Intelligent Agents Who Wear Your Face: Users' Reactions to the Virtual Self

Jeremy N. Bailenson[1], Andrew C. Beall[1], Jim Blascovich[1], Mike Raimundo[1], and Max Weisbuch[1]

[1] Research Center for Virtual Environments and Behavior, Department of Psychology, University of California, Santa Barbara, CA, 93101, USA
bailenson@psych.ucsb.edu

Abstract. The three-dimensional models used to embody intelligent agents are becoming increasingly realistic. We discuss two studies in which we embodied intelligently behaving virtual agents with photographically realistic models of human subjects' heads and faces. We then immersed those subjects with agents embodied with their <u>virtual selves</u> and compared their interactions and nonverbal behaviors to separate subjects who were immersed with agents embodied with <u>virtual others</u>. Subjects treated agents embodied with their virtual selves fundamentally differently than agents embodied with virtual others in regards to both measured nonverbal behaviors and questionnaire ratings. Implications for systems incorporating realistic embodied agents are discussed.

1 Introduction

About twenty years ago, William Gibson [6] described an outrageous world in which an intelligent agent masqueraded through virtual space by embodying the faces, bodies, and personalities of real people. Veritable human beings who interacted with this agent had great difficulty discriminating the agent from their fellow humans. While his brilliant work, *Neuromancer*, was fiction, as the decades pass by certain aspects of his visions begin to ring true. Embodied agents are becoming increasingly common in business applications, communications systems, and entertainment.

How intelligent would a virtual agent have to be in order to fool a reasonable human in the manner described above? Not surprisingly, this depends on how one defines intelligence. From a traditional artificial intelligence perspective, one might look to the agent's ability to solve specific problems such as machine vision or language understanding. For these tasks and many others, no agent (i.e., algorithm) exists today that competes favorably with human capabilities, so when comparing agents to humans in an objective sense, agents are not likely to fool a human. While this certainly may change in the future, we believe in many situations today it is not the actual intelligence that matters but rather the <u>perceived state</u> (i.e., intelligence, intention, identity, etc.) of the agent that matters. As philosophers and psychologists have argued for over a century, what matters in human-human interaction are the interactants' subjective beliefs about one another, not the objective truth of the interaction. Since one of the many important applications of virtual agent technology is interaction with humans, understanding how an agent can fool or otherwise impact human-agent interaction will be crucial to development and future success of agent technology.

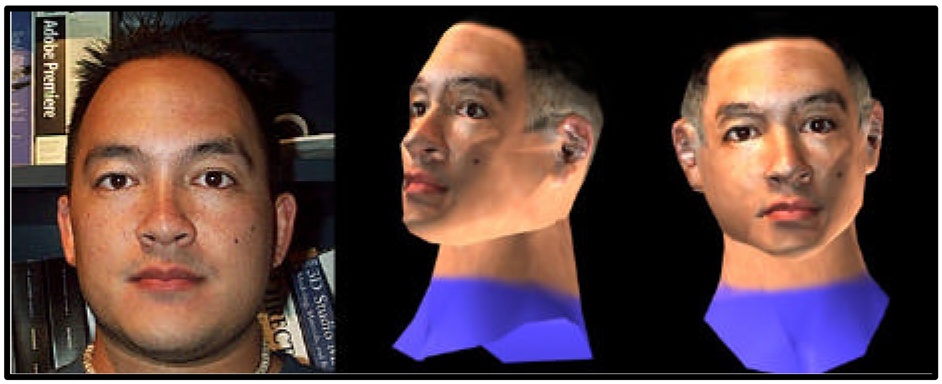
The question becomes: What drives the perception of an agent's intelligence, intention, and identity? There are many likely variables that interact in complex ways; some of which are photo-realism, non-verbal behavior, autonomy, and interactivity [4]. However, extremely realistic digital humans are now making their debut in the public arena and may have a dramatic impact on the manner in which these variables interact. As a case in point, we cite both Eve Solal, a new and popular personality on the World Wide Web who models clothing, DJ's parties, and even has her own "agent" (i.e., a human being who is responsible for managing her contracts); and a current film, "Final Fantasy," whose cast consists exclusively of realistic three-dimensional agents (in contrast to previous full-length animated films that used the cartoon mechanism as a way of suspending disbelief).

