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The Proteus Effect: The Effect of Transformed Self-Representation on Behavior

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Virtual environments, such as online games and web-based chat rooms, increasingly allow us to alter our digital self-representations dramatically and easily. But as we change our self-representations, do our self-representations change our behavior in turn? In 2 experimental studies, we explore the hypothesis that an individual's behavior conforms to their digital self-representation independent of how others perceive them—a process we term the Proteus Effect. *In the first study, participants assigned to more attractive avatars in immersive virtual environments were more intimate with confederates in a self-disclosure and interpersonal distance task than participants assigned to less attractive avatars. In our second study, participants assigned taller avatars behaved more confidently in a negotiation task than participants assigned shorter avatars. We discuss the implications of the Proteus Effect with regards to social interactions in online environments.*

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The notion of transforming our appearances permeates our culture. On the one hand, minor alterations such as haircuts, makeup, and dressing up are seen as socially acceptable, if not socially desirable. On the other hand, the ability to truly transform oneself has been regarded in myths and legends as both dangerous and powerful. Consider, for example, werewolves and vampires from Europe, the kitsune (foxes that can take on human form) from Japan, the God Loki from Norse mythology, and the God Proteus from Greek mythology. The Greek God Proteus is notable for being the origin of the adjective "protean"—the ability to take on many different self-representations. And although extreme self-transformations are expensive (e.g., cosmetic surgery) or difficult to perform (e.g., gender reassignment surgery) on our physical bodies, nowhere is self-representation more flexible and easy to transform than in virtual environments where users can choose or customize their own *avatars*—digital representations of themselves. For example, the documentation for the online

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social world *Second Life* notes that "using over 150 unique sliders, they can change everything from their foot size to their eye color to the cut of their shirt" (Linden Labs, 2006). In other words, the mutability of our self-representations in online environments is a fundamental aspect of what it means to have a virtual identity (Turkle, 1995).

Even though the plasticity of our self-representations is an important part of our online identities, the quantitative research in computer-mediated communication (CMC) has tended to focus instead on the impact of technical affordances on social interaction in online environments. For example, it has been argued that lack of social presence (Hiltz, Johnson, & Turoff, 1986; Short, Williams, & Christie, 1976) or the lack of social cues (Culnan & Markus, 1987; Kiesler, Siegel, & McGuire, 1984) creates an impoverished social environment, whereas others have shown that relationships develop slower in CMC but are not impoverished in the long term (Walther, 1996; Walther, Anderson, & Park, 1994). Other research has looked at how the narrow communication channels in CMC impacts impression formation (Hancock & Dunham, 2001; Jacobson, 1999; Trevino & Webster, 1992; Walther, Slovacek, & Tidwell, 2001). And although there has been research on self-representation in online environments, the focus has been on the impact of anonymity and authenticity (Anonymous, 1998; Flanagin, Tiyaamornwong, O'Connor, & Seibold, 2002; Jarvenpaa & Leidner, 1998; Postmes & Spears, 2002)—in other words, the gap between the real and virtual self and how that difference changes social interactions. In the current work, we were instead interested in exploring how our avatars change how we behave online. As we change our self-representations, do our self-representations change our behaviors in turn? As we choose or create our avatars online and use them in a social context, how might our new self-representations change how we interact with others? Thus, we were interested in the impact of our actual self-representations on our behaviors in virtual environments rather than the effects of anonymity or authenticity.

Behavioral confirmation

There is good reason to believe that our avatars change how we interact with others. Behavioral confirmation offers one potential pathway for this change. Behavioral confirmation is the process whereby the expectations of one person (typically referred to as the *perceiver*) cause another person (typically referred to as the *target*) to behave in ways that confirm the perceiver's expectations (Snyder, Tanke, & Berscheid, 1977). In the seminal study by Snyder et al. (1977), male and female undergraduate students interacted over a telephone. Male perceivers who believed that a female target was attractive caused her to behave in a more charming and friendly manner regardless of how attractive the target actually was. Thus, in an online environment, a perceiver interacting with a target who is using an attractive avatar may cause the target to behave in a more friendly and charming manner. In fact, the study by Snyder et al. itself occurred in a mediated context (i.e., over the telephone). It is important to note that the source of behavioral change from the effects of behavioral confirmation stem from the perceiver rather than the target. It is the perceiver's behavior that in turn causes a change in the target's behavior.

Self-perception theory and deindividuation theory

Behavioral confirmation provides one potential pathway for avatars to change how a person behaves online, but might our avatars change how we behave independent of how others perceive us? When given an attractive avatar, does a user become more friendly and sociable regardless of how others interact with them? Another line of research suggests a potential explanation for why this might occur. Bem (1972) has argued that people observe their own behaviors to understand what attitudes may have caused them (i.e., self-perception theory). For example, people given extrinsic rewards to do something they already enjoy doing are more likely to view the behavior as less intrinsically appealing (i.e., the overjustification effect) because this is what an impartial observer would have concluded as well. Other researchers have shown the far-reaching implications of this theory. In a study by Valins (1966), when participants were made to believe their heartbeat had increased while viewing a photograph of a person, they came to believe the person in the photograph was more attractive. In a study by Frank and Gilovich (1988), subjects that wore black uniforms behaved more aggressively than subjects in white uniforms. According to Frank and Gilovich, wearing a black uniform is a behavior that the subjects used to infer their own dispositions—"Just as observers see those in black uniforms as tough, mean, and aggressive, so too does the person wearing that uniform" (p. 83). The subjects then adhere to this new identity by behaving more aggressively. And finally, this effect has been replicated more recently in a digital environment, where users given avatars in a black robe expressed a higher desire to commit antisocial behaviors than users given avatars in a white robe (Merola, Penas, & Hancock, 2006).

Another line of research has shown that the impact of identity cues is particularly strong when people are deindividuated. Zimbardo (1969) originally used deindividuation theory to argue that urban or crowded areas cause deindividuation that leads to antisocial behavior; however, it has also been shown that deindividuation can lead to affiliative behavior as well (Gergen, Gergen, & Barton, 1973). When dyads were placed in a darkened room for an hour, many deliberately touched or hugged the other person. On the other hand, dyads in the fully lit room talked politely and did not engage in physical contact. Thus, the effects of deindividuation are not necessarily antisocial. The argument that deindividuation can lead to both prosocial and antisocial behavior has also been demonstrated in another well-known study. In a teacher–learner paradigm with electric shock as punishment, subjects in costumes that resembled Ku Klux Klan robes delivered significantly longer shocks than subjects in nurse uniforms (Johnson & Downing, 1979). It was also found that these effects were stronger when subjects were made anonymous in the study. Thus, deindividuation does not necessarily always lead to antisocial behavior as Zimbardo originally argued but may in fact cause a greater reliance on identity cues whether they are antisocial or prosocial.

