*
*Stanford University*

JIM BLASCOVICH
*University of California, Santa Barbara*

ROSANNA E. GUADAGNO
*University of Alabama*

This experiment varied whether individuals interacted with virtual representations of themselves or of others in an immersive virtual environment. In the self-representation condition, half of the participants interacted with a self-representation that bore photographic resemblance to them, whereas the other half interacted with a self-representation that bore no resemblance to them. In the other-representation condition, participants interacted with a representation of another individual. The experimental design was a 2 (Participant Gender) × 3 (Agent Identity: high-similarity self-representation vs. low-similarity self-representation vs. other representation). Overall, participants displayed more intimacy-consistent behaviors for representations of themselves than others. Implications of using immersive virtual environment technology for studying the self are discussed.

Building on James' (1890) mental distinctions between the subjective self (the "I") and the more objective self (the "Me"), Cooley (1902) introduced the *looking-glass self* as a metaphor for describing the way in which people objectify themselves mentally. In retrospect, Cooley pointed to the only technology of his time for online renderings of virtual self-representations: a mirror. Although Cooley used the mirror only as a metaphor, much later others used it in investigations of objective self-awareness (e.g., Duval & Wicklund, 1972).

Today, immersive virtual environment technology (IVET) allows individuals to interact with virtual human representations—including virtual representations of their physical selves (VRSs) and virtual representations of others (VROs)—three-dimensionally in real time. Thus, researchers can

[2]Correspondence concerning this article should be addressed to Jeremy N. Bailenson, Department of Communication, Stanford University, Building 120, Room 101, 450 Serra Mall, Stanford, CA 94305-2050. E-mail: bailenso@stanford.edu

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manipulate virtual representations experimentally. Hence, the implications for the use of IVET as a methodological tool for advancing social psychological theory regarding studies of the self are quite important (Blascovich et al., 2002; Loomis, Blascovich, & Beall, 1999).

In this IVET-based study, we seek to determine whether theoretically derived predictions regarding the nature of interaction with oneself will be borne out within immersive virtual environments. More specifically, we seek to determine whether or not individuals will interact more intimately with VRSs, as compared to VROs. Concurrently, another goal is to demonstrate the viability of IVET as a research tool to better understand the self.

## Immersive Virtual Environment Technology

IVET is a methodological tool that can be used to study human behavior across a variety of domains (for a review, see Blascovich et al., 2002). Using IVET, researchers can design three-dimensional, digital, virtual humans bearing photographic, morphological, and behavioral resemblance to specific individuals. Recently, researchers have begun to use IVET to explore social psychological processes, including interpersonal distance (Bailenson, Blascovich, Beall, & Loomis, 2001, 2003), eye gaze (Bailenson, Beall, & Blascovich, 2002; Beall, Bailenson, Loomis, Blascovich, & Rex, 2003), nonverbal mimicry (Bailenson & Yee, 2005), conformity (Swinth & Blascovich, 2001), persuasion (Guadagno, Blascovich, Bailenson, & McCall, 2007), and social facilitation (Hoyt, Blascovich, & Swinth, 2003). Overall, these studies support the idea that people interact with virtual others as social beings to the extent that the virtual others exhibit realistic nonverbal behavior (e.g., mutual eye gaze, blinking, lip movement when speaking).

Using IVET, investigators can design an *embodied agent* (i.e., a digital representation that can behave in a realistic, human-like manner, but that is entirely driven by a computer algorithm) using a three-dimensional model that resembles a person. Hence, a person can enter a virtual world and interact with a virtual agent modeled after his or her own likeness.

Self-representations can take external forms based on various types of technology, such as mirror images, photographs, voice recordings, videotapes, and verbal descriptions. In the current study, we examine a specific type of external self-representation: the VRS. In some ways, interacting with one's VRS is similar to observing oneself in a mirror, particularly when the VRS looks like the physical self (Bailenson, Beall, Blascovich, Weisbuch, & Raimmundo, 2001; Biocca, 1997; Nass, Kim, & Lee, 1998).