In the research community, there is a growing body of research using experimental methods to carefully test human-agent interactions. This research shows that humans respond to virtual agents in ways that are very similar to their responses to other humans. A remarkable finding of this work is that this is true even for non-photorealistic agents that have very basic levels of behavior or interactivity [10]. It appears that built-in mechanisms in the human mind engage and respond in social manners to certain low-level stimuli, including agents. As such, we propose that in many instances it may be possible to generate meaningful human-agent interactions by evoking these built-in mechanisms, while at the same time relieving the agent developer from the burden of programming sophisticated algorithms of cognitive abilities. In these ways, we believe agents can use low-level influences to 'fool' humans in a social arena. In fact, it may be nearly impossible to avoid being fooled in cases in which an agent evokes certain basic characteristics or behaviors.

In the current paper, we discuss what we believe to be an extremely serious and substantial issue. How do people react when exposed to agents embodied with their virtual selves?

What is the virtual self? The answer to this question may in fact be more appropriate for philosophers than for social or computer scientists. However, in this discussion, we operationally define the virtual self as a virtual entity that resembles a given human along a certain dimensions (e.g., face, body, behavior, personality, etc.). The middle and right panels of Figure 1 show an example of a virtual self that has facial resemblance to a particular individual (as shown in the left panel). We contrast the term "virtual self" to the term "avatar," which has recently been adopted to describe a virtual entity that serves as one's proxy, because an avatar need not resemble the self along any particular dimension.

According to our definition, the virtual self can be conceptually framed in ways quite different from one's actual self. Consider an Internet-based chat room, or perhaps an immersive virtual environment (IVE) in which there are many virtual representations of people walking around. A given user can traverse that environment, and the virtual self, the representation that looks just like the user, can be used as her avatar. In other words, the movements and actions of that virtual representation can be completely tied to and controlled by the user. The user does not see her own face



(unless she looks into a virtual mirror), and when the user looks down, she sees her own torso and feet. In this type of a situation, the virtual self is most closely tied with the actual self.

However, consider the following situation. A given user has her virtual self in the chatroom, and then decides to get up and abandon whatever interface device she was using to control it. While she is gone, her little brother meanders into the room and plugs into the chatroom, commandeering the user's virtual self to traverse the environment. The little brother tours the chatroom, guiding the visual analog of his older sister through the environment. In this sense, a virtual self can be used by anyone to masquerade through virtual space. Virtual identity is not necessarily tied to physical identity.

More provocatively, a virtual self can be driven by an intelligent agent, some kind of algorithm that controls the representation. Virtual environments are increasingly becoming popular for both communications and commerce. One can conceivably design a computer program that is capable of guiding his virtual self through these different types of environments. In other words, if a user wants to send his virtual self to a chatroom, and to have his virtual self personally give every user in that environment his home phone number, the user does not necessarily have to be physically attached to his virtual self in order to accomplish that goal. He can simply use his virtual self to embody an intelligent agent who can easily run such an errand.

If we examine this last case more closely, some potentially unsettling questions arise. Assume that a person uses his virtual self to embody an agent and sends that embodied agent into a virtual environment. Then that user himself enters the virtual environment, and while traversing the environment encounters the agent driving his virtual self. In other words, he discovers another entity that resembles him along various dimensions and yet is in no way respondent to his movements or actions (as would be if he were looking in a mirror). Does he treat that virtual entity like himself, or like someone else entirely? Is this like running into a long lost twin, or is the resemblance between the user and the agent irrelevant to their interaction? In other words, can the virtual self be defined by a user's visual representation or behavioral personality, even if that visual representation is not at all tied to a user's actions or behaviors?