In the CMC literature, the social identity model of deindividuation effects (SIDE) (Postmes, Spears, & Lea, 1998; Spears & Lea, 1994) argued that factors that lead to deindividuation, such as anonymity, might thus reinforce group salience and conformity to group norms. In this light, deindividuation does not, in and of itself, always lead to antinormative behavior, but rather, behavioral changes depend on the local group norms (Postmes, Spears, & Lea, 2000). More importantly, behavior that is typically seen as antinormative, such as flaming on message boards (Lea, O'Shea, & Spears, 1992), may in fact turn out to be normative and expected in particular contexts (Postmes et al., 1998).

The Proteus Effect

Online environments that afford anonymity are like digital versions of a darkened room where deindividuation might occur, and indeed, many researchers have suggested that deindividuation occurs online due to anonymity or reduced social cues (Kiesler et al., 1984; McKenna & Bargh, 2000). And in online environments, the avatar is not simply a uniform that is worn, the avatar is our entire self-representation. Although the uniform is one of many identity cues in the studies mentioned earlier, the avatar is the primary identity cue in online environments. Thus, we might expect that our avatars have a significant impact on how we behave online. Users who are deindividuated in online environments may adhere to a new identity that is inferred from their avatars. And in the same way that subjects in black uniforms conform to a more aggressive identity, users in online environments may conform to the expectations and stereotypes of the identity of their avatars. Or more precisely, in line with self-perception theory, they conform to the behavior that they believe others would expect them to have. We term this the Proteus Effect.

Although the Proteus Effect is similar to SIDE theory, there are several important theoretical differences. Most importantly, SIDE theory emphasizes conformity to local group norms (e.g., becoming more hostile on a hostile message board). On the other hand, the Proteus Effect emphasizes conformity to individual identity cues (e.g., becoming friendlier in an attractive avatar). Thus, theoretically, it would also be possible to pit one against the other—that is, having an attractive avatar on a hostile message board. We would also argue that having an attribute (e.g., "being attractive") is conceptually different from being among a group of individuals who have that attribute (e.g., "being in a group of attractive people"), whereas SIDE theory literature tends to conflate the two. Thus, in a situation where Person A in a black uniform interacts with Person B in a white uniform, SIDE theory might predict that the social identity of Person A would default to the black uniform (i.e., become more aggressive) or the combined colors of the group in question—in other words, gray (i.e., remain neutral). The Proteus Effect would only predict the former. Another point of differentiation is that although the SIDE theory operates on the basis of an existing local group and its social norms, the Proteus Effect should operate even when the user is alone. This is because self-perception theory is not predicated on the actual presence of other people but simply that a person evaluates him or herself from a third-person perspective (i.e., an imagined third party).

Collaborative virtual environments and transformed social interaction

In designing of our studies, it was crucial that we isolate the impact of the Proteus Effect from that of behavioral confirmation. If participants were perceived to be attractive and believed themselves to be attractive at the same time, it would be impossible for us to claim that the Proteus Effect occurred independent of behavioral confirmation. To isolate the potential effect of the Proteus Effect, we employed a novel methodological paradigm. In the current set of studies, we utilized collaborative virtual environments (CVEs, see Normand et al., 1999) to study the effects of the Proteus Effect. CVEs are communication systems in which multiple interactants share the same three-dimensional digital space despite occupying remote physical locations. In a CVE, immersive virtual environment technology monitors the movements and behaviors of individual interactants and renders those behaviors within the CVE via avatars. These digital representations are tracked naturalistically by optical sensors, mechanical devices, and cameras. Because these avatars are constantly redrawn for each user during interaction, unique possibilities for social interaction emerge (Blascovich et al., 2002; Loomis, Blascovich, & Beall, 1999).

Unlike telephone conversations and videoconferences, the physical appearance and behavioral actions of avatars can be systematically filtered in immersive CVEs idiosyncratically for other interactants, amplifying or suppressing features and nonverbal signals in real time for strategic purposes. Theoretically, these transformations should impact interactants' persuasive and instructional abilities. Previously, we outlined a theoretical framework for such strategic filtering of communicative behaviors called *Transformed Social Interaction* (Bailenson, Beall, Blascovich, Loomis, & Turk, 2005). In a CVE, every user perceives their own digital rendering of the world and each other, and these renderings need not be congruent. In other words, the target may perceive his or her own avatar as being attractive, whereas the perceiver sees the target as being unattractive.

Previous work on transformed social interaction has demonstrated quite resoundingly that changing one's representation has large implications on other's in terms of social influence (Bailenson, 2006). In other words, transforming Avatar A strategically causes Avatar B to behave consistently with the representation of Avatar A (as opposed to the actual representation of Avatar A). In the current set of studies, this decoupling of representation allowed us to test a separate question relating to transforming a representation. Instead of seeing the strategic outcome of a transformation, we examined whether our changes in self-representations—independent of how others perceive us—cause the people behind the avatars to behave differently.

Overview of studies and hypotheses

In the current work, we conducted two experimental studies to explore the Proteus Effect. Participants interacted with a confederate's avatar in a virtual reality (VR) environment. In the first study, we manipulated the attractiveness of the participant's avatar while the confederate was blind to condition. Studies have shown that attractive individuals are perceived to possess a constellation of positive traits (Dion, Berscheid, & Walster, 1972) and are evaluated more favorably by jurors in courtrooms (Friend & Vinson, 1974).

Interpersonal distance

According to nonverbal expectancy violations theory (Burgoon, 1978), when attractive individuals violate nonverbal expectancies, such as moving too close to someone, the positive valence that is created can be socially advantageous (Burgoon & Walther, 1990; Burgoon, Walther, & Baesler, 1992). Given that attractive individuals have higher confidence (Langlois et al., 2000), we hypothesized that

> H1: Participants in the attractive condition walk closer to the confederate than the participants in the unattractive condition.

