Attitudes in Virtual Reality

Jim Blascovich and Cade McCall

Department of Psychology and

The Research Center for Virtual Environments and Behavior

University of California, Santa Barbara

To appear in: Forgas, J., Crano, W. & Cooper, J. (Eds.). Attitudes and persuasion.

Attitudes in Virtual Reality

Rapid and continuing enhancements of digital virtual reality technologies have important implications for research in social psychology. These advancements provide behavioral scientists, including social psychologists, with continually improving and increasingly powerful digital technology-based media and measurement tools that can be used for research, especially experimentation. These tools increase the power and reach of social psychology’s empirical methods, bolstering both the internal and ecological validity of our experiments and quasi experiments (Blascovich et al., 2002; Loomis, Blascovich, & Beall, 1999).

Additionally, open-to-the-public digital virtual venues, such as Facebook©, MySpace©, Second Life©, etc., as well as private ones, provide new “worlds” for everyday social interactions. An ever-growing and substantial proportion of the world’s population is spending more and more time interacting with each other, thereby creating increasingly important societal venues about which relatively little has been studied and little is known by social psychologists and other scientists (but see Boellstorff, 2008, for an exception). Hence, knowledge of social influence and social interaction processes within digital virtual worlds is relatively scarce, resulting not only in meager understanding of increasingly important social milieus but also providing a new challenge regarding the generalizability of research results.

In this chapter, the substantive focus is on the operation and measurement of attitudes and persuasion. Although attitudes toward virtual reality or any of its many ramifications will not be discussed, this chapter may help shape or change attitudes toward virtual reality among attitude researchers.

What is virtual reality?

Scholars have debated the nature of reality for ages. Analogously to how philosophers of mind and others divide the study of consciousness into “hard” and “simple” consciousness problems (Chalmers, 1995; i.e., “What is consciousness?” and “What are the types of consciousness?” respectively), we suggest that the study of the nature of reality can be divided similarly. Consequently, one might label the question, “What is reality?” as the “hard” or difficult problem and the question, “What are the types of reality?” as the “simple” problem. However, as implied below, it is not clear which question is really the more difficult one.

In contrast to the continuing struggle and debate among interested scholars over the hard consciousness problem, many scholars from many fields concerned with the question, “What is reality?” agree that what people think of as reality is an hallucination; that is, a cognitive construction. Together with religious gurus and mystics, philosophers (Huxley, 1954) and experimental psychologists (e.g., Shepard, 1984), maintain that perceptions are invariably idiosyncratic hallucinations, albeit often assumed and treated as collective. Perceptions can be thought of as hallucinations in at least two ways. The first is that what people perceive via input from the senses are impoverished and mentally constructed representations of external environments. The second is that people perceive things that do not exist in external environments.

Philosophers of mind and psychologists do not appear to be struggling as much with the simple consciousness problem and describe a tripartite division of consciousness into unconscious, conscious, and metaconscious categories (Blascovich, in press; Schooler, 2002). The same is not true for those distinguishing among levels of reality.

Hence, slower progress has been made by scholars, including virtual reality researchers, regarding the problem, “What are the categories of reality?” or, “What is real?” Problematically, simply asking the question, “What is real?” relies upon the assumption that there are things that are not real or what some would label “virtual.”

Like people who claim not to know anything about art, but know what they like, many people who don’t know metaphysics “know” what is real and what is virtual. Or, do they? Is the real world what people think it is? The answer is “no” if they think it is some stable objective external reality that they see, hear, touch, smell and taste. The answer is “yes” if they realize that the real world is only a cognitive construction.

Our position is that perceptions (i.e., hallucinations) of environments are categorized as “real” or “virtual” on the basis of what we invoke and label as the principle of *psychological relativity* (Blascovich & Bailenson, in press; Laming, 2003). Analogous to Einstein’s theory of special relativity regarding time and space, psychological relativity theory states that what is mentally processed (i.e., perceived or thought of) as real and what is mentally processed (and thought of) as not real (i.e., virtual) depends on one’s point of view. People contrast a particular “grounded reality”—what they believe to be the natural or physical world—with other realities they perceive—what at times they believe to be imaginary or “virtual” worlds. However, what is thought to be grounded reality and what is thought to be virtual reality is often muddled or even reversed. Novelists and screen writers illustrate the relativity of virtual to grounded reality quite well in novels like *Snow Crash* (Stephenson, 1992) and *Neuromancer* (Gibson, 1984) and in movies like *The Matrix* and *The Truman Show*.

However, one need not rely solely on science fiction examples. Humans have the same experience as “Neo” or “Truman” every day. For example, during dreams, sleeping humans are often convinced that their dream worlds are their grounded reality, sometimes pleasurably, sometimes unpleasurably. Only when sleepers awaken are they upset or relieved that it wasn’t so. As another example, consider religious beliefs. More than 75% of the earth’s people report a belief in a “supreme being” of various types (Gallup International, 2009). Religious people profess that they believe the physical world itself to be a virtual world created by this supreme being. Furthermore, the physical world is described in some testaments as a sort of testing ground to triage individuals for placement after death in absolute or grounded reality of one sort (e.g., heaven) or another (e.g., hell).

