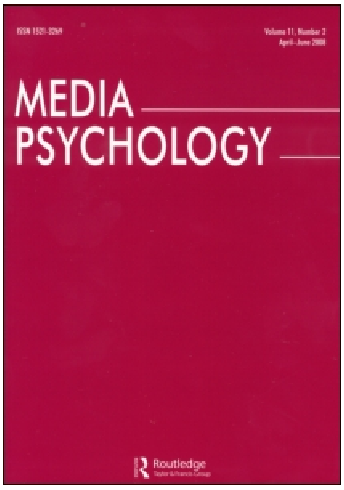

Media Psychology
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t775653678

What Can Virtual Reality Teach Us About Prosocial Tendencies in Real and Virtual Environments?

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Online Publication Date: 01 April 2008

To cite this Article Gillath, Omri, McCall, Cade, Shaver, Phillip R. and Blascovich, Jim(2008)'What Can Virtual Reality Teach Us About Prosocial Tendencies in Real and Virtual Environments?',Media Psychology,11:2,259 — 282

To link to this Article: DOI: 10.1080/15213260801906489

URL: http://dx.doi.org/10.1080/15213260801906489

Media Psychology, 11:259–282, 2008

ISSN: 1521-3269 print/1532-785X online
DOI: 10.1080/15213260801906489

What Can Virtual Reality Teach Us About Prosocial Tendencies in Real and Virtual Environments?

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As virtual environments (VEs) become increasingly central to people's lives (Terry, 2002), understanding reactions to VEs may be as important as understanding behavior in the real world (Yee, Bailenson, Urbanek, Chang, & Merget, 2007). Immersive Virtual Environment Technology (IVET), which is now being used in psychological research (Blascovich et al., 2002), can provide greater experimental control, more precise measurement, ease of replication across participants, and high ecological validity, making it attractive for researchers. It also can create links between researchers who study basic social psychological processes and those who study new media. In two studies we examined people's reactions as they navigated through a virtual world and interacted with virtual people, some of whom needed help. Participants' compassion and tendency to experience personal distress predicted emotional reactions (concern) and proxemic behavior (gaze orientation and degree of interpersonal distance) to a virtual person in need but not to a control person. The results support the use of IVET and proxemic variables to measure compassion unobtrusively and they encourage the use of IVET to advance our understanding of people's behavior in and reactions to virtual worlds and new media.

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New media (Terry, 2002) include all forms of computer-enhanced or digital communication—both new forms of digital media, such as virtual reality (VR), and adaptations of more traditional media forms to new technologies. New media can be found almost everywhere—in people's homes, in classrooms, and in workplaces; and although traditional media have obviously affected life in many ways, the new media may have even more pervasive and potent effects (e.g., Preiss, Gayle, Burrell, Allen, & Bryant, 2007; Scheufele & Tewksbury, 2007), including shaping and framing the news, saturating all of life with advertising, offering online education, and intensifying the effects of video and role-playing games.

Virtual reality is a good example of the new media, surrounding people with an immersive artificial environment. Given the growing use of virtual environments or VEs (e.g., Second Life, World of Warcraft), it is important to understand their effects on human emotions and behavior. For example, do people behave in normative ways toward others when they interact with them in a virtual world? Do they behave differently toward agents (virtual people whose actions are controlled by computer code) than they act toward real human beings? Can we generalize from studies of people in the real world to people's reactions to a virtual world, and vice versa? Finally, can we influence behavior in the real world by training people in virtual settings? The present studies begin to explore these matters in the domain of prosocial behavior. They also contribute to solving challenging methodological issues in the study of prosocial behavior.

Experimental social and personality psychology, like other social science disciplines that use experimental methods, often suffer from at least three problems: (a) an imbalance between experimental control and mundane realism (or ecological validity); (b) lack of precise replication, due to difficulties in repeating a particular procedure exactly (especially if it involves live actors or confederates); and (c) nonrepresentative samples. In an influential article, Blascovich, Loomis, Beall, Swinth, Hoyt, et al. (2002) argued that Immersive Virtual Environment Technology (IVET) can help to ameliorate, if not solve, these methodological problems. For example, IVET can provide nearly complete control over the experimental situation, including confederates' behavior and characteristics (e.g., sex, stature, ethnicity), while maintaining relatively high mundane realism. IVET assures exact replications of confederates' behavior and appearance across participants within experimental conditions. Furthermore, the networking capabilities of digital technology make it easier to use subjects in distal locations and to have those subjects interact in the same virtual spaces. These developments will eventually allow research to be conducted beyond the confines of university subject pools.

In addition to addressing traditional research problems, IVET also offers opportunities to measure a host of dependent variables, including many covert, continuous, and online behaviors and social configurations (e.g., mutual gaze, interpersonal distance) as participants move through a virtual environment. In the current studies we took advantage of some of these opportunities to study prosocial reactions and behavioral tendencies.