Self-disclosure

Friendliness was one of the measures used in Snyder et al.'s (1977) original study, and in this study, we used self-disclosure as a behavioral operationalization. Because attractive individuals tend to be more extraverted and more friendly (Langlois et al., 2000), we hypothesized that

> H2: Participants in the attractive condition would exhibit higher self-disclosure and present more pieces of information about themselves than participants in the unattractive condition.

In the second study, we manipulated the height of the participant's avatar again with the confederate blind to the condition. Similar to the attractiveness literature, taller people are perceived to be more competent (Young & French, 1996), more desirable as romantic partners (Freedman, 1979; Harrison & Saeed, 1977), and more likely to emerge as leaders (Stogdill, 1948). In this study, we implemented a negotiation task to best gauge confidence.

> H3: Participants in taller avatars would behave in a more confident manner and negotiate more aggressively than participants in shorter avatars.

Experiment 1

Design

In a between-subjects design, participants were randomly assigned to have an avatar with an attractive or unattractive face of his or her own gender and then interact with a confederate. We followed the paradigm in the study by Snyder et al. (1977) and always used a confederate of the opposite gender. The confederate was blind to the attractiveness condition such that the participant's avatar appeared to the confederate with an untextured face—one which was structurally human but left uncolored.

Participants

Thirty-two undergraduate students at Stanford (16 men and 16 women) participated in the study for course credit.

Materials

Facial attractiveness pretest

We ran a pretest to get subjective determinations of attractive and unattractive faces (for the participants), and also average attractiveness faces (for the confederates). To minimize the chances that our findings would be driven by idiosyncrasies of a particular face, we chose two faces in each of these three attractiveness conditions. Thus, there were two attractive faces, two unattractive faces, and two average faces for each gender. In total, we used 12 faces in the study.

To generate these 12 faces, digital photographs of 34 undergraduate students (17 male and 17 female) from a different academic institution from the main study were used in a pretest. The chances of participant recognition of these faces were thus minimized. To reduce other variations in facial features, only Caucasians were used in the pretest.[1] Frontal and profile photographs of these 34 undergraduate students were converted into digital, three-dimensional head busts using 3DMeNow software. These three-dimensional head busts were then converted into Vizard 2.17 models, our CVE platform, and attached to generic male and female bodies. Finally, a frontal and three-quarter screenshot of every face was taken (see Figure 1). Thus, altogether, 68 screenshots were generated.

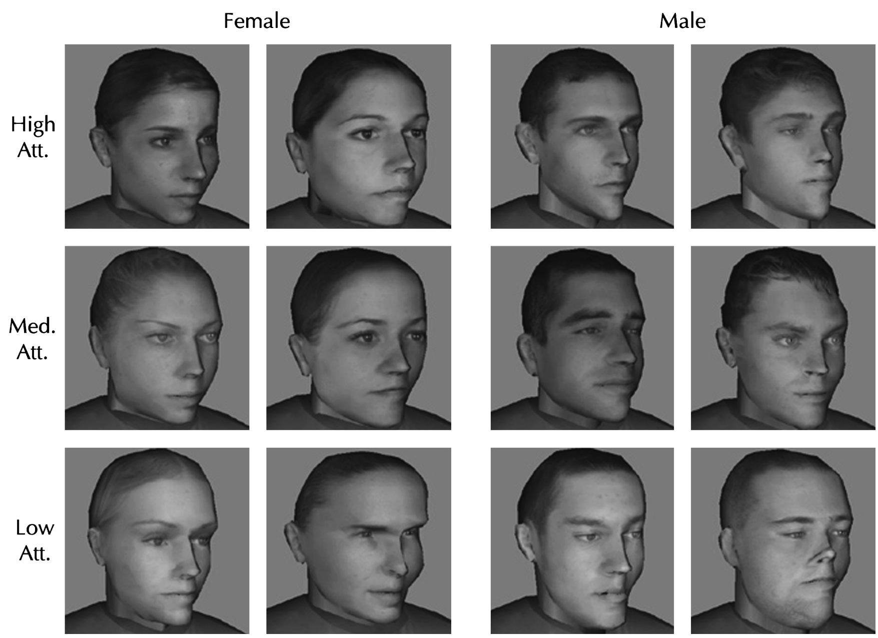

Figure 1 Faces with high, medium, and low attractiveness ratings by gender.

Fourteen undergraduates from a separate subject pool from the main study used a web-based survey to rate the attractiveness of every screenshot's face on a unipolar seven-point fully labeled construct-specific scale (from *not attractive at all* to *extremely attractive*). The frontal and three-quarter screenshot of every face were thus rated separately. Each screenshot was shown by itself and the order of faces was uniquely randomized for every rater.

The ratings of the frontal and three-quarter image of every face were averaged. Then six faces were selected for each gender, where the two attractive faces were each rated as significantly more attractive than the two average faces, and the two average faces were each rated as significantly more attractive than the two unattractive faces. All pairwise t tests had a p value less than .05 (dfs = 26). The 12 faces used in the study are shown in Figure 1. The means and standard deviations of their attractiveness ratings are shown in Table 1. In the entire sample of faces we pretested, the mean attractiveness was 3.09 with a standard deviation of 1.30. The faces we chose for the high-attractiveness condition had a mean of 4.63 and a standard deviation of 1.22, whereas the faces in the low-attractiveness condition had a mean of 1.61 and a standard deviation of 0.83. Thus, our faces in the high-and-low attractiveness conditions varied from the average by about one standard deviation.

The physical lab setting

The lab consisted of two rooms with an open doorway. In the room where the study took place, a black curtain divided the room. To ensure that confederates and participants were not biased by the attractiveness of each other's real faces, confederates stayed behind this black curtain until the VR interaction began and thus never saw the participant's real face and vice versa.