However, an embodied agent differs from a mirror image in three important ways. First, because the virtual image need not be a mirror reflection,

one is able to achieve perspective views of oneself in ways not possible with a reflection from a single mirror (e.g., looking at oneself from directly above or behind). Second, the movements of the VRS need not be exactly coupled to oneself; instead, like any other type of representation, it can behave as independently of the observer as the experimenter desires. This allows for novel manipulations, such as putting the VRS on "autopilot," exhibiting stock behaviors in the absence of the actual user. Third, the visual resemblance (i.e., structural and textural) between a person and his or her VRS can vary continuously from a near-exact analog to an extremely different appearing representation. Features such as attractiveness or skin color can be manipulated easily by an experimenter.

The VRS provides researchers a unique tool to examine the traditional notion of the self. In any social interaction, people attribute levels of comfort, intimacy, and familiarity to other interactants. Although these attributions are sometimes difficult to quantify directly, their operation may be inferred from various theoretically based markers. Relevant to the current research, equilibrium theory (Argyle & Dean, 1965) posits that people employ various nonverbal behaviors in order to maintain an appropriate level of intimacy in social interactions, and alter the use of behaviors to adjust for intimacy levels in different contexts. Similarly, Mehrabian's (1967) theory of immediacy posits that interactants strive to use nonverbal as well as verbal behavior to communicate a specific level of closeness and attitude valence toward one another. Finally, expectancy violation theory (Burgoon, 1978) provides a framework for the types of verbal and nonverbal behaviors one would expect given contextual levels of mutual familiarity and intimacy.

In the current work, the convergent predictions derived from all three of the aforementioned theories lead us to predict that people will display nonverbal and verbal behaviors that are highly intimate, immediate, and consistent with familiar persons when interacting with a VRS. Certainly, the current work does not allow for specific tests of any of the theories to the exclusion of another. Furthermore, logically, a plurality of closely related processes may be operating. In order to avoid repetition, we adopt Argyle and Dean's (1965) equilibrium model in terms of discussion here. However, we could easily substitute either Mehrabian's (1967) or Burgoon's (1978) models and make the same predictions.

## Overview of the Experiment

We examined participant interactions with VRSs and VROs in terms of interpersonal distance behavior, embarrassment, and liking toward the virtual representation. To do so, we created virtual environments in which

participants traversed virtual rooms containing a virtual agent. Participants were told that they would be entering a virtual world using a head-mounted display and would be asked to examine and walk around a virtual representation.

We manipulated agent identity (i.e., VRS vs. VRO). In the VRS conditions, each participant walked around an agent who ostensibly represented himself or herself. In the VRO condition, the participant walked around an agent who ostensibly represented an unfamiliar stranger. There were two VRS conditions: one in which the VRS bore a photographic resemblance to the participant, and one in which the VRS did not.

We continuously recorded the participant's location in the virtual environment in order to assess interpersonal distance behavior. We also administered questionnaires to gauge liking for the virtual representation and willingness to commit embarrassing acts in the presence of the virtual representation (see the Appendix). More details on the experimental procedure appear in the Procedure section. We briefly discuss the literature relating to each of these dependent variables in terms of intimacy and make specific predictions in turn.

*Interpersonal Distance*

Researchers have begun to use virtual environments to understand interpersonal distance (Krikorian, Lee, Chock, & Harms, 2000; Reeves & Nass, 1996; Sommer, 2002). In previous interpersonal distance studies with VROs (Bailenson, Blascovich et al., 2001; Bailenson et al., 2003), we measured the interpersonal distance participants maintained between themselves and unfamiliar virtual human representations and found that participants consistently interacted with avatars (representations of people) and embodied agents (representations of computer algorithms) in a manner similar to physical humans in terms of interpersonal distance. For example, participants demonstrated intimacy regulation consistent with equilibrium theory, in that the degree of mutual gaze and interpersonal distance were negatively correlated. Furthermore, females adjusted their personal space in terms of eye gaze more than males did. This differential reception and transmission of nonverbal cues by gender occurs in face-to-face interactions as well (Hall, 1984).

Previous research has demonstrated that interpersonal distance decreases between two people as they become more familiar or intimate with each other (e.g., Edney, Walker, & Jordan, 1976; Mehrabian, 1967). Consequently, we predicted that the distance participants would maintain between themselves and their VRSs would be smaller than the distance they maintain between themselves and VROs.