It is possible to take this hypothetical situation a bit further. Suppose that the user always uses his virtual self to embody a given agent, and on a daily basis he shares virtual space with the agent and interacts often with the virtual representation. How attached does he become with the embodied agent? If there was a database failure or a computer crash, and the virtual self was destroyed, is the user upset? Does he mourn for the death of his virtual representation? Is it like losing a best friend, or like losing a faithful dog? Or is it more akin to losing a goldfish? Is the representation of the virtual self completely replaceable, or will the old one be sorely missed?

The notion of a detachable virtual self opens up a plethora of mind-boggling questions; moreover every question raised tends to hint at dozens of others. For this reason, social science research concerning embodied and intelligent agents is uniquely exciting. In the following paper we describe two studies which barely scratch the surface of the research which will become absolutely necessary as humans begin to rely more and more on visual analogs of themselves.

The remainder of this paper will be structured as follows. First, we briefly discuss previous work that has measured human behavior in the presence of agents. Next, we describe the technique we use to produce realistic virtual representations of people in a single experimental session. Finally, we report data from two experiments in which subjects came to the lab, waited while we built their virtual selves, and then interacted in a number of novel situations with agents that were embodied with their virtual selves.

1.1 Behavioral Measures of Social Influence

There has been substantial research on interactions between intelligent agents and humans. For the sake of brevity, we limit discussion here to work on measuring the degree of social influence that humans exhibit during an interaction with an embodied agent.

We define social influence as the degree to which users of a virtual environment behave as if a virtual agent is in fact a real human being. Previous work suggests that the true litmus test for social influence lies in the behavioral experience of the user [3,4,7,8,9,12,13] . In other words, asking the user to explicitly discuss the humanity of the agent may be somewhat informative, but the surefire way to determine a user's regard for an agent's humanlike characteristics is to measure that user's behavior.

In our previous work [3], we have focused on a specific nonverbal behavior called proxemics, the amount of interpersonal distance that a user leaves between himself and an embodied agent in an IVE, as a gauge for social influence. We manipulated the realism of virtual agents' behavior and appearance. In regards to personal space, subjects in those studies treated embodied agents in a manner similar to real humans. Our users traversed the virtual environment attempting to memorize incidental features of the agent, such as the agent's name, hair color, and shirt color. Even though they were unaware of our measuring their personal space, the average minimum distance between them and the virtual agent was close to a half-meter away, indicating that users avoided direct contact with the agents. In addition, the shape of the personal space bubble around the embodied agents closely resembled the shape of the bubble that people typically leave around real humans, with the front distance being larger than the back distance [1]. This study also included a control condition in which subjects walked around a pylon of similar shape and size of a virtual human. They went much closer to the pylon than to the embodied agent.

Furthermore, the personal space bubble changed as a function of our realism manipulations. Previous research has demonstrated that interpersonal distance is higher between people who are maintaining eye contact than between those who are not [1]. Consequently, we also manipulated gaze in our studies. In conditions where the virtual agent exhibited realistic mutual gaze behavior by turning their heads to maintain eye contact with the users, the users left more personal space between themselves and the virtual agent than in conditions where the agent did not maintain mutual gaze.

In the first study described in this paper, we again measure the user's proxemic behavior, this time while they are immersed with an agent embodied with their virtual self in an IVE. We also gauge their explicit reactions through post-experimental interviews and questionnaires. In the following section we discuss the manner in which we build the virtual self.

2 Virtual Self Construction

Building the virtual self involves three main stages: creating the texture mask of the user's head and face, applying that texture of the user to a three dimensional template model, and then animating behaviors of the agent embodied with the user's texture map. We describe those processes in turn.

When the user arrives at our laboratory, we use a digital camera to take four photographs of the user's head and face: one profile, one head-on shot with the user's eyes closed, one with the user's eyes open, and one with the user's mouth open. Using a technique similar to that described by Sannier and Thalmann [11], we then stitch the profile and one of the front views together in order to create a texture mask that wraps around a three-dimensional model. Next, we use an image editor to create an additional texture mask with the user's eyes closed (to be used in a blinking animation).