The virtual setting

The virtual setting was a white room that had the same exact dimensions as the physical room participants were in (see Figure 2). Two meters behind the participant was a *virtual mirror* that reflected the head orientation (rotations along pitch, yaw, and roll) and body translation (translation on X, Y, and Z) of the participant with the designated face (see Figure 2). Thus, the mirror image tracked and reflected six degrees of freedom such that when the participant moved in physical space, his or her avatar moved in perfect synchrony in the mirror. The confederate's avatar was

Table 1 Means and Standard Deviations of Attractiveness Ratings for Avatar Faces

	Female		Male	
Attractiveness	Face 1 *M* (*SD*)	Face 2 *M* (*SD*)	Face 1 *M* (*SD*)	Face 2 *M* (*SD*)
High	5.50 (1.35)	4.32 (1.25)	4.64 (1.19)	4.04 (1.10)
Medium	3.39 (1.47)	3.50 (1.40)	3.11 (1.34)	2.93 (1.65)
Low	2.29 (1.15)	1.18 (0.55)	1.75 (1.11)	1.21 (0.50)

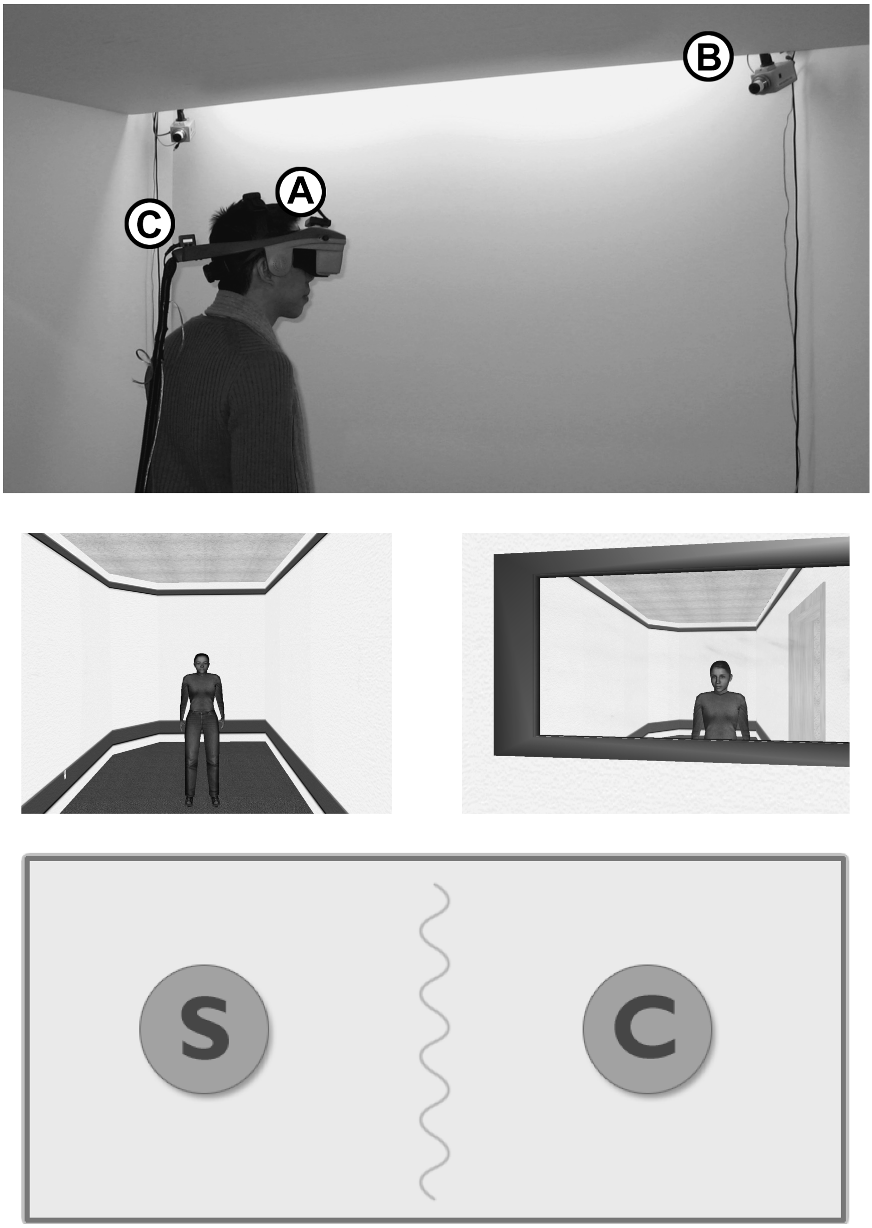

Figure 2 The equipment setup is shown in the top panel. In the lab space, the participant wears the head-mounted display (HMD) (A). The orientation device (B) attached to the HMD tracks rotation, whereas the cameras (C) are used for optical tracking of the participant's position in the room. The virtual room with the confederate is shown in the middle left panel. In the middle right panel is the participant's view of the mirror. In the bottom panel is a diagram showing the layout of the room, the position of the Subject (S), the position of the Confederate (C), and the curtain.

located 5 m in front of the participant, facing the participant, and remained invisible until the conversational portion of the experiment began. The confederate's avatar also had an automated blink animation based on human blinking behavior and lip movement that matched the volume of the confederate's speech.

Apparatus

Perspectively correct stereoscopic images were rendered at an average frame rate of 60 Hz. The simulated viewpoint was continually updated as a function of the participants' head movements, which were tracked by a three-axis orientation sensing system. The position of the participant along the *x*, *y*, and *z* planes were tracked via an optical tracking system. Participants wore an nVisor SX head-mounted display (HMD) that featured dual 1,280 horizontal by 1,024 vertical pixel resolution panels that refreshed at 60 Hz. See Figure 2 for the equipment setup.

Procedure

Three researcher assistants were present during each trial—the lead research assistant, the male confederate, and the female confederate. The confederate in the trial was always the opposite gender of the participant and remained blind to condition. Participants were told that the goal of the experiment was to study social interaction in virtual environments and that they would be having a conversation with another person in a virtual environment. Once the virtual world was loaded, participants saw themselves in a room that was exactly the same dimensions as the physical lab room, as depicted in Figure 2.

Participants were then asked by the lead research assistant to turn around 180° and asked to verify that they saw a mirror in front of them. After verbal affirmation, participants were then told that this is how they appeared to others in the virtual room. Several exercises (head tilting and nodding in front of the mirror) were used to make sure participants had enough time to observe their avatars' faces. Every participant was thus exposed to the designated face for between 60 and 75 seconds.