Humans are clearly neurophysiologically wired to travel mentally back and forth between grounded and virtual realities as well as among virtual realities themselves. Humans not only dream during sleep, they (day) dream while awake. Human minds wander often and effortlessly from grounded reality (e.g., Klinger, 1978; Schooler & Smallwood, 2006) to somewhere else. Undoubtedly, mind wandering serves some adaptive function (but discussion of what function is not in the scope of this chapter). Furthermore, although enjoying endogenous capabilities to do so, humans have developed media tools, starting with language-based story telling, to graphic arts, to theatre, to manuscripts and printed books, to photographs and movies, to radio and television, and most recently to digital media, that augment their human ability to travel mentally between their grounded and virtual realities.

The most sophisticated current version of the latter, digital immersive virtual environment technology (IVET) allows people to relatively easily and inexpensively put themselves or others in “The Matrix,” so to speak, for a variety of purposes. One purpose, as social psychologists espouse, has been to experimentally manipulate or observe social influence processes and social interactions within those contexts. This is not a new idea. Rather, it is an old one combined with a newer and more powerful technology than was available when social psychologists had to construct experimental scenarios (i.e., virtual environments) with words (e.g., the ubiquitous vignette) instead of graphics, with actors (e.g., confederates) rather than digital agents, or with hardware (e.g., Haney, Banks & Zimbardo’s prison, 1973) rather than software.

In sum, the rapid and continuing advancements of digital virtual reality technologies have important implications for social psychology on two major fronts. First, these technological advances continue to provide investigators with new media technology-based laboratory research tools that increase the power of our empirical methods with regard to both internal and external validity concerns. Second, these advances are creating new highly populated three-dimensional “worlds” (e.g., Second Life©, World of Warcraft©) for social interactions. Data reveal that an ever increasing and already substantial proportion of the world’s population is spending more and more of time interacting with each other via digital virtual reality media technology. At the time of this writing nearly one-quarter of the world’s population (approximately 1.6 out of 6.7 billion; Internet World Statistics, 2009) are networked via the internet. Consequently, virtual realities are becoming more and more important social venues in raising external validity concerns because what is generalizable in the physical world might not be in digital virtual ones.

Strong arguments can be made that if the “situation” in Lewin’s “person x situation topology” (Lewin, Heider, & Heider, 1936) is a virtual one, the operation of fundamental social influence processes including attitudinal ones needs to be examined more closely. Virtual environment technology, in particular, provides people concerned with attitudes (e.g., researchers, marketers, politicians) not only with increases in power to assess attitudes unobtrusively but to change them covertly.

Virtual Reality Technology

Throughout human history, people have developed technologies to help their minds travel between grounded and virtual realities. These mind augmenting technologies include ones that stimulate virtual experiences endogenously, such as pharmacological agents ranging from mind expanding herbal (e.g., cannabis) and plant (e.g., peyote) extracts to mind altering manufactured drugs like lysergic acid diethylamide (LSD) and chlorpromazine (Thorazine). Importantly, for our purposes here, these technologies also include a long history of ever improved media communication tools that operate exogenously.

Over the millennia, humans have developed communication media tools to facilitate social interaction via shared symbols and meaning. These tools have also expanded the communicative reach of individuals both in space (i.e., to geographically distant others) and in time (i.e., to future generations). Perhaps the first such media tools supporting mental virtual experiences was story-telling, invoking in listeners a semantic framework facilitating a more or less common mental experience. The first physical evidence of mediated communication comes from bone carvings and cave paintings, emerging as far back as 45,000 B.C. (Fang, 2008) These early graphic representations were followed by increasingly elaborate means of representation. Playwrights combined story telling and graphic representations via human actions and scenery to form theatre. Language recorded via hieroglyphics and later alphabet based words led to manuscripts and eventually, with the invention of movable type, to mass produced printed books. Nearly two centuries ago, still photography arrived, followed a century later by motion pictures. By the late 1800s, the "domestication" of electricity led to startlingly more powerful media including the telegraph and the telephone. Invention of the vacuum tube led to the invention of radio, television, and the first computers. Later, invention of the transistor and other solid state devices led to the miniaturization of computers and the multitude of digital media tools humans have at their disposal today.

