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

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Abstract

The prevalence of virtual environments, such as online games, chatrooms, and video conferences, increasingly allows us to alter our digital self-representations dramatically and effectively. But as we change our self-representations, do our self-representations change our behavior in turn? In two experimental studies, we explore the hypothesis that an individual's behavior conforms to their self-representation independent of how others perceive them - a process we term *the Proteus Effect*. In the first study, participants assigned 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.

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

The notion of transforming our appearances permeates our culture. On the one hand, minor alterations such as haircuts, make-up, 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 while extreme self-transformations are expensive (e.g., cosmetic surgery) or difficult to perform (e.g., gender reassignment surgery) in real life, nowhere is self-representation more flexible and simple 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 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" (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, while 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 while

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 and colleagues

(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 and colleagues 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 Valins' study (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 Frank and Gilovich's study (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" (pg. 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 anti-social 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 which 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 anti-social. The argument that deindividuation can lead to both pro-social and anti-social 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 anti-social behavior as Zimbardo originally argued, but may in fact cause a greater reliance on identity cues whether they are anti-social or pro-social.

In the computer-mediated communication literature, the Social Identity Model of Deindividuation Effects (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 anti-normative behavior, but rather, behavioral changes depend on the local group norms

(Postmes, Spears, & Lea, 2000). More importantly, behavior that is typically seen as anti-normative, 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. Whereas 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.

While 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 - i.e., 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 amongst a group of individuals who have that attribute (e.g., "being in a group of attractive people"), while 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 while 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 isn't 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 (Loomis, Blascovich, & Beall, 1999; Blascovich et al., 2002).

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 while 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, Tanke, and Berscheid's original study (1977), 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.

H2: Participants in taller avatars would behave in a more confident manner and negotiate more aggressively than participants in shorter avatars.

Experiment One

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 and colleagues (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 (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 pretest1. 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.

Fourteen undergraduates from a separate subject population from the main study used a web-based survey to rate the attractiveness of every screenshot's face on a unipolar 7-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 pair-wise t-tests had a p-value less than .05 (df's = 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, while 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 each other's real faces, confederates stayed behind this black curtain until the virtual reality 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 located 5 meters 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 1280 horizontal by 1024 vertical pixel resolution panels that refreshed at 60 Hz. See Figure 2 for 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 degrees 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 to 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 inter-reliability was .84.

<div align="center">Results and Discussion</div>

       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, Blascovich, Beall, &

Loomis, 2003) which were less than 15 centimeters. The reason the current manipulation

produced such a drastic effect is most likely due to the personal nature of the social interaction.

<div align="center">Experiment Two</div>

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 NHANES 2003-2004 data set (NCHS, 2004), we calculated the mean and standard deviation of height among Caucasians aged 18 to 22 in the US population. The mean height was 171.5 cm (or 5 feet and 7.5 inches) with a standard deviation of 10.2 cm. While 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 were 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 who were paid ten dollars for their participation.

Materials

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

Apparatus

The apparatus used in Experiment Two was identical to the apparatus described in Experiment One.

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 virtual reality 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 one*), amount offered by participant in the third round (from hereon referred to as *split two*), 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 3

standard deviations from the mean) in split one and split 3 were excluded from analysis. The cut-offs were 88.5 and 84.2 respectively.

We ran an ANOVA with height as the between-subject factor and split one 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 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 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 Two 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 one 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 don't have control over in online environments.

Another limitation in our studies was the lack of a direct manipulation check. Since 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. Secondly, 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. Thirdly, 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 while 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 over 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. While 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. While 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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Footnotes

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

2In 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.

3In 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.

Acknowledgements

Table 1

Means and Standard Deviations of Attractiveness Ratings for Avatar Faces.

	Female		Male	
Attractiveness	Face 1	Face 2	Face 1	Face 2
	M (*SD*)	*M* (*SD*)	*M* (*SD*)	*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)

Table 2

The Means and Standard Deviations of Interpersonal

Distance and Split One across Height Conditions.

Height	Split One	Split Two	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)

Figure Caption

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

Figure 2. The equipment setup is shown in the top panel. In the lab space, the participant wears

the HMD (A). The orientation device (B) attached to the HMD tracks rotation while 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.