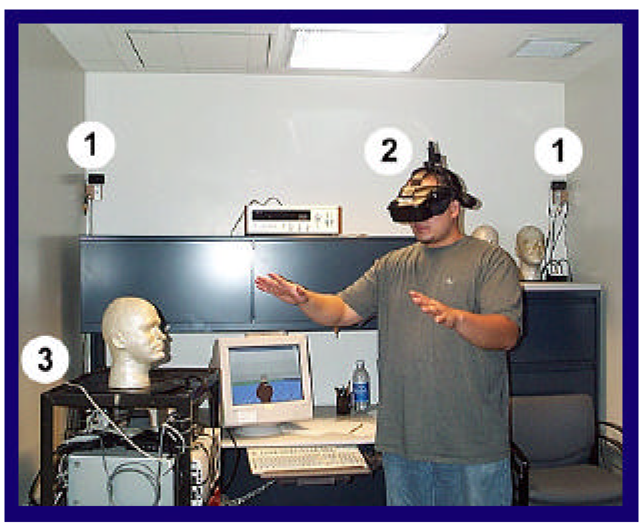
We used two three-dimensional mesh models as templates: one for women and one for men. To apply a user's mask texture onto the appropriate three-dimensional model, we stretched the texture mask to ensure that the user’s eyes, nose, mouth, and ears were in the correct locations on the model. We then used 3D modeling software to wrap the texture mask onto the model.

The embodied agent exhibited two separate nonverbal behaviors in order to create the perception of at least low-level intelligence. The first was blinking. At random intervals between two and five seconds, we swapped the texture map with the user's eyes closed onto the mesh model. The eyes remained closed for 200 ms before we switched back to the original texture mask.

The second behavior was head-turning. The embodied agent continually turned its head so that it constantly gazed at the user’s face as he or she traversed the environment. The agent's head turned 85 degrees about the vertical axis in either direction. When the user walked beyond that point, the agent's head slowly turned back to looking straight ahead, until the user walked back within the 85 degree range. At that point the agent again maintained eye contact with the user.

3 Experiments

We now describe two studies we have conducted that measure the different re-



sponses people make to virtual agents. In both studies, we designed our agents to exhibit behaviors such as mutual gaze and blinking that create the perception of at least rudimentary intelligence. The key distinction we addressed with the current research is whether or not the agents visually resembled our subjects. The first study draws on the previous findings (as discussed in section 1.1) that people are unwilling to approach behaviorally realistic agents closer than they would a real human being, and tests further how this behavior may change when one uses self-identity to manipulate the perceived level of intimacy with an agent. Study two again uses identity to manipulate agent intimacy and tests whether perceived agent mortality affects peoples' emotions and self esteem.

In these studies, we sought to maximize a) social influence from the virtual agents and b) the ecological validity of walking behavior and personal space tendencies. As a result we chose to use IVE rather than desktop simulations. The technology for the current studies has been described in detail elsewhere [3], but is described briefly here. The head mounted displays (HMDs) were Virtual Research V8 HMDs with 680 by 480 resolution stereoscopic LCD devices running at 72 Hz refresh rates. Visual rendering was stereoscopic with a 60 degrees diagonal field of view. The display updated on average at a frame rate of 36 Hz with a latency of less than 65 ms between subjects' head or body movements and the concomitant update in the visual display. We tracked the subjects' orientation with inertial tracking and their position with passive optical tracking. Graphics were generated on a 450 MHz dual-processor, Intel Pentium III based-PC using an Evans & Sutherland Tornado 3000 video adapter. The real-time rendering software is OpenGL-based and has been developed internally. Figure 2 shows a photograph of the different components of the system we employed to run both studies.

3.1 Study 1: Personal Space

The fundamental question we ask in this experiment is this: Do people feel special ties with a three-dimensional model that looks like them? In other words, does a user pay special regard to an agent if it is embodied with their virtual self?