All of these technological advances in communicative media reflect the inherent human propensity to travel someplace other than grounded reality. They are the psychological analog of the invention of the wheel. Most advances in media technology are taken for granted. Consider the telephone. If one asks a friend, "Who are you talking to on the telephone?" he might reply, "A friend." Technically, this answer is incorrect. Indeed, most people forget that the voice they hear on a phone is not actually another person's voice. Rather, today, it is a continuously digitally tracked and rendered facsimile of that voice. The fidelity of the auditory renderings is usually good enough so that we never think that we are interacting with an auditory avatar of the person with whom we are speaking rather than the person himself or herself. Digital immersive video technology is beginning to provide levels of visual fidelity akin to the fidelity of the telephone, and social interactions in digital virtual worlds will soon be as "real" as a telephone conversations are today.

The Concept of Attitude

The concept of attitude has an interesting etymological history. It has been and is used both as a psychological and a positional (i.e., navigational) term in a somewhat related way. Modern usage of the term "attitude" stems from a 17th century Italian term, "*attitudine*," meaning disposition (in the physical sense) or posture. In the 18th century, attitude took on its psychological meaning as "a posture of the body supposed to imply some mental state." A century later it took on its association with emotion and beliefs as "settled behavior reflecting feeling or opinion" (cf. Harper, 2001). In the 19th century, Darwin introduced the notion that attitudes are embodied in movement and expressions (Darwin, 1873). In the 20th century, Hall (1963) introduced the notion of proxemics or the study of personal space and distances, relating proxemic behavioral movements to constructs including attitudes especially ones involving affect or liking. Because a survey of definitions of attitudes is not our main purpose here, and at the risk of oversimplification and without prejudice toward other definitions, we adopt Fazio's (1990) general definition of attitudes; that is, the association between an object and its evaluation, where "object" refers to perceived objects or abstractions.

This chapter contains the first aggregation, albeit non-exhaustive, of studies involving attitude research in virtual reality of which we are aware. Here, we describe our own and others' research involving attitudinal processes in virtual environments. The foci here include implicit (e.g., proxemic and physiological) and explicit (e.g., self-report) attitude measurements and the implicit manipulation of attitudes within digital immersive virtual environments.

Attitude Assessment

Social psychologists and others have a long history of interest in the study and measurement of attitudes. Indeed, many self-report questionnaire and scaling techniques were originally developed to assess attitudes, including classic techniques originally described by Thurstone (1928), Guttman (1954), Likert (1932), and Osgood, Suci, and Tannebaum (1957). However, even as these techniques were being developed, the accuracy of self-report-based techniques became suspect when attitude-behavior discrepancies appeared, particularly regarding attitudes toward minority racial groups (e.g., LaPierre, 1934). By the 1980s, implicit physiological measures of attitudes, at least insofar as the association of attitudinal objects with affect, were validated (e.g., Cacioppo, Petty, Losch & Kim, 1984). The interplay between the automatic activation of attitudes and conscious control was examined (cf. Devine, 1989) and implicit attitudinal measurement techniques (e.g., Nosek, Greenwald, & Banaji, 2007; see Wittenbrink & Schwarz, 2007, for others) rose to the forefront of attitude measurement.

Measuring Attitudes in Virtual Reality.

Implicit proxemic indicators (e.g., interpersonal distance, personal space, head orientation) of attitudes preceded the appearance of implicit measures based on the relationship between associations of objects and evaluations and response times by more than two decades (Hall, 1963). However, difficulties associated with the recording and scoring of proxemic measures in even the simplest physical experimental venues proved too cumbersome for most researchers. Given that it is inherent to digital immersive virtual environment technology that all spatial relationships and movements of both animate and inanimate objects are tracked (and rendered) in real time very precisely (i.e., spatial accuracy within a millimeter and temporal accuracy within 40 milliseconds), a plethora of highly accurate spatial-temporal measures (e.g., interpersonal distance, velocities, accelerations, decelerations, etc.) are automatically scored and available online to investigators (see Blascovich et al., 2002 for a review). We and others have found such proxemic measures exquisitely sensitive to object-evaluation associations; that is, attitudes. Additionally, the use of digital immersive environment technology does not exclude implicit peripheral neurophysiological measures including ones associated with attitude assessment. We describe examples of these below.

Finally, digital immersive virtual environment technology does not exclude subjective, self-report types of attitude assessments. Indeed, experience time sampling measures are particularly appropriate using digital immersive virtual environment technology as research participants can be placed in ecologically realistic virtual environments for relatively long periods of time. In fact, the researcher can structure immersive virtual environments to include specified social circumstances, which might be hit or miss in naturalistic field studies, thereby assuring the occurrence of circumstances of interest. Hence, research participants can be prompted at precisely identified occurrences of specific contexts. For example, participants can be signaled via a semitransparent open ended question or Likert-type scale to which they can respond vocally or gesturally (e.g., pointing to a scale point).

Virtual Reality-Based Attitudinal Studies involving Implicit Measures.