Participants were then asked to turn back around to face the front (i.e., their original orientation). Slightly ahead of time, the lead research assistant had triggered the program to make the confederate's avatar visible to the participant in the virtual world. The lead research assistant then introduced the confederate to the participant. The confederate followed a strict script that was displayed in their HMD so they could follow the specific verbal procedures while interacting with the participant inside the CVE. Their behaviors were not scripted, and they were instructed to use natural head movements when interacting with the participant. First, participants were greeted and asked to walk closer to the confederate. When the participant stopped or asked whether the distance was close enough, the confederate would then ask them to move a little closer. The confederate then asked the participants to introduce themselves. When the participants stopped or asked whether what they said was enough, the confederate asked the participants to say a little more. If the participants ever asked the confederate any other question, the confederate would reply with "I'm sorry. I can't answer that question. Let's continue."

Measures

Interpersonal distance

The distance between the participant and the confederate was automatically tracked by the VR system. Previous research has validated the interpersonal distance measure inside CVEs (Bailenson, Blascovich, Beall, & Loomis, 2003).

Self-disclosure

The amount of self-disclosure was measured by counting the number of pieces of information that participants gave during the two introduction prompts near the beginning of the conversational portion of the study (e.g., "Tell me a little bit about yourself" and "Tell me a little more"). Two blind coders were asked to count the number of pieces of information given by the participants. Every tape recording was coded by two blind coders, and the coder interreliability was .84.

Results and discussion

To ensure that our attractiveness manipulation was not so obvious as to elicit strong demand characteristics, we asked all participants to write a paragraph and guess the intent of the experiment. Two coders blind to experimental condition read through these responses. Most participants guessed that the goal was to study conversational dynamics in VR as compared with face-to-face interactions. According to both coders, no participant mentioned attractiveness or mentioned that they thought the avatar's attractiveness was manipulated in the study.

Interpersonal distance

We ran a *t* test with attractiveness as the between-subject variable[2] and the final distance as the dependent variable. Participants in the attractive condition walked significantly closer to the confederate ($M = 0.98$, $SD = 0.36$) than participants in the unattractive condition ($M = 1.74$, $SD = 1.20$), $t(30) = -2.42$, $p = .02$, $d = .40$.

Self-disclosure

We performed a *t* test using attractiveness as the between-subject variable and the self-disclosure count as the dependent variable. Participants in the attractive condition revealed significantly more pieces of information ($M = 7.19$, $SD = 2.77$) than participants in the unattractive condition ($M = 5.42$, $SD = 1.56$), $t(30) = 2.23$, $p = .03$, $d = .38$.

The results from the first experiment provided support for the Proteus Effect—that our self-representations shape our behaviors in turn. Participants in the attractive condition were willing to move closer to the confederate and disclosed more information to the confederate than participants in the unattractive condition. More importantly, this effect was measurable and significant immediately after only a brief exposure to the mirror task. The effect size in the current study—interpersonal distances changes of almost a meter—are quite large, much more so than effects found in previous studies on interpersonal distance (Bailenson et al., 2003), which were less than 15 cm. The reason the current manipulation produced such a drastic effect is most likely due to the personal nature of the social interaction.

Experiment 2

In the second experiment, we replicated the Proteus Effect with another manipulation—height. Because height is more often associated with self-esteem and competence rather than friendliness (Young & French, 1996), we employed a different behavioral measure. Instead of a proximity and self-disclosure task, a negotiation task—the "ultimatum game" (Forsythe, Horowitz, Savin, & Sefton, 1994)—was used as a behavioral measure of confidence. In the ultimatum game, two individuals take turns to decide how a pool of money should be split between the two of them. One individual makes the split, and the other must choose to either accept or reject the split. If the split is accepted, the money is shared accordingly. If the split is rejected, neither of them gets the money. We hypothesized that participants with taller avatars would be more confident and be more willing to make unfair splits than participants in shorter avatars.

Design

In a between-subjects design, participants were randomly assigned to have an avatar that was shorter, taller, or the same height as a confederate who was of the opposite gender. We relied on demographic data to assign the base height and height differences in the study. From the National Health and Nutrition Examination Study (NHANES) 2003–2004 data set (National Center for Health Statistics [NCHS], 2004), we calculated the mean and standard deviation of height among Caucasians aged 18–22 in the U.S. population. The mean height was 171.5 cm (or 5 feet and 7.5 inches) with a standard deviation of 10.2 cm. Although men and women have different average heights, we decided to use the same base height across all conditions to avoid confounding height with gender in the experimental design. In our study, the confederate had a base height of 172 cm. In the short condition, participants were 10 cm shorter than the confederate. In the tall condition, participants were 10 cm taller than the confederate. In the same height condition, participants were the same height as the confederate. Thus, the size of our manipulations in the short and tall conditions was about one standard deviation in height. In our study, the confederate was blind to the height condition and the participant's avatar always appeared to the confederate as the same height.[3] In other words, confederates did not know the experimental condition and always perceived the participant as the same height as themselves.

Participants

Participants were 50 undergraduate students at Stanford who were paid $10 for their participation.

Materials

The physical lab and the virtual setting of Experiment 2 were identical to the ones described in Experiment 1 except there was no mirror in the virtual room.

Apparatus

The apparatus used in Experiment 2 was identical to the apparatus described in Experiment 1.

Procedure

Three researcher assistants were present during each trial—the lead research assistant, the male confederate, and the female confederate. The confederate was always the opposite gender of the participant and was blind to condition. Participants were told that the goal of the experiment was to study social interaction in VR environments and that they would be having a conversation with another person in VR. Once the VR world was loaded, participants saw themselves in a room that was exactly the same dimensions as the physical lab room they were in. The confederate's avatar was visible across the virtual room.

The confederate followed a strict verbal script that was displayed in their HMD. Their behaviors were not scripted, and they were instructed to use natural head movements when interacting with the participant. First, participants were greeted by the confederate. The confederate then asked the participants to introduce themselves. After the introductory phase, the lead research assistant explained the money-sharing task. A hypothetical pool of $100 was to be split between the confederate and the participant. One of the two would designate a split. The other would either accept or reject the split. If the split was accepted, the money would be shared accordingly. If the split was rejected, neither would receive any money. The participant was told there would be four rounds of this game and that the lead research assistant would alternate as to who would be making the split for each round.