*Embarrassing Acts*

Previous research has demonstrated that people prefer to be alone rather than in another's presence when behaving in an embarrassing fashion (Fish, Karabenick, & Heath, 1978; Sabini, Siepmann, Stein, & Meyerowitz, 2000). Consequently, participants should be more willing to commit embarrassing acts in the presence of VRSs (with whom they should perceive more intimacy), because they will not feel that they are in the presence of anyone but themselves. Conversely, in the presence of VROs, participants will presumably see the virtual representation as someone or something distinct from themselves (with whom they should share less intimacy) and, thus, will see themselves as being in the presence of someone else.

*Liking*

Given that the social psychological literature has clearly demonstrated that individuals like the familiar and similar (Byrne, 1971; Cialdini, 2001), we predict that individuals will show a preference for a VRS over a VRO. Indeed, Mehrabian (1967) partly defined *immediacy* as positive attitude.

## Hypotheses

For the present study, we predict that participants will maintain less interpersonal distance with VRSs than with VROs. We also predict that participants will be more willing to commit embarrassing acts in front of VRSs than in front of VROs.

We expect that participants will rate VRSs as more likable and more attractive than VROs as a result of overall differences in intimacy. Furthermore, we hypothesize that the likability and attractiveness effect will be stronger with VRSs bearing high similarity than with low-similarity VRSs[3] because the VRS with high photographic similarity will be a stronger manipulation. In line with our previous research (Bailenson, Blascovich et al., 2001; Bailenson et al., 2003), we examine participant gender as an

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[3]Participants from the high- and low-similarity conditions were run in two separate experiments. The only difference between the two studies was the time participants were run (less than 1 month apart) and the software used to generate the three-dimensional face models. The software used different techniques to generate the avatars, and they may have looked slightly different in terms of facial structure across the two studies. Because of this confound, we do not generalize from any of the findings concerning potential differences between high- and low-similarity VRSs. We combined the two studies into a single analysis because of the extreme congruence of findings across the two experiments and to increase the readability of the paper.

independent variable because our prior research indicated that under some circumstances, women adjust interpersonal distance behavior (i.e., maintain larger distances between themselves and VRSs than between themselves and VROs) more than do men.

## Method

### Design

The experiment employed a 2 (Participant Gender) × 3 (Agent Identity: high-similarity VRS, low-similarity VRS, or VRO) factorial design.[4]

### Participants

Study participants were 64 students (32 female, 32 male) who received partial credit for an introductory psychology course for participation. Participants' ages ranged from 18 to 22 years ($M = 18.8$ years). All participants were born in the United States and were native speakers of English. According to a self-report questionnaire, 61% of participants were Caucasian, 17% were Asian, 12% were Hispanic, 6% were African American, and 4% indicated "Other."

There were equal numbers of males and females in each of the three agent identity conditions. There were 32 participants in the VRO condition, and 16 participants in each of the two VRS conditions. This disparity was created in order to yoke the head models used from participants in the VRS conditions to participants in the VRO conditions.

### Materials and Apparatus

The rectangular physical room in which the experiment took place measures approximately 3.0 m × 2.5 m × 3.0 m (length, width, and height, respectively). The virtual environment contained no walls, but did contain virtual horizontal ropes placed in the environment to demarcate an active exploration area to ensure that participants did not collide with any physical walls. Figure 1 depicts two views of a virtual representation in the virtual room, as well as the virtual ropes. The virtual human representations' heights were

[4]The first 2 participants in the high VRS similarity condition were run as VRSs in order to provide faces for the subsequent VRO participants. After the first 2 participants, condition was assigned randomly.

*Figure 1.* A sample participant's view of his or her virtual self from the front (top panel) and the side (bottom panel) in the virtual room when he or she started the experiment. The virtual bars are guidelines to prevent participants from walking into physical walls.

always the same (approximately 1.8 m). We set the virtual eye height of all participants at the same eye height as the virtual agent, so that regardless of participants' actual height, their eyes were in the same horizontal plane as the agents' eyes.