We turn now to a review of several research studies conducted in our own and others' immersive virtual environment-based laboratories. This review is divided into two sections: studies aimed primarily at attitude assessment and studies aimed primarily at attitude manipulation. Within the first of these sections, we describe studies involving implicit (i.e, proxemic and physiological) attitudinal measures and operationalizations. Although there are also many studies in which explicit, self-report measures are utilized, such studies tend to be associated more with implicit attitude manipulation and are reviewed in the second section.

Proxemic Assessments of Attitude

Our initial forays into empirical work involving digital immersive virtual environment technology (IVET) involved implicit measures of people's associations of sentience or "humanness" with the depiction of human-like representations. In virtual reality terminology, digital representations of humans typically take one of two forms: avatar or agent. "Avatar" is defined as the digital representation of an actual human being, typically in real time, and "agent" is defined as the digital representation of a computer algorithm (i.e., a sort of artificial intelligence), typically, operating in real time (Bailenson & Blascovich, 2004). Although representations in either case can be other than visual (e.g., auditory), here the focus is on visual or graphic representations.

Based on Blascovich et. al.'s (2003) model of social influence within immersive virtual environments, Bailenson, Blascovich, Beall and Loomis (2003). investigators focused on the association of sentience and digital human-like representations. More specifically, they investigated whether such associations would vary as a function of two factors: first, whether the digital human-like representations were believed to be avatars or agents by participants; and second, as a function of whether or not the digital human-like representations exhibited human-like non-verbal (i.e., movement) behaviors. Interpersonal distance served as the primary proxemic implicit measure of the association between sentience and the digital human-like representations.

The avatar/agent manipulation was accomplished by informing the participants that the representations were either actual online digital representations of actual humans or of agents. They hypothesized that research participants would be more likely to respect the personal space bubble (cf. Sommer, 1969) of avatars (i.e., online representations they thought were actual humans) independently of their human-like movements, but would respect the personal space bubble of agents as a function of the realism of their human-like movements and non-verbal signals. In the first experiment, participants approached standing virtual human representations that varied in their movements including those associated with gaze. In the second experiment, the virtual human representations approached standing participants.

The results of the first experiment revealed that as participants walked toward the digital human representations they maintained patterns of interpersonal space around those they thought to be avatars quite similarly to the patterns reported in human studies in the past. However, participants respected the personal space bubble of digital human representations they thought to be agents only if the agents displayed naturalistic mutual gaze behavior. The results of the second study, in which the digital human representations approached stationary participants, indicated that participants were more avoidant of the agent than avatars in terms of personal space. Moreover, their degree of avoidance correlated with the strength of their emotional reaction for both agents and avatars. Together these results point to the naturalistic quality and operation of proxemics when others in digital immersive virtual environments are avatars. However, agentic (i.e., algorithmic) behavioral attributions complicate the picture requiring naturalistic communicative, in this case nonverbal gaze, behavior to produce the same effect.

Most importantly, these studies suggested strongly that proxemic data collected in digital immersive virtual environments could be used to assess attitudes. Below we review several examples of such use.

McCall, Blascovich, Young and Persky (2009). More recently, these researchers utilized implicit proxemic indexes to assess prejudice and overt aggression towards Black and White male agents in a digital immersive virtual environment. The experiment consisted of two tasks. In the first, participants were instructed, similarly to the proxemic study described above, to approach and walk around each of two agents with whom they would subsequently engage in a gun fight. The gun fight was the second task. The two conditions in the experiment were based on the apparent race of the agents, African-American or Anglo-American.

During the first task, the interpersonal distance that participants maintained from the agents as well as the degree of gaze avoidance participants exhibited while approaching the agents were recorded. During the second task, participants and agents engaged in shooting and hiding (behind virtual barriers) behaviors in the immersive virtual shooting room. Participants were given points for successfully hitting the agent targets and lost points when they were hit by the agents' gunshots.

Results indicated that both the interpersonal distance participants maintained between themselves and agents as well as the degree of gaze aversion during the first task predicted aggressive gunshots toward African-American but not Anglo-American agents. McCall et al. interpreted the interpersonal distance and gaze avoidance behaviors in the first task as proxemic indicators of racial attitudes, ones consistent with their subsequent shooting behavior.

Dotsch and Wigboldus (2008). These researchers also examined intergroup attitudes using immersive virtual environment technology and proxemic behaviors. More specifically, they examined the relationship between participants' implicit negative associations toward Moroccans and participants' subsequent proxemic behaviors around them. Native Dutch participants were immersed in a digital virtual environment in which they encountered digital avatars with either White or Moroccan facial features. Participants maintained greater interpersonal distance when approaching Moroccan as opposed to White avatars. Participants' implicit negative associations with Moroccans moderated both effects. Dotsch and Wigboldus concluded that their data "demonstrate how prejudiced implicit associations may unintentionally lead to impulsive discriminatory responses."