The participant always designated the split in the first and third rounds. The confederate was instructed to always accept a split as long as it did not exceed $90 in favor of the participant. The confederate always designated a split of 50/50 in the second round and 75/25 (in the confederate's favor) in the fourth round. These two ratios were chosen to represent a fair and unfair split. After the money-sharing task, the participant was taken out of the virtual setting.

Measures

Monetary splits

The split offers were recorded by the research assistant during the negotiation task.

Results and discussion

To ensure that our height manipulation was not so obvious as to elicit strong demand characteristics, we asked all participants to guess the intent of the experiment. Two coders blind to condition read through the responses. Most participants guessed that the goal was to study conversational dynamics in VR as compared with face-to-face interactions. According to both coders, no participant mentioned height or guessed that height was manipulated in the study.

Negotiation behavior

There were three measures of interest: amount offered by participant in the first round (from hereon referred to as Split 1), amount offered by participant in the third round (from hereon referred to as Split 2), and whether the participant accepted the unfair split by the confederate in the final round (from hereon referred to as final split). Three outliers (more than three standard deviations from the mean) in Split 1 and Split 3 were excluded from analysis. The cutoffs were 88.5 and 84.2, respectively.

We ran an analysis of variance (ANOVA) with height as the between-subject factor and Split 1 as the dependent variable. The effect of height was not significant, $F(2, 47) = 0.63$, $p = .53$, $\eta^2 = .03$, see Table 2.

We then ran an ANOVA with height as the between-subject factor and Split 3 as the dependent variable. There was a main effect of height, $F(2, 46) = 5.64$, $p = .006$, $\eta^2 = .20$. A post hoc test using Tukey's Honest Significant Difference (HSD) showed that participants in the tall condition split the money significantly more in their own favor ($M = 60.63$, $SD = 6.55$) than participants in the short condition ($M = 52.06$, $SD = 7.30$), $p = .004$. See Table 2 for all means and standard deviations of the splits by condition.

Finally, to test the effect of height on the acceptance rate of the final unfair offer, we ran a logistic regression using acceptance rate as the dependent variable and height (recoded short as 1, normal as 2, and tall as 3) as the independent variable. Height was a significant predictor of acceptance rate, $\chi^2(1, N = 50) = 4.41$, $p = .04$. Prediction success for acceptance of the unfair offer was 54%, and it was 80% for rejection of the unfair offer. Participants in the short condition were about twice as likely to accept the unfair offer (72%) as participants in the normal (31%) and tall condition (38%).

We were surprised that the effect of height on negotiation did not emerge until the second split. Informal discussion with the research assistants and review of the

Table 2 The Means and Standard Deviations of Interpersonal Distance and Split 1 Across Height Conditions

Height	Split 1	Split 2	Final Split
Short	54.99 (12.47)	52.06 (7.30)	0.72 (0.46)
Normal	58.69 (15.85)	55.69 (8.10)	0.31 (0.48)
Tall	53.75 (10.25)	60.63 (6.55)	0.38 (0.50)

recordings suggest that many participants were "testing the waters" in the first split but became more bold in the second split. In any case, the effect of height on the second split was highly significant and suggests that the manipulation of height does affect negotiation behavior, but that these effects may emerge over time.

In summary, our findings from Experiment 2 extended the Proteus Effect with a different manipulation. Participants in the tall condition were significantly more likely to offer an unfair split than participants in the normal and short conditions. At the same time, participants in the short condition were significantly more likely to accept an unfair split than participants in the normal and tall condition. Thus, our findings from the negotiation task support the Proteus Effect.

General discussion

Across different behavioral measures and different representational manipulations, we observed the effect of an altered self-representation on behavior. Participants who had more attractive avatars exhibited increased self-disclosure and were more willing to approach opposite-gendered strangers after less than 1 minute of exposure to their altered avatar. In other words, the attractiveness of their avatars impacted how intimate participants were willing to be with a stranger. In our second study, participants who had taller avatars were more willing to make unfair splits in negotiation tasks than those who had shorter avatars, whereas participants with shorter avatars were more willing to accept unfair offers than those who had taller avatars. Thus, the height of their avatars impacted how confident participants became. These two studies show the dramatic and almost instantaneous effect that avatars have on behavior in digital environments.

In our experimental studies, we purposefully excluded the effect of behavioral confirmation even though it too clearly plays a crucial role in social interactions—both online and offline. The advantage of this exclusion was that it enabled us to isolate the effect of changing an individual's self-representation. The disadvantage is the inability to understand how these changes may unfold in an actual situation where the Proteus Effect interacts with behavioral confirmation. What is striking about the current data is that we demonstrated drastic changes in behavior even though there was absolutely no way for behavioral conformation to occur, as the confederates always were blind to experimental condition. Another limitation was that we were unable to explore the role of choice in the Proteus Effect. In our studies, participants were given avatars rather than being able to choose their own avatar—the typical situation in online environments. However, it bears pointing out that the range of avatar choice in many online environments is not truly diverse. For example, in the social online world *There.com*, users can only create youthful avatars. Old people do not exist in *There*. In other words, there may be many features of our avatars that we actually do not have control over in online environments.

Another limitation in our studies was the lack of a direct manipulation check. Because our theoretical claim is based partly on self-perception theory, our results would have been more convincing if participants in the attractive condition rated their avatar as indeed more attractive than participants in the unattractive condition. And finally, our reliance on the opposite-gender paradigm may have limited our studies to a certain class of interactional behavior (e.g., with a romantic or sexual tone). It would be interesting to carry out additional studies in same-gender pairings to examine this potential bias.

Future research in this area might focus on several other things. First, the Proteus Effect may generalize to other fundamental aspects of self-representation, such as gender or race. For example, when male participants employ female avatars, they may behave in a more gender-stereotypical manner. Second, examining whether or not there are long-term consequences of the Proteus Effect, which carry over into the physical world, is obviously an important research agenda. Do users who frequently use tall and attractive avatars become more confident and friendly in real life? If so, virtual environments may be an excellent venue for therapeutic purposes. Third, examining the role of choice in the Proteus Effect might reveal that choice either augments or diminishes the effect. Also, while we argued in the theoretical framing that the Proteus Effect could occur even if participants were alone and not in a group setting, this was something we did not directly test for in our experimental designs. It would be interesting to devise similar experiments where participants were not in a group setting.