VRSs and VROs exhibited the same behaviors. They blinked and turned their heads as much as 85 degrees in either direction to gaze at the participant's face as the participant traversed the environment. We used the same generic body for all agents. As Figure 1 illustrates, the agent's body was always covered by a loosely fitting robe. We provided more detail on the heads and faces of the representations because we believe that many

*Figure 2.* A depiction of our virtual environment system. The components are (1) position tracking cameras; (2) head-mounted display and orientation tracking sensor; and (3) image generator.

self-relevant aspects of a person's identity are captured in that region, as Bull and Rumsey (1988) pointed out. For example, observing human faces is crucial in the process of emotional assessment (Ekman & Oster, 1979).

The technology used to render the IVEs is described in detail in Bailenson, Blascovich et al. (2001) and is depicted in Figure 2. Using the IVET tracking system, participants experienced appropriate sensory input when they simultaneously turned their heads and walked.

*Procedure*

Participants arrived at the lab for a 1-hr session and were told that they would be entering a virtual world using a head-mounted display and would be asked to examine and walk around a virtual representation. Depending on the agent identity condition, they were instructed that they would examine a virtual representation of themselves or a virtual representation of someone else.

In the low VRS similarity condition, participants examined photographs of two virtual human representations, matched to their gender[5] but not

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[5]Some research has demonstrated distinct differences in interpersonal distance patterns by gender. However, as Hayduk (1983) pointed out, the literature on interpersonal distance by gender is quite inconsistent, and gender differences are often exaggerated. Nonetheless, we matched the gender of the agent to the participant in an attempt to minimize potential differences.

*Figure 3.* Photographs of a participant (bottom) and two views of his photographically realistic virtual representation (top).

photographically similar, and then randomly selected one of the representations to function as a VRS by flipping a coin. Next, the participant completed a demographic questionnaire. Afterward, participants were shown pictures of both of the virtual representations again, and were asked to identify the picture of the virtual human that they had randomly picked. Everyone correctly identified their randomly chosen virtual selves. In the VRS condition, participants interacted with the representation they chose via coin flip.

In the high VRS similarity condition, each participant was photographed upon his or her arrival at the laboratory in order to build a three-dimensional model of his or her head. While the head models depicted in Figure 3 were being constructed (which took approximately 20 min to complete), participants completed a demographic questionnaire. Each participant in the VRS condition saw his or her own head model on the agent.

In the VRO condition, participants always interacted with a virtual representation wearing a head model that was the VRS for another participant. In other words, participants in the VRO condition were always yoked to a participant in the VRS condition. Consequently, the specific heads used for a VRO condition were exactly the same as the ones used in the VRS condition across participants.

In all conditions, participants were given the opportunity to ask questions until they fully understood their respective agent identity conditions. After agreeing that they understood the instructions, participants were immersed in an IVE that contained a floor and a virtual agent. Depending on the agent identity condition, participants were immersed with either the VRS or the VRO. Participants entered the virtual room facing an agent approximately 1.5 m away from them. Participants were instructed to examine the agent first by walking to its left side, then to its right side, and finally to its front.

After they had examined the agent for approximately 1 min, participants were asked to step back in order to see a Likert-type scale ranging from −3 to +3 that appeared on a small virtual billboard above the agent's head. Participants were able to view both the agent and the scale while the experimenter verbally administered the questionnaires (see the Appendix). The first was a four-item embarrassment questionnaire designed to gauge how willing participants were to perform a series of embarrassing acts in front of the agent. The second was a two-item liking questionnaire designed to measure the likability and attractiveness of the virtual agent. Questions were asked during participants' immersion in order to capture replies while the virtual agent was present. After participants completed the questionnaires, the head-mounted display was removed.

## Results

### *Interpersonal Distance*

Because the IVE system constantly sampled participants' positions, we were able to compute the distance between the center points of participants' and virtual agents' heads, which we did at 8 Hz for each participant. Following the study, none of the participants indicated that they had guessed that their interpersonal distance behavior was under scrutiny.