Gillath, McCall, Shaver, & Blascovich (2008). This research team examined participants proxemic behaviors as they walked up and down a virtual street full of shops and populated with human-appearing agents, some of which were apparently in need of help. Participants' proxemic behaviors (interpersonal distance and gaze avoidance) toward virtual agents in apparent need of help were negatively (i.e., closer distances and less gaze avoidance) related to their pre-assessed dispositional degree of compassion and tendency to experience personal distress. No relationship was found between interpersonal distance and gaze avoidance toward virtual agents without need of help.

Physiological Assessments of Attitude

Blascovich, Hurst & McCall (under review). These investigators examined stigma in an immersive virtual environment. On the basis of Blascovich's biopsychosocial model of challenge and threat (Blascovich, 2008; Blascovich & Mendes, 2000; Blascovich & Tomaka, 1996), numerous studies employing implicit peripheral neurophysiological markers (e.g., Blascovich, Mendes, Hunter, Lickel & Kowai-Bell, 2001) demonstrate that when an individual interacts with a stigmatized other, even cooperatively, that individual is threatened as evidenced by the threat pattern of cardiovascular responses (i.e., increased heart rate and increased ventricular force couple with little change in cardiac output and increases in total peripheral resistance). In this study, it was reasoned that if the threat response to stigma is automatic, then participants should exhibit cardiovascular responses indicative of threat when they interact with stigmatized avatars (digital representations) representing people who weren't themselves stigmatized physically.

The experiment consisted of two parts. During the first part, female research participants met a same sex participant (actually a confederate) physically when they arrived at the lab. The confederate either physically bore a facial stigma (i.e., a "port wine" facial birthmark) or did not. In the second part, the participant and the confederate entered a shared digital immersive virtual environment where they sat at the same virtual game table and played a cooperative word-finding game. The experimental manipulation was whether or not the confederate's avatar bore the facial birthmark in the virtual world independently of whether she bore it in the physical world. Hence a classic 2 x 2 design was utilized.

The results indicated that during the first minute of game play in the immersive virtual environment, participants were threatened (as indicated by the threat pattern of cardiovascular responses) only if the confederate bore the birthmark physically independently of whether she bore it in the immersive virtual environment. Importantly, by the fourth minute of game play, participants became threatened only if the avatar bore the birthmark in the virtual environment independently of whether she bore it physically, and became challenged if she did not bear it virtually.

These data not only demonstrate the feasibility of peripheral neurophysiological assessment of attitudes in immersive virtual environments, but provide an important demonstration of the utility of assessing changes in attitudes implicitly over time. Interestingly, the change in attitude had to have been somehow caused by the increasingly compelling nature of the virtual experience over time and clearly point toward automatic processes at play.

Attitude Manipulation involving Implicit Processes

As social psychologists know, there are many routes to attitude change or persuasion. Some are explicit and both persuader and target are aware of the attempt. But others factors are hidden as Vance Packard pointed out many years ago (1957). Debate has waxed and waned over the efficacy of so-called persuasive subliminal or unreportable messages (auditory and visual) over the years, but the current zeitgeist suggests that such techniques work. Like other media, digital virtual technology can easily accommodate such techniques.

However, there are implicit techniques that are unique to digital virtual technology, especially the immersive variety. These techniques are labeled “transformed social interactions” or “TSIs” (Bailenson, Beall, Blascovich, Loomis & Turk, 2005). The power of TSIs rests on unique aspects of the technology. As described above, all movements, speech, etc. must be tracked with a high degree of precision by various devices so that they can be rendered quickly and accurately in immersive virtual environments.,

However, it is not necessary that the computer be programmed to veridically render images. Rather, algorithms can be added to alter the renderings. For example, when a person being tracked looks left, the computer can transpose the rendering so that his avatar looks right. When a person being tracked is sitting, the computer can render the avatar to be standing. Furthermore, the graphic representations of an individual’s avatar need not be the one he has chosen or of which he is aware. Individuals’ avatar movements can be rendered in ways that take account of others’ movements and behaviors as well as their preferences so that an individual’s avatar appears differently to different others in the virtual environment. Hence, people’s avatars can become chameleons taking on nonverbal attributes for different interactants..

Combined with what social psychologists and others know about attitude change and persuasion, the TSI capabilities of digital virtual reality technology advances a potentially powerful set of implicit persuasive applications. Do they work? In a word, “yes”. Are they ethical? Some probably are and some probably are not. Here we review pioneering work on TSIs.

<u>Bailenson, J. N., Beall, A. C., Loomis, J., Blascovich, J., & Turk, M. (2005).</u> These investigators examined augmented or non-zero sum gaze, a TSI in which a selected participant’s head and eye movements are transformed by an algorithm that renders his or

avatar's gaze directly and simultaneously at the eyes of multiple others' avatars whose own head and eye movements are being rendered veridically in terms of the movement of the person they represent. Hence, each of the others perceives that the transformed interactant is gazing back only at him or her. In the reported study, a presenter read a persuasive passage to two listeners under various transformed gaze conditions, including augmented gaze. Consistent with the argument that women are more sensitive to non-verbal behaviors of others than men, the results showed that women agreed with a persuasive message more during augmented gaze than other gaze conditions.