VIRTUAL REALITY THEORY AND RESEARCH

Virtual reality (VR) is a computer-based artificial environment that presents synthetic sensory information to a user in a form that seems real rather than synthetic (see Figure 1). An immersive virtual environment (IVE) is one that perceptually surrounds an individual, who perceives himself or herself to be enveloped by, included in, and interacting with a continuous stream of stimuli (Witmer & Singer, 1998). IVEs allow for action, movement, and sometimes speech on the part of users, and—important for the present article—they allow for online collection of behavioral data.

Online data acquisition has various advantages over other methods that can be used to measure people's behavior toward others, such as self-reported proxemic measures (Gifford, 1983), the stop-distance procedure (Aiello, 1987), or the seating-choice procedure (e.g., Word, Zanna, & Cooper, 1974); the use of objects to demonstrate or represent interpersonal distance (e.g., Knowles, 1980); and passive role-playing scenarios (e.g., Mehrabian, 1968), which tend to be imprecise and fairly subjective. (See Hayduk, 1983, for a classic review of studies using projective measures of interpersonal dis-

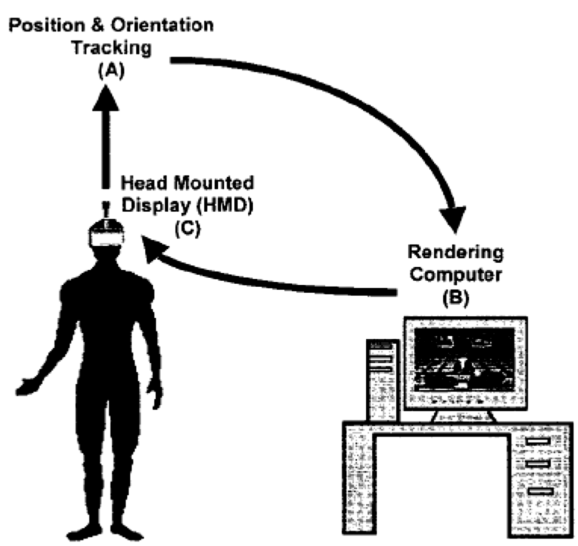


FIGURE 1 A conceptual depiction of immersive virtual environment technology (IVET).

tance and their limitations.) For example, nonverbal indications of prejudice have generally been assessed by observers coding characteristics such as friendliness or mutual gaze (e.g., Dovidio, Kawakami, Johnson, Johnson, & Howard, 1997), a method that is both time consuming and open to demand characteristics. In contrast, IVET provides objective and highly precise measures of position in space and physical orientation toward a virtual person. This makes IVET an attractive research tool.

VR and IVET offer more than research tools, however; they can change people's lives, providing them with new physical and social environments to explore. One can find VR in many different places (e.g., Blascovich et al., 2002; Buckley & Anderson, 2006): in army simulators, in schools and other sorts of training or educational settings, and in people's social lives (e.g., virtual communities or game communities immersed in *Second Life: A 3D Online Digital World*). Because of the importance of technology-mediated communication in everyday life, there are many studies of computer-mediated communication (CMC) in chat rooms or via e-mail (e.g., Guéguen, Pichot, & Le Dreff, 2005; Markey, 2000; Walther, Anderson, & Park, 1994).

Although providing valuable information, CMC studies do not usually include measures of nonverbal, relational processes (Culnan & Markus, 1987). For example, Blair, Thompson, and Wuensch, (2005) studied the virtual presence of others in e-mail correspondence to examine helping behavior. Participants were sent an e-mail message requesting assistance with an online library search task. Each participant in the study received the message along with an indication that other people (0, 1, 14, or 49 of them) also were contacted. As expected based on prior research, the virtual presence of many others significantly reduced the e-mail responsiveness of participants in the study. Because this work and similar studies (e.g., Markey, 2000; Markey, Wells, & Markey, 2002) used desktop computer environments, but they could not reveal much about participants' motivation or responses.

Using IVET, a researcher can overcome some of the disadvantages of CMC and simulate physical and social environments in which a study participant can become immersed (Slater, 1999). Degree of immersion is important because it affects a user's sense of presence, "the subjective experience of being in one place or environment, even when one is physically situated in another" (Witmer & Singer, 1998, p. 225). Research suggests that participants have a stronger experience of presence in more immersive devices or environments (e.g., Baños et al., 2004).

IVET not only provides a sense of presence, it also allows researchers to obtain behavioral information without having to ask participants about their inclinations or planned actions. Such behavioral information usually includes proxemic indexes (distance, orientation, time spent in a particular place), which were unavailable to researchers using CMC (or real-world scenarios). In the study reported here, we took advantage of IVET's features to examine helping behavior.