We indexed interpersonal distance by using *minimum distance*, which is the shortest distance that a given participant maintained between themselves and the agent across trials. Our previous studies (Bailenson, Blascovich et al., 2001; Bailenson et al., 2003) on interpersonal distance in IVEs also utilized this measure. Figure 4 shows the means of minimum distance for the three agent identity conditions.[6]

[6]All but one of our participants, even those who self-reported a different ethnicity, were born in the United States. Consequently, examining these different ethnicities to understand cultural differences in proxemic behavior was not possible, since their culture was largely southern Californian. In addition, even if cultural differences existed in the population from which our participants were drawn, because of the small sample size of non-Caucasians in the current work,
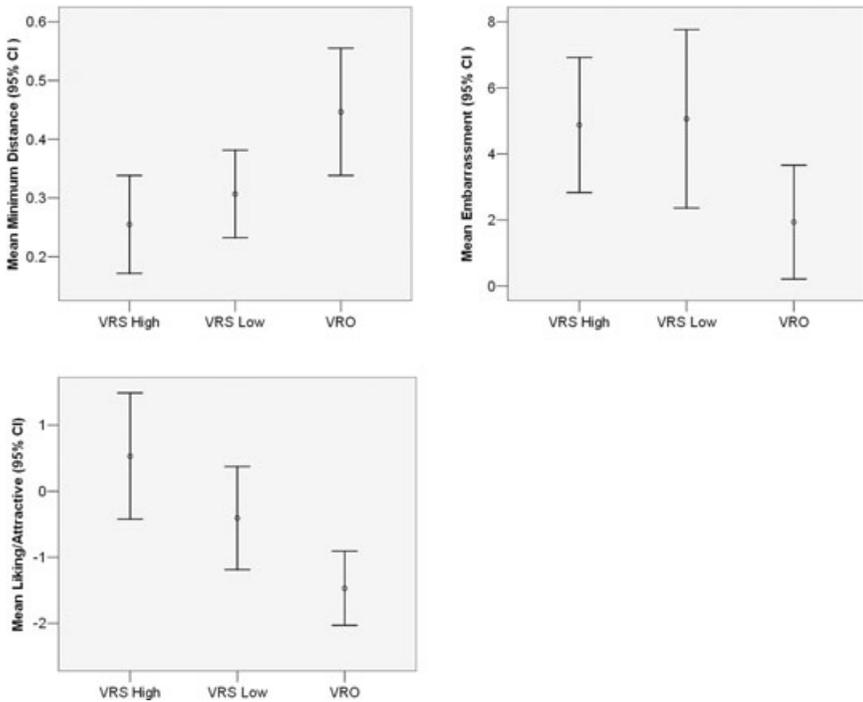
*Figure 4.* Mean minimum distance (in cm), embarrassment ratings, and liking/attractiveness by agent identity (95% confidence interval).

An ANOVA with gender and agent identity as between-subject factors[7] and minimum distance as the dependent variable reveals a reliable main effect of agent identity, $F(1, 58) = 4.19$, $p < .02$, partial $\eta^2 = .13$. Participants in the VRO condition ($M = 0.45$, $SD = 0.30$) maintained approximately twice as much distance between themselves and the agent representation than did participants in the high-similarity VRS condition ($M = 0.25$, $SD = 0.16$, $p < .01$). Additional tests of simple effects indicate that the difference in minimum distance between the VRO condition and the low-similarity VRS condition was also significant ($M = 0.31$, $SD = 0.14$, $p < .05$). However, there

there were no differences in interpersonal distance between Caucasian Americans, African Americans, Latino Americans, or Asian Americans. However, it is important to note that interpersonal distance varies drastically from culture to culture, as discussed in detail by Hall (1966) and demonstrated by Beaulieu (2004).

[7]In the low-similarity VRS condition, we also ran an ANOVA with face (i.e., which of the two faces the participants chose) as an additional two-level, between-subjects variable. There was no main effect and no significant interactions, so we do not discuss this variable further.

was no difference between the two VRS conditions ($p < .55$). Additionally, the main effect of gender was not significant, $F(1, 58) = 0.07$, $p < .80$, partial $\eta^2 = .00$. Finally, the two-way interaction between agent identity and gender was not significant, $F(1, 58) = 2.38$, $p < .10$, partial $\eta^2 = .08$.