Guadagno, Blascovich, Bailenson, and McCall, C. (2007). These researchers examined whether persuasive messages could be delivered by known agents (i.e., computer simulations). More specifically, they investigated whether participant attitudes would change toward positions advocated by an ingroup member even if the latter was known to be an embodied agent (again, a humanlike representation of a computer algorithm). In their first study, immersed participants listened to a persuasive communication from what they thought to be an avatar of another student. The latter was actually an embodied agent (again, a computer-controlled digital representation of a human), whose apparent gender was manipulated.

The results revealed an ingroup favoritism effect such that there was more persuasion when the communication was delivered by a same gendered virtual human representation. In study 2, the investigators manipulated gender of the digital representation, communicative movement realism, and agency; that is, whether the digital representation was believed by participants to be an actual avatar or an agent. Specifically, virtual human representations high in communicative realism were more persuasive and, as in the first study, this effect was moderated by the gender match of the virtual human and the research participant. Agency was not a significant factor.

Yee and Bailenson (2006). These investigators argued that immersive virtual environments provide people the opportunity to literally take the perspective of another person and, hopefully, reduce any negative stereotypes they may have toward that person or his or her group. In this study, Yee and Bailenson manipulated embodied perspective-taking by assigning elderly or younger avatars to participants. Their results indicated that negative stereotyping of the elderly was significantly reduced among participants who were given elderly looking avatars compared to those who were given younger looking avatars.

Bailenson and Yee (2005). In this study, participants interacted with an embodied agent in immersive virtual reality who verbally delivered a persuasive argument. The mimicry behaviors of the agent were manipulated such that the agent either was animated via mimicry of actual participants' head movements (at a 4-sec delay) or animated via mimicry of a prerecorded participant. Agents mimicking the actual participant with whom they were interacting were more persuasive and received more positive trait ratings than those mimicking a yoked participant. Participants were unable to explicitly detect the mimicry. Of note, this was the first research to demonstrate mimicry effects with a nonhuman, nonverbal mimicker, a confirmation of the automaticity of such effects.

Bailenson and Yee (2007). These investigators examined mimicry in a non-visual domain. More specifically, they investigated mimicry involving physical touch (i.e., haptics) by utilizing a mechanical force-feedback "handshaking" device and assessing the effects of such mimicry on participants' attitudes toward a partner. In this study, each of a pair of same sex participants shook hands with a force-feedback joystick that recorded their hand movements. Subsequently, the two participants then greeted one another via a virtual "hand shake" mediated by the force-feedback device. In each dyad, one participant received the other participant's virtual handshake. The other participant received his or her own virtual handshake back under the guise that it was the other person's handshake. Results demonstrated three effects. First, within participants, the position, angle, speed, and acceleration of their hand movements were highly correlated. Second, hand shaking characterististics differed in predictable ways by gender. Third, and most importantly, there was an interaction between gender and mimicry, such that male participants liked people who mimicked their handshakes more than female participants did.

Yee, Bailenson and Ducheneaut (in press). This team examined self-perception effects on individuals using immersive virtual environment technology, labeling such effects in virtual reality as "Proteus" effects. In previous work, the investigators demonstrated that participants randomly assigned taller avatars acted more aggressively than participants randomly assigned shorter avatars. In this investigation, the researchers examined Proteus effects in the online community, Second Life. In their first study, they found that both an avatar's height and attractiveness in an online game were significant predictors their performance. In a second study, they found that behavioral changes stemming from the virtual environment transferred to subsequent face-to-face interactions.

Fox and Bailenson (in press). These investigators also examined modeling and self-perception theory, this time examining the effects of self-modeling on change in attitudes toward healthy behaviors. In the first study, participants were randomly assigned to one of three conditions: vicarious reinforcement, in which participants watch their avatar gain or lose weight as the participants' physically exercised; no vicarious reinforcement in which their avatar did not gain or lose weight as they exercised; and a condition with no avatar. Later, in a voluntary phase, participants in the vicarious reinforcement condition performed significantly more exercise than those in the other conditions.

In the second study, the investigators manipulated contingency; that is, reward (weight loss) vs punishment (weight gain). They also manipulated model identity; that is, whether participants watched a virtual representation of themselves (VRS) or a virtual representation of an other (VRO). Results indicated that participants planned to exercise significantly more when they viewed the virtual representation of themselves, regardless of whether reward or punishment was shown.

In a third study, participants watched a VRS running on a treadmill, a VRO running, or a VRS loitering. Post-experimental surveys indicated that participants in the VRS-Running condition reported significantly higher levels of exercise than those in other conditions.