To answer this question, we examined users' proxemic behavior. We had the users walk around the IVE and examine an embodied agent. We had two conditions in this study. In the self condition, people walked around an agent embodied with their virtual self. In the other condition, people walked around an agent embodied with a virtual other. Unbeknownst to the user, we constantly recorded their position in the room in order to measure the amount of personal space they left between their physical body and the agent embodied with their virtual self. Previous research has demonstrated that people traversing an IVE leave appropriate amounts of personal space between themselves an unfamiliar agent [3]. However, if the agent is familiar to a user, if in fact that agent is embodied with the user's virtual self, does the user still feel the need to maintain the appropriate amount of personal space? This question, one which never had the mechanism or the motivation to be studied before the advent agent technology, was our focus here.

Subjects arrived at the lab one at a time for a one-hour session. We immediately took their pictures and began stitching their photographs together. During the stitching process (which took approximately 20 minutes to complete), subjects completed a biographical questionnaire.

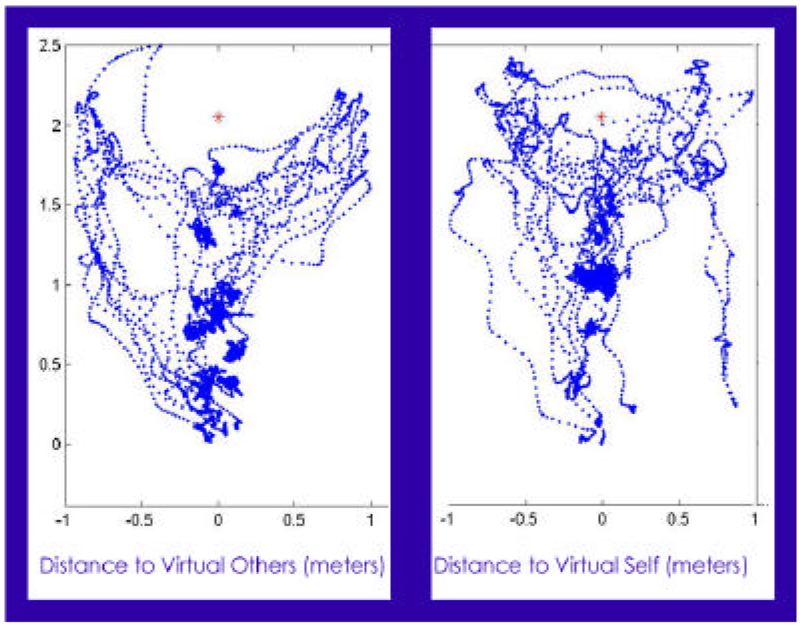
We then immersed the subjects in a virtual environment that contained a floor and a virtual agent. Figure 3 illustrates the setup; here we have inserted a photograph of an actual participant into the rendered scene in order to illustrate the scale of the room. However, the subjects could not see themselves wearing the HMD; they could only see virtual agent.

The virtual eyeheight of the participant was set to 1.7 m, which was also the exact

height of the agent's eyes. We used the same generic body for all subjects. As Figure 3 illustrates, the body was always covered by a loosely fitting robe. We focus on the head and face because we believe that a majority of a person's identity is captured in that region. Furthermore, modeling the entire body would be too time consuming and difficult to do in a single experimental session using our current methods.

The usable tracking space in the physical room was approximately 3m x 3m. When the subjects entered the virtual room, they were approximately 1.5m away but facing the agent, who was also initially facing the subjects. We instructed subjects to walk to the left side of the agent, then to the right side of the agent, and then to the front of the agent.

There were 16 subjects in the study; eight of whom walked up to their virtual selves and eight of whom walked up to a virtual other (a control condition). The model used to embody the agent in the virtual other condition was always the same gender as the subject, and was chosen from a pool of models of people unfamiliar to the subjects. As a further control, subjects in the virtual other condition also had their pic-



tures taken and their faces made into virtual models. Both types of agents—self or other—exhibited the same behaviors, namely blinking and head-turning. All subjects received partial course credit for an introductory psychology course for participation.