*Embarrassing Acts*

A score of willingness to commit embarrassing acts was calculated as the sum of responses to the four embarrassment questions from the Appendix ($\alpha = .84$): Positive sums indicate an overall willingness to commit an embarrassing act (i.e., change clothes or tell secrets to the agent), while negative numbers indicate an overall unwillingness to commit an embarrassing act. Figure 4 shows the means of embarrassing act scores by the three agent identity conditions.

An ANOVA with gender and agent identity as between-subjects variables and willingness to commit an embarrassing act as dependent variable reveals a main effect of agent identity, $F(1, 58) = 3.35$, $p < .05$, partial $\eta^2 = .10$. Participants were more willing to commit embarrassing acts in front of the high-similarity VRS ($M = 4.88$, $SD = 3.85$) than they were in front of the VRO ($M = 1.94$, $SD = 4.77$, $p < .05$). The same was the case for the low-similarity VRS ($M = 5.06$, $SD = 5.06$), as compared to the VRO ($p < .05$), but there was no difference between the two VRS conditions ($p < .90$). Neither of the main effects of gender, $F(1, 58) = 1.24$, $p < .28$, partial $\eta^2 = .02$; nor the two-way interaction between gender and agent identity, $F(1, 56) = 0.34$, $p < .72$, partial $\eta^2 = .00$, were significant.

*Liking and Attractiveness*

Participants rated their liking for the virtual representations and the attractiveness of the virtual representations on single, Likert-type scale items. Higher ratings indicate greater positive liking and attractiveness. Figure 4 shows the means of liking and attractiveness by the three agent identity conditions.

Individually, the patterns of significance for liking and attractiveness were identical, so for brevity, we averaged the two into a single preference score ($\alpha = .70$). An ANOVA with gender and agent identity as between-subject variables and the mean of attractiveness and liking as dependent variable reveals a main effect of agent identity, $F(1, 58) = 8.71$, $p < .001$, partial $\eta^2 = .22$, such that high-similarity VRSs ($M = 0.53$, $SD = 1.79$) were preferred over VROs ($M = -1.47$, $SD = 1.56$). As with the other dependent measures,

this was also the case for the low-similarity VRS ($M = -0.41$, $SD = 1.46$) condition versus the VRO condition ($p < .05$), while the difference between the two VRS conditions was not significant ($p < .10$). The main effect of participant gender was not significant, $F(1, 58) = 0.39$, $p < .85$, partial $\eta^2 = .00$; nor was the two-way interaction between participant gender and agent identity, $F(1, 58) = 1.20$, $p < .31$, partial $\eta^2 = .04$.

## Discussion

In the present study, we examined whether or not participants would interact with VRSs more intimately than with VROs. During an exploratory walk through a virtual environment, participants maintained less distance between their physical selves and VRSs than they did between their physical selves and VROs. These behavioral effects were mirrored by willingness to commit embarrassing acts and ratings of attractiveness and liking. These findings are consistent with the notion that individuals display more intimacy (Argyle & Dean, 1965; Mehrabian, 1967) with the VRS than with the VRO. This finding occurred consistently across all of our dependent variables.

The effect occurred not only with VRSs that resembled the participants, but also with virtual humans that were arbitrarily assigned to be their VRSs. We varied the similarity of the VRS to participants and did not find any differences as a result of changes in appearance. However, one should be hesitant to draw conclusions concerning a null result.

Furthermore, as we discussed previously, this similarity manipulation was slightly confounded with technical differences. Because of this, there are several possible explanations for why our results did not support our prediction that participants would show a preference for the photographically similar VRS over the non-photographically similar VRS. Specifically, it may be that we lacked the statistical power to detect the predicted effect owing to a small effect size, our sample size, or the additional error variance generated by the aforementioned technical differences. Certainly, the fact that the means trended in the predicted direction is suggestive that one of these explanations may be the case. Conversely, it may be that the belief that an embodied agent is a representation of the self is more important than whether this embodied agent is photographically similar to an individual. Future research on this topic should continue to try to disentangle this issue.