Bailenson, Iyengar, Lee & Collins (2009). Although this series of studies did not involve immersive virtual environment technology, its applicability to use in such technology is quite apparent.

In online voting preference studies, these investigators experimentally manipulated facial familiarity of political candidates. Their manipulation involved digital facial morphing, a technique in which two photographs of faces are combined in various proportions to produce a hybrid photograph. They compared voting intentions of participants after viewing political candidate photos (i.e., classic bust shots) that had been morphed for each participant either with that participant's own photo (secured in a unrelated priori study) or that of another voter.

In the first experiment, voter participants saw photographs of unfamiliar candidates for office morphed with either photographs of themselves or photographs of other voters. Results indicated stronger voter preferences, regardless of voter's political affiliation, for candidates morphed with the voter's photograph. Furthermore, participants proved unaware that their own photo was morphed with the target candidate's.

In the second experiment, conducted a week prior to the 2004 United States Presidential election, another national representative sample of voters saw photographs of familiar candidates (Bush and Kerry). Although strong party partisan voters were unaffected by the morphing manipulation, the voting preferences of weak partisans and nonpartisans leaned toward the candidate with whose photo their own face had been morphed. Similar results were found in a third study.

Summary

Digital immersive virtual environment technology (IVET) arrived on the scene in social psychology as a research tool just before the turn of the millennium. Its empirical value stems from natural human propensities for "psychological travel" or mind wandering abetted by a long history of media technologies to do so. A relatively small but growing cadre of social psychological researchers utilizing this technology have focused primarily on examining social influence and social interactional processes within ecologically realistic environments. More recently, researchers have begun to examine so-called transformed social interactions (TSIs) that the technology affords within the contexts of attitudes and persuasion. The results of their pioneering studies demonstrate the sensitivity of IVET-based unobtrusive or implicit assessments of attitudes as well as implicit, unreportable manipulations that lead to attitude change or persuasion with success.

Works cited

Bailenson, J.N., Beall., A.C., 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.N., Beall, A.C., Loomis, J., Blascovich, J., & Turk, M. (2004). Transformed social interaction: Decoupling representation from behavior and form in collaborative virtual environments. *PRESENCE: Teleoperators and Virtual Environments*, *13*(4), 428-441.

Bailenson, J.N., & Blascovich, J. (2004) Avatars. *Encyclopedia of Human-Computer Interaction*, Berkshire Publishing Group, 64-68.

Bailenson, J.N., Blascovich, J., Beall, A.C., Looms, J.M. (2003). Interpersonal distance in immersive virtual environments. *Personality and Social Psychology Bulletin*, *29*, 1-15.

Bailenson, J.N., Iyengar, S., Yee, N., & Collins, N. (2009, in press). Facial similarity between voters and candidates causes influence. *Public Opinion Quarterly*.

Bailenson, J.N. & Yee, N. (2005). Digital Chameleons: Automatic assimilation of nonverbal gestures in immersive virtual environments. *Psychological Science*, *16*, 814-819.

Bailenson, J.N. & Yee, N. (2007). Virtual interpersonal touch: Haptic interaction and copresence in collaborative virtual environments. *International Journal of Multimedia Tools and Applications*, *37*(1), 5-14.

Blascovich & Bailenson (in press). *More human than human: How virtual reality is changing human existence*. New York: Morrow.

Blascovich J., Hurst J. & McCall, C. (under review). Virtual stigma and the clash of consciousness.

Blascovich, J. Mendes, W. B., Hunter, S.B. & Lickel, B. , & Kowai-Bell, N. (2001). Perceiver threat in social interactions with stigmatized others. *Journal of Personality and Social Psychology, 80*, 253-267.

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

Blascovich, J., & Mendes, W. B. (2000). Challenge and threat appraisals: The role of affective cues. In J. Forgas (Ed.) *Feeling and Thinking: The Role of Affect in Social Cognition*. (pp. 59-82). Cambridge UK: Cambridge University Press.

Blascovich, J., & Tomaka, J. (1996). The biopsychosocial model of arousal regulation. In M. Zanna (Ed.). *Advances in Experimental Social Psychology, 28,* (pp. 1-51). New York: Academic Press.

Boellstorff, T. (2008). *Coming of age in second life: An anthropologist explores the virtually human.* Princeton, NJ & Oxford, UK: Princeton University Press.

Cacioppo, J. T., Petty, R. E., Losch, M. E., & Kim, H. S. (1986). Electromyographic activity over facial muscle regions can differentiate the valence and intensity of affective reactions. *Journal of Personality and Social Psychology, 50*(2), 260-268.

Chalmers, D. (1995) Facing up to the problem of consciousness. *Journal of Consciousness Studies* 2: 200-19.

Darwin, C. (1873). *The expression of emotions in man and animals.* New York: Appleton.