And finally, we suggest that the most interesting area of research lies in the mismatch of self-representation and how others perceive us. In the traditional behavioral confirmation paradigm, the false assumptions of the perceiver are unknown to the target. Unlike the target-centric paradigm that denies the target of their awareness of how others may stereotype them, we have shown that an individual's false self-concept (i.e., self-stereotyping) has a significant impact on their behavior. More importantly, the false self-concept may override behavioral confirmation. In our studies, participants using attractive avatars became more intimate and friendly with strangers. This initial friendliness may elicit more positive responses from the interactant and lead to a more positive interaction overall. Thus, we hypothesize that the precise reverse of behavioral confirmation—a target's false self-concept causes them to interact with the perceiver in a way such that the perceiver behaves in a way that confirms the target's false self-concept—can occur. The most interesting test of this hypothesis may be to pit the Proteus Effect against behavioral confirmation. In other words, future work should examine an experimental paradigm in which participants believe that they are attractive, whereas other interactants perceive them as unattractive. A similar research agenda has been proposed by Blascovich and colleagues (Blascovich et al., 2002).

The Proteus Effect is a particularly important theoretical framework in understanding behavior in virtual environments where users are able to choose or customize their avatar's appearances. In our experimental studies, dyads interacted after one interactant had their self-representation manipulated. In virtual communities, thousands of users interact with altered self-representations. In many of these environments, the only avatar choices are youthful, in shape, and attractive. If having an attractive avatar can increase a person's confidence and their degree of self-disclosure within minutes, then this has substantial implications for users in virtual environments. First, the Proteus Effect may impact behavior on the community level. When thousands of users interact, most of whom have chosen attractive avatars, the virtual community may become more friendly and intimate. This may impact the likelihood of relationship formation online (Parks & Floyd, 1996). As graphical avatars become the dominant mode of self-representation in virtual environments, the Proteus Effect may play a substantial role in encouraging hyperpersonal interaction (see Walther, 1996). And second, these behavioral changes may carry over to the physical world. If users spend more than 20 hours a week in these environments (Yee, 2006), in an avatar that is tall and attractive, is an equilibrium state reached or do two separate behavioral repertoires emerge?

The set of studies presented in this paper makes clear that our self-representations have a significant and instantaneous impact on our behavior. The appearances of our avatars shape how we interact with others. As we choose our self-representations in virtual environments, our self-representations shape our behaviors in turn. These changes happen not over hours or weeks but within minutes. Every day, millions of users interact with each other via graphical avatars in real time in online games (Chan & Vorderer, 2006). All of them are using an avatar that differs from their physical appearance. In fact, most of them are using avatars that are attractive, powerful, youthful, and athletic. Although most research in CMC has focused on the technical affordances of the medium (lack of social cues, social presence, anonymity, etc.), we argue that theoretical frameworks of self-representation cannot be ignored because choosing who we are is a fundamental aspect of virtual environments. More importantly, who we choose to be in turn shapes how we behave. Although avatars are usually construed as something of our own choosing—a one-way process—the fact is that our avatars come to change how we behave.

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Notes

1 In the analysis of Experiment 1, there was no significant interaction effect with the race of the participant. In Experiment 2, participants do not see their own avatar, so this was not an issue.

2 In both studies, the effect of subject gender was not significant, and including this factor in the ANOVA did not change the reported significance of the results.

3 In the cases where this caused a mismatch between the perceived and actual height of the participant's avatar, real-time algorithms using trigonometry were used to correct the eye-gaze angle between the participant and the confederate to preserve the possibility of making eye contact.

References

Anonymous. (1998). To reveal or not to reveal: A theoretical model of anonymous communication. *Communication Theory*, **8**, 381–407.

Bailenson, J. (2006). Transformed social interaction in collaborative virtual environments. In P. Messaris & L. Humphreys (Eds.), *Digital media: Transformations in human communication* (pp. 255–264). New York: Peter Lang.

Bailenson, J., Beall, A., Blascovich, J., Loomis, J., & Turk, M. (2005). Transformed social interaction, augmented gaze, and social influence in immersive virtual environments. *Human Communication Research*, **31**, 511–537.

Bailenson, J., Blascovich, J., Beall, A., & Loomis, J. (2003). Interpersonal distance in immersive virtual environments. *Personality and Social Psychology Bulletin*, **29**, 1–15.

Bem, D. (1972). Self perception theory. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 6). New York: Academic Press.

Blascovich, J., Loomis, J., Beall, A., Swinth, K., Hoyt, C., & Bailenson, J. (2002). Immersive virtual environment technology as a methodological tool for social psychology. *Psychological Inquiry*, **13**(2), 103–124.

Burgoon, J. (1978). A communication model of personal space violation: Explication and an initial test. *Human Communication Research*, **4**, 129–142.

Burgoon, J., & Walther, J. (1990). Nonverbal expectancies and the evaluative consequences of violations. *Human Communication Research*, **17**, 232–265.

Burgoon, J., Walther, J., & Baesler, E. (1992). Interpretations, evaluations, and consequences of interpersonal touch. *Human Communication Research*, **19**, 237–263.

Chan, E., & Vorderer, P. (2006). Massively multiplayer online games. In P. Vorderer & J. Bryant (Eds.), *Playing computer games—Motives, responses, and consequences*. Mahwah, NJ: Lawrence Erlbaum.

Culnan, M. J., & Markus, M. L. (1987). Information technologies. In F. M. Jablin & L. L. Putnam (Eds.), *Handbook of organizational communication: An interdisciplinary perspective* (pp. 420–443). Thousand Oaks, CA: Sage Publications.

Dion, K., Berscheid, E., & Walster, E. (1972). What is beautiful is good. *Journal of Personality and Social Psychology*, **24**, 285–290.

Flanagin, A. J., Tiyaamornwong, V., O'Connor, J., & Seibold, D. R. (2002). Computer-mediated group work: The interaction of member sex and anonymity. *Communication Research*, **29**, 66–93.

Forsythe, R., Horowitz, J., Savin, N., & Sefton, M. (1994). Fairness in simple bargaining experiments. *Games and Economic Behavior*, **6**, 347–369.

Frank, M., & Gilovich, T. (1988). The dark side of self and social perception: Black uniforms and aggression in professional sports. *Journal of Personality and Social Psychology*, **54**, 74–85.

Freedman, D. G. (1979). *Human sociobiology*. New York: Free Press.