The computer system sampled the subjects' position at a rate of approximately 8 hertz. Each sample measured the subjects' position in the virtual room, and we computed the distance obtained between the participant and the center-point of the virtual agent's head during each trial. Subjects had no problems navigating (i.e., physically walking) through the virtual space and none experienced any significant simulatorsickness. After the study, none of the subjects indicated that he or she had guessed their proxemic behavior was under scrutiny.

We measured personal space, our index of social influence, by using minimum distance, the shortest distance that a given participant maintained between themselves and the agent across trials. Our previous studies on proxemics in IVEs also utilized this measure.

We hypothesized that virtual selves would be perceived as more intimate and therefore subjects would not feel the need to maintain as high a level of personal space between their virtual selves as between virtual others. This is exactly what we found. Subjects went much closer to their virtual selves (M = .23 m, SD = .15) than to the virtual others (M = .51 m, SD = .19), $F(1,14)=11.23$, $p<.005$. Figure 4 shows plots of the position samples in the two conditions. Clearly, the bubble of personal space is much larger around the agent embodied with the virtual other than around the agent embodied with the virtual self.

Importantly, the current study replicates the size of the personal space bubble (about half a meter) that has been established in previous research on agents in virtual environments with respect to virtual others. The current data provide a notable exception in the case of virtual selves; here subjects do not leave a large personal space bubble between their physical bodies and their virtual selves.

This result makes sense given the past research on personal space. The size of the personal space bubble between two people gets is inversely proportional to the level of intimacy [1]. When people identify aspects of themselves in an otherwise autonomously behaving agent, we conclude they experience increased levels intimacy with the agent and are therefore willing to reduce the personal space bubble.

In addition to measuring their personal space, we also verbally administered a ratings questionnaire while they were immersed with the agent. The questionnaire is shown in the Appendix, and measures self reported social presence (i.e., the degree to which people report being in the presence of a veritable human being), affect towards the agent, and finally, how willing they would be to perform a series of embarrassing acts in front of the agent.

To measure affect, we averaged questions seven and eight from the Appendix. There was a trend for people to show positive affect towards the agent embodied with their virtual self (M = .50, SD = 1.40) and negative affect towards the agent embodied with the virtual other (M = -.37, SD = 1.18), however, due to the small number of subjects in this study, this difference was not statistically reliable. To measure social presence, we took a summation score of the first six questions from the Appendix. Positive numbers indicate high social presence while negative numbers indicate low social presence. According to their verbal report, people experienced no reliable difference in social presence in the two conditions, with a mean score of -1.95 (SD = 6.00) for the virtual self and -2.04 (SD = 6.85) for the virtual other.

Perhaps the most interesting data from the questionnaires is the willingness to perform an embarrassing act. We took a summation score of the last four questions from the Appendix; positive numbers indicate willingness to commit an embarrassing act (i.e., change clothes or tell secrets to the agent) while negative numbers indicate unwillingness to commit an embarrassing act. Subjects were more willing to commit an embarrassing act in front of an agent embodied with their virtual self (M = 4.25, SD = 3.11) than in front of an agent embodied with a virtual other (M = .13, SD = 5.11), $F(1,15)=3.80$, $p<.07$. Clearly, our subjects were experiencing a unique relation with the agent embodied with their own representation if they were willing to change their clothes in front of it! In other words, the subjects experienced a lesser degree of self-consciousness in front of their virtual self than in front of the virtual other.

3.2 Study 2: Agent Mortality

In the first study, we demonstrated that people exhibit unique nonverbal behavioral affinities towards an agent embodied with their virtual self. In the second study, we sought to answer the following question: Are the ties that people form with their virtual selves strong enough to elicit negative responses when those virtual selves are destroyed?