Devine, P. (1989). Stereotypes and prejudice: Their Automatic and Controlled Components. *Journal of Personality and Social Psychology,56,* 5-18.

Dotsch, R., & Wigboldus, D. H. J. (2008). Virtual prejudice. *Journal of Experimental Social Psychology, 44*(4), 1194-1198.

Fang, I. (2008). *Alphabet to Internet: Mediated Communication in Our Lives*. St. Paul: Rada Press.

Fazio, R. (1990). Multiple Processes by which Attitudes Guide Behavior. *Advances in Experimental Social Psycholog, 23*.

Fox, J., & Bailenson, J.N. (2009, in press). Virtual self-modeling: The effects of vicarious reinforcement and identification on exercise behaviors. *Media Psychology*.

Gallup International. (2009). Religion in the world at the end of the Millennium. In *Gallup International*. Retrieved February 12th, 2009 from http://www.gallup-international.com.

Gibson, W. (1984) *Neuromancer*. New York : Ace Books.

Gillath, O., McCall, C., Shaver, P., Blascovich J.B. (2008) Reactions to a Needy Virtual Person: Using an Immersive Virtual Environment to Measure Prosocial Tendencies. *Media Psychology, 11*, 259-282.

Guadagno, R.E., Blascovich, J., Bailenson, J.N., McCall, C. (2007). Virtual Humans and Persuasion: The effects of agency and behavioral realism. *Media Psychology, 10,* 1-22.

Hall, E.T.(1963). A system for the notation of proxemic behavior. *American Anthropologist, 65*, 1003-26.

Haney, C., Banks, C.,& Zimbardo, P. (1973). Interpersonal dynamics in a simulated prison. *International Journal of Criminology &Penology, 1*, 69–97.

Harper, Douglas (2001). *Attitude*. Retrieved February 12, 2009, from Online Etymology Dictionary Web Site: www.etymonline.com.

Huxley, A. (1954; 2004). *The Doors of Perception*. New York: Harper Collins.

Internet World Statistics: Usage and Population Statistics. (2009). The internet big pictures. Retrieved February 12, 2009 from Internet World Statistics. Web site: http://www.internetworldstats.com/stats.htm

Guttman, L. (1954). *The principal components of scalable attitudes*. New York, NY, US: Free Press.

Huxley, A. (1954). The Doors of Perception. London: Chatto and Windus.

Klinger, E. (1978). Modes of normal conscious flow. In K. S. Pope & J. L. Singer (Eds.), *The stream of consiousness*. New York: Plenum.

Laming, D. (2003) Psychological relativity, *Behavioral and Brain Sciences, 26*: 416-417.

LaPierre, R. (1934). Attitudes vs. Actions. *Social Forces,13*, 230-237.

Lewin, K., Heider, F., & Heider, G. (1936). Principles of Topological Psychology. New York: McGraw-Hill.

Likert, R. (1932). A technique for the measurement of attitudes. *Archives of Psychology, 22,* 55.

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

McCall, C., Blascovich, J., Young, A, Persky, S. (2009, in press) Using Immersive Virtual Environments to Measure Proxemic Behavior and to Predict Aggression. *Social Influence, 4*.

Nosek, B. A., Greenwald, A. G., & Banaji, M. R. (2007). The implicit association test at age 7: A methodological and conceptual review. In J. A. Bargh (Ed.), *Social psychology and the unconscious: The automaticity of higher mental processes.* (pp. 265-292). New York, NY, US: Psychology Press.

Osgood, C. E., Suci, G. J., & Tannenbaum, P. H. (1957). *The measurement of meaning*. Champaign, IL, US: University of Illinois Press.

Packard, V. (1957). *The Hidden Persuaders*. New York: McKay.

Schooler, J. W. (2002). Re-representing consciousness: Dissociations between experience and meta-consciousness. *Trends in Cognitive Sciences, 6*, 339-344.

Shepard, R. (1984). Ecological constraints on internal representation: Resonant kinematics of perceiving, imaging, thinking and dreaming. *Psychological Review, 91*, 417-447.

Smallwood, J., & Schooler, J. W. (2006). The restless mind. *Psychological Bulletin, 132*, 946-958.

Sommer, R., & Becker, F. D. (1969). Territorial defense and the good neighbor. *Journal of Personality and Social Psychology, 11*, 85-92.

Stephenson, N. (1992). *Snow Crash*. New York: Bantam Dell.

Thurstone, L. L. (1928). Attitudes can be measured. *American Journal of Sociology, 33*, 529–554.

Wittenbrink, B. & Schwarz, N. (. (2007). *Implicit measures of attitudes*. New York, NY, US: Guilford Press.

Yee, N., Bailenson, J.N., & Ducheneaut, N. (2009, in press). The Proteus Effect: Implications of transformed digital self-representation on online and offline behavior. *Communication Research*.