Friend, R. M., & Vinson, M. (1974). Leaning over backward: Jurors responses to defendants' attractiveness. *Journal of Communication*, **24**, 124–129.

Gergen, K., Gergen, M., & Barton, W. H. (1973). Deviance in the dark. *Psychology Today*, **11**, 129–130.

Hancock, J., & Dunham, P. (2001). Impression formation in computer-mediated communication revisited: An analysis of the breadth and intensity of impressions. *Communication Research*, **28**, 325–347.

Harrison, A. A., & Saeed, L. (1977). Let's make a deal: An analysis of revelations and stipulations in lonely hearts advertisements. *Journal of Personality and Social Psychology*, **35**, 257–264.

Hiltz, S., Johnson, K., & Turoff, M. (1986). Experiments in group decision making: Communication processes and outcome in face-to-face versus computerized conferences. *Human Communication Research*, **13**, 225–252.

Jacobson, D. (1999). Impression formation in cyberspace: Online expectations and offline experiences in text-based virtual communities. *Journal of Computer-Mediated Communication*, **5**. Retrieved April 26, 2007, from http://jcmc.indiana.edu/vol5/issue1/jacobson.html

Jarvenpaa, S., & Leidner, D. (1998). Communication and trust in global virtual teams. *Journal of Computer-Mediated Communication*, **3**. Retrieved April 26, 2007, from http://jcmc.indiana.edu/vol3/issue4/jarvenpaa.html

Johnson, R., & Downing, L. (1979). Deindividuation and valence of cues: Effects on prosocial and antisocial behavior. *Journal of Personality and Social Psychology*, **37**, 1532–1538.

Kiesler, S., Siegel, J., & McGuire, T. W. (1984). Social psychological aspects of computer-mediated communication. *American Psychologist*, **39**, 1123–1134.

Langlois, J., Kalakanis, L., Rubenstein, A., Larson, A., Hallam, M., & Smoot, M. (2000). Maxims or myths of beauty?: A meta-analytic and theoretical review. *Psychological Bulletin*, **126**, 390–423.

Lea, M., O'Shea, T., & Spears, R. (1992). "Flaming" in computer-mediated communication. In M. Lea (Ed.), *Contexts of computer-mediated communication* (pp. 89–112). New York: Harvester Wheatsheaf.

Linden Labs (2006). *What is second life?* Retrieved May 5, 2006, from lindenlab.com/ProductFactSheet.pdf

Loomis, J., Blascovich, J., & Beall, A. (1999). Immersive virtual environments as a basic research tool in psychology. *Behavior Research Methods, Instruments, and Computers*, **31**, 557–564.

McKenna, K., & Bargh, J. (2000). Plan 9 from cyberspace: The implications of the Internet for personality and social psychology. *Personality and Social Psychology Review*, **4**, 57–75.

Merola, N., Penas, J., & Hancock, J. (2006). *Avatar color and social identity effects: On attitudes and group dynamics in virtual realities*. Paper presented at the ICA 2006, Dresden, Germany.

National Center for Health Statistics (2004). National health and nutrition examination survey 2003-2004. Retrieved September 5, 2006, from http://www.cdc.gov/nchs/about/major/nhanes/nhanes2003-2004/nhanes03_04.htm

Normand, V., Babski, C., Benford, S., Bullock, A., Carion, S., Chrysanthou, Y, et al. (1999). The COVEN project: Exploring applicative, technical, and usage dimensions of collaborative virtual environment. *Presence: Teleoperators and Virtual Environments*, **8**, 218–236.

Parks, M. R., & Floyd, K. (1996). Making friends in cyberspace. *Journal of Communication*, **46**, 80–96.

Postmes, T., & Spears, R. (2002). Behavior online: Does anonymous computer communication reduce gender inequality? *Personality & Social Psychology Bulletin*, **28**, 1073–1083.

Postmes, T., Spears, R., & Lea, M. (1998). Breaching or building social boundaries? *Communication Research*, **25**, 689–699.

Postmes, T., Spears, R., & Lea, M. (2000). The formation of group norms in computer-mediated communication. *Human Communication Research*, **26**, 341–371.

Short, J., Williams, E., & Christie, B. (1976). *The social psychology of telecommunications*. London: Wiley.

Snyder, M., Tanke, E. D., & Berscheid, E. (1977). Social perception and interpersonal behavior: On the self-fulfilling nature of social stereotypes. *Journal of Personality & Social Psychology*, **35**, 656–666.

Spears, R., & Lea, M. (1994). Panacea or panopticon? The hidden power in computer-mediated communication. *Communication Research*, **21**, 427–459.

Stogdill, R. M. (1948). Personal factors associated with leadership: A survey of the literature. *Journal of Psychology*, **25**, 35–71.

Trevino, L., & Webster, J. (1992). Flow in computer-mediated communication: electronic mail and voice mail evaluation and impacts. *Communication Research*, **19**, 539–573.

Turkle, S. (1995). *Life on the screen: Identity in the age of the Internet*: New York: Simon and Schuster.

Valins, S. (1966). Cognitive effects of false heart-rate feedback. *Journal of Personality and Social Psychology*, **4**, 400–408.

Walther, J. (1996). Computer-mediated communication: Impersonal, interpersonal, and hyperpersonal interaction. *Communication Research*, **23**(1), 3–43.

Walther, J., Anderson, J., & Park, D. (1994). Interpersonal effects in computer-mediated interaction: A meta-analysis of social and anti-social communication. *Communication Research*, **21**, 460–487.

Walther, J., Slovacek, C., & Tidwell, L. (2001). Is a picture worth a thousand words?: Photographic images in long-term and short-term computer-mediated communication. *Communication Research*, **28**, 105–134.

Yee, N. (2006). The demographics, motivations, and derived experiences of users of massively multi-user online graphical environments. *Presence: Teleoperators and Virtual Environments*, **15**, 309–329.

Young, T. J., & French, L. A. (1996). Height and perceived competence of U.S. Presidents. *Perceptual and Motor Skills*, **82**, 1002.

Zimbardo, P. (1969). The human choice: Individuation, reason, and order vs. deindividuation, impulse and chaos. In W. J. Arnold & D. Levine (Eds.), *Nebraska symposium on motivation* (Vol. 17, pp. 237–307). Lincoln: University of Nebraska Press.