In the second experiment, we recruited people from the community and embodied agents with their virtual selves. As a cover story, we told them we were creating a permanent archive to store three-dimensional versions of people. We then had two conditions: a mortality and a control condition. In the mortality condition, we feigned a computer crash and deceived subjects by convincing them we had lost their virtual selves. In the control condition, we kept the version of their virtual selves. We then compared the two groups on a number of measures to gauge their reaction to the "loss" of their virtual selves.

We recruited subjects from our second study by putting an advertisement in the local newspaper, offering to pay subjects to put themselves into our virtual three-dimensional database. The purpose of doing this was to ensure that our subjects were highly motivated to have their virtual selves created. In other words, if someone was willing to answer an advertisement in the newspaper and drive out to campus, then we could assume that they were at least moderately excited at the prospect of having a virtual self. An unanticipated benefit of this recruitment strategy was that we had large amounts of diversity in age (M = 35, Min =21, Max =58) and occupation.

This study was very similar to the first one, in that subjects came into the lab, posed for photographs, and waited while we built virtual versions of them. We constructed the virtual self and animated the embodied agent in exactly the same way as in the first study. In the mortality condition, while the subjects were navigating about the IVE and interacting with their virtual self, we feigned a computer failure and convinced the subjects that we had not only crashed our system, but also had lost all traces of their virtual selves. We then administered a number of questionnaire-based measures of attitude change and self-esteem. In the control condition, subjects traversed through the IVE with the agent embodied with their virtual selves and then filled out the same attitude and esteem measures (without being led to believe their representation had been destroyed). There were 30 subjects in the study, 15 in each of the two conditions.

The results demonstrated no difference between the two conditions. In other words, subjects were not upset by the loss of their virtual self. First, there was no difference between attitude ratings concerning virtual people or virtual environments. Second there was no change on self-esteem scales between the two conditions. Third, anecdotally, subjects in the virtual mortality condition did not display any strong reactions or regret to the loss of their virtual representation.

Certainly there are limitations to this study. One problem is that our subjects only became acquainted with their virtual selves for about an hour before the virtual mortality occurred. In order to understand the relationship between a person and her virtual self, a study needs to allow subjects to become more attached to their three-dimensional representations. Future studies should examine users' interaction with their virtual selves in more detail. Nonetheless, the current study provides a worthy starting point for examining the nature of one's regard for her personal self. The current data suggest that the loss of such a representation is not a particularly devastating event.

4. Conclusions

In the current set of studies, we begin to examine the nature of human behaviors in the presence of agents, specifically ones embodied with the head and face of the users. Study 1 shows that people do exhibit a unique relationship with agents embodied with their virtual selves. First, we demonstrated nonverbal behavioral evidence: users were willing to violate those agents' personal space (but not other agents' personal space). Second, we demonstrated evidence from questionnaires: on ratings scales, users indicated that they would be more willing to commit embarrassing acts in front of an agent that resembles themselves than in front of an unfamiliar agent. In Study 2 we qualified this effect, saying the ties that users created between themselves and their virtual selves were not so strong to suggest that the loss of the virtual self was in any way traumatic.

These studies are only an initial foray towards understanding the virtual self. In the future, we would like to model the virtual self behaviorally, as opposed to photographically. There is a growing body of work that describes techniques to tailor the behaviors and gestures of agents [2,5]. Future endeavors along the lines of the current studies should examine embodied agents whose gesture sets and behavioral personalities are tailored towards specific users.

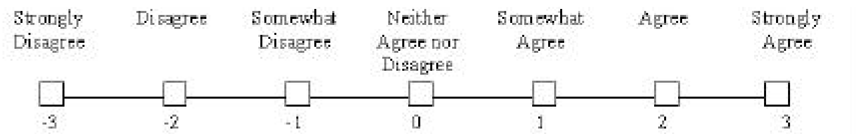
The personal space findings from the current study replicate a number of previous studies described in the Introduction. In previous studies, we featured a number of different experimental tasks in attempt to induce our subjects to violate the personal space of an agent. For example, we tried putting small labels on the agents' shirts that the subjects had to memorize. However, subjects consistently left a bubble of about half a meter around the agent, despite the realization that they may perform poorly on the task. But in the current study, subjects had absolutely no problem violating the personal space of agents when those agents looked like themselves. We hypothesize that the reason subjects were willing to come so close to their virtual self stemmed from some kind of implicit familiarity or intimacy. In the same way one does not necessarily feel the need to respect the personal space of his significant other, he doesn't feel the need to respect the space of his virtual self.