### Alternative Explanation for the Intimacy Effect

We have argued that people tend to be more intimate and familiar with virtual representations of themselves than with others. Consequently, when

interacting with a virtual representation of the self, people do not feel the need to maintain the interpersonal distance that they would normally maintain with a virtual stranger. An alternative explanation could be that participants were merely more interested in their VRSs than VROs, the same way they would be interested in their winter jackets or automobiles. It is not possible to completely rule out this "interest" explanation, given the current dataset. Indeed, it is most likely the case that interest is highly related to the plurality of processes that contribute to intimacy. Whether the driving force behind intimacy is familiarity, interest, or some other variable, the outcome remains the same: People interact with the VRS in a manner that may allow researchers to utilize the VRS as a vehicle to gain a more thorough understanding of the self.

Future research could test this alternate explanation via a study that replicates and expands on the one reported here by including conditions in which participants interact with a virtual representation of something (e.g., car, jacket) that belongs to them or something that belongs to another. Additionally, using the Inclusion of Other in the Self scale (Aron, Aron, & Smollan, 1992) and other similar measures designed to test whether the VRS is seen as something familiar or as an aspect of the self may help to address this issue.

### Implications

The present results have implications for researchers who investigate the self. By demonstrating that people treat the VRS as more intimate, we can begin to test hypotheses derived from traditional perspectives on the self using the virtual self. This IVET/interpersonal-distance paradigm could be used to understand better the nature of self-concept clarity and change by answering such questions as whether or not viewing one's VRS engaging in a certain behavior would provide feedback likely to become incorporated into one's self-concept. For example, researchers could study individuals who view their VRS helping a stranger, and test whether their self-concept is altered in order to see themselves as more helpful. In this case, one prediction would be that self-concept clarity would moderate the extent to which individuals incorporate such feedback, as prior research has suggested (e.g., Burger & Guadagno, 2003). Furthermore, we can utilize the VRS to examine self-perception theory (Bem, 1972) and self-concept change, particularly in novel situations.

There are also implications for our knowledge of self-presentation (DePaulo, 1992; Goffman, 1959). For instance, an individual's choice of VRS can provide information about his or her self-presentational concerns, as well

as the long-term implications of VRS choice on impression formation. A VRS that can be created to appear younger, more attractive, or thinner than the person behind it gives people the ability to have a high degree of control over the impressions that others form of them and provides insight regarding an individual's self-presentation concerns. Given that people today are spending so much time online playing video games with VRSs that can bear photographic similarity or not to the user, understanding that both of these types of characters are treated more intimately than are VROs is very important in understanding the psychological consequences of time spent using the VRS (e.g., Anderson & Bushman, 2002). In sum, there are many empirical questions that could be investigated utilizing this paradigm that could enrich our knowledge of the self.

In addition, using representations of participants' selves, researchers can easily parse features that otherwise tend to be largely confounded (Loomis et al., 1999): gender from sex, race from skin color, and emotional expressions from anthropometric facial features. These changes in the appearance of the VRSs can also serve as an experimental manipulation of group identity.

The current study demonstrated that people interact with VRSs in a manner consistent with high intimacy. Using affective and behavioral measures, we demonstrated systematic differences between participants interacting with VRSs and participants interacting with VROs such that participants in the former condition showed greater liking, perceived greater attractiveness, and moved closer to the virtual human representation than did participants in the latter condition. These results open the way for a host of studies to examine the concept of self via IVET.

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## Appendix

### Study Questionnaire

*Note*. Items are rated on a 7-point scale ranging from −3 (*strongly disagree*) to +3 (*strongly agree*).

Embarrassment
_____ 1. If nobody else was in the physical room, I would be willing to sing the *National Anthem* in front of this virtual person.
_____ 2. If nobody else was in the physical room, I would be willing to change clothes in front of this virtual person.
_____ 3. If nobody else was in the physical room, I would have no problem telling personal secrets to the virtual person.
_____ 4. If nobody else was in the physical room, I would be upset if the virtual person noticed something stuck in my teeth.

Liking
_____ 5. I like the virtual person.
_____ 6. I think the virtual person is attractive.