These findings certainly have implications towards both educational and commercial systems employing embodied intelligent agents. Agents who are trying to forge some kind of a relationship with the user may be more successful if they look like the user. Along the same lines, users should be wary of agents who wear their face, as these agents may unwittingly elicit preferential treatment from a user.

References

1. Argyle, M. (1988). *Bodily communication* (2nd ed.). London, England UK: Methuen.
2. Badler, N. I., Chi, D. & Chopra, S. (1999). Virtual human animation based on movement observations and cognitive behavior models. In *Proceedings of SIGGRAPH'99*: p. 1-17.
3. Bailenson, J.N., Blascovich, J., Beall, A.C. & Loomis, J. (In Press). Equilibrium revisited: Mutual gaze and personal space in virtual environments. *PRESENCE*.
4. Blascovich, J., Loomis, J., Beall, A., Swinth, K., Hoyt, C., & Bailenson, J.N. (In Press). Immersive virtual environment technology as a methodological tool for social psychology. *Psychological Inquiry.*
5. Cassell, J. & Vilhjalmsson, H. (1999). Fully embodied conversational avatars: Making communicative behaviors autonomous. *Autonomous Agents and Multi-Agent Systems, 2, 45-64*.
6. Gibson, W. (1984). *Neuromancer*. New York : Ace Books.
7. Heeter, C. (1992). Being there: The subjective experience of presence. *PRESENCE ,1(2)*, 262-271.
8. Isbister, K., Nakanishi, H., Ishida, T. & Nass, C. (2000). Helper agent: Designing an assistant for human-human interaction in a virtual meeting space. *Proceedings of ACM CHI 2000 , v.1*, 57-6
9. Rickenberg, R. & Reeves, B. (2000). The effects of animated characters on anxiety, task performance, and evaluations of user interfaces. *Proceedings of ACM CHI 2000, v.1*, 49-56
10. Reeves, B. & Nass, C. (1996). *The Media Equation: How People Treat Computers, Television, and New Media Like Real People and Places.* Cambridge: Cambridge University Press.
11. Sannier G. & Thalmann, M. N. (1998). A user friendly texture-fitting methodology for virtual humans. *Computer Graphics International '97*, 1997
12. Swinth, K. R., & Blascovich, J. (2001, June). Conformity to group norms in an immersive virtual environment. Hot Topic Paper presented at the annual meeting of the American Psychological Society (APS), Toronto, Ontario.
13. Zahorik, P., & Jenison, R. L. (1998). Presence as Being-in-the-World. *Presence, 7*, 78-89

Appendix



How much do you agree with each of these statements?

_____ 1. I perceive that I am in the presence of another person in the virtual room with me.

_____ 2. I feel that the person in the virtual room is watching me and is aware of my presence.

_____ 3. The thought that he (or she) is not a real person crosses my mind often.

_____ 4. The person appears to be sentient (conscious and alive) to me.

_____ 5. I perceive the person as being only a computerized image, not as a real person.

_____ 6. I feel that the person in the virtual room would be able to experience pain.

_____ 7. I like the virtual person.

_____ 8. I think the virtual person is attractive.

_____ 9. If nobody else was in the physical room, I would be willing to sing the national anthem in front of this virtual person.

_____ 10. If nobody else was in the physical room, I would be willing to change clothes in front of this virtual person.

_____ 11. If nobody else was in the physical room, I would have no problem telling personal secrets to the virtual person.

_____ 12. If nobody else was in the physical room, I would be upset if the virtual person noticed something stuck in my teeth.