THE USE OF VE AND IVE IN SOCIAL PSYCHOLOGICAL RESEARCH

Even when realism is increased only slightly—for example, when participants use a keyboard and mouse to maneuver avatars (digital representations of themselves) in a massively multiplayer online role-playing game (e.g., *World of Warcraft*)—people seem to follow real-world social norms regarding gender, interpersonal distance (IPD), and eye gaze (Yee et al., 2007). Yee and colleagues found that male–male dyads maintain larger IPDs and make less eye contact than female–female dyads. They also found, as predicted by equilibrium theory (Argyle, 1988) and observed in real-world experiments that decreases in IPD are compensated by gaze avoidance.

Bailenson, Blascovich, Beall, and Loomis (2003) examined a variety of measures available in IVEs. In two studies they used interpersonal distance (proxemic) measures to examine social influence, finding that participants maintained greater distance from virtual humans when approaching them face-to-face than when approaching them from the back. In addition, participants maintained more personal space around virtual agents (a virtual figure controlled by a computer program) who engaged them in mutual gaze. This work suggests that people react to virtual others while in an immersive virtual environment in ways they would react to other human beings in the real world.

Encouraged by such findings, we used IVET to measure individual differences in caring and the inclinations to help or withdraw from a virtual person in need. Finding such behavioral tendencies and emotions toward virtual people would have implications for both compassion research and the understanding of behavior in virtual worlds or environments (such as Second Life and other virtual communities, virtual chat rooms, and gaming). Based on work by Eisenberg and Miller (1987) and Batson (1991), we hypothesized that people who scored higher on measures of prosocial attitudes and lower on personal distress in social situations would be more willing to approach a needy virtual person in a virtual world.

In Study 1, which was designed to test whether people would exhibit concern toward a virtual needy person, we expected people who had prosocial attitudes to express more concern for a virtual blind man in need. In Study 2, in which we also measured behaviors, we expected participants who scored high on prosocial tendencies to exhibit more approach-oriented than avoidance-oriented behavioral tendencies; for example, looking more at a needy person, getting closer to him, and staying nearer over time.

EMPATHY, COMPASSION, AND PROSOCIAL BEHAVIOR

Empathy and altruism have been studied by personality and social researchers for some time (e.g., Batson, 1998; Gilbert, 2005; Penner, Dovidio, Piliavin,

& Schroeder, 2005; Rudolph, Roesch, Greitemeyer, & Weiner, 2004). The dependent measures used in most of this research are based on behavioral observations and self-reports. Behavioral observation has been used successfully in both the laboratory (e.g., Darley & Batson, 1973; Karakashian, Walter, Christopher, & Lucas, 2006; Mikulincer, Shaver, Gillath, & Nitzberg, 2005) and the field (e.g., Regan & Gutierrez, 2005; Wilson & Kennedy, 2006), and is considered to have high reliability. A main problem, however, is that such studies are difficult to replicate precisely, either within a study across participants or between different studies and laboratories. Another problem is that behavioral measures often are operationalized as dichotomous: People either help a needy person or they do not.

Self-report methods, in contrast, are usually easy to replicate and amenable to continuous scaling of dependent variables. But self-reports often focus on prosocial traits, attitudes, and beliefs, such as humanitarianism or belief in a just world (Penner, Fritzsche, Craiger, & Freifeld, 1995) rather than behavior, or they tap projected or self-described reactions to a true story or a hypothetical scenario about a person in need (e.g., Christopher, Westerhof, & Marek, 2005). Self-reports also have lower mundane realism and may be less valid than behavioral measures. Moreover, relying on self-reports of both independent and dependent variables (e.g., personality traits and reported willingness to help) may lead to problems associated with response bias and shared method variance, which raise concerns about the validity of the findings.

Combining the two methods (dispositional self-reports and behavior in a repeatable situation with high mundane realism) offers advantages relative to the traditional methodological approaches alone. We explored this possibility using IVET, which allowed us to present exactly the same situations to different participants while making the situations more realistic than written or orally described scenarios. Hence, we were able to examine the extent to which self-reported traits, attitudes, and emotions predicted prosocial behavior in response to different virtual people.

The process that determines whether one person helps another is complex and includes numerous personal and situational factors. Over the years, several different approaches have been advanced to explain the "when and why" of prosocial behavior: decision-making models (e.g., Latane & Darley, 1970); cost-reward models (e.g., Piliavin, Dovidio, Gaertner, & Clark, 1981); evolutionary models, based on concepts such as kin selection or inclusive fitness (e.g., Barrett, Dunbar, & Lycett, 2002; Dawkins, 1989); social norm models, including concepts such as reciprocity and responsibility (e.g., Dovidio, 1984); personality models, based on traits such as agreeableness (e.g., Graziano, Habashi, Sheese, & Tobin, 2007), attachment security (e.g., Gillath, Shaver, & Mikulincer, 2005), and dispositional compassion (e.g., Unger & Thumuluri, 1997); social learning models (e.g., Eisenberg et al., 2002; Staub, 2002); and emotion models (e.g., Batson, 1991).

These approaches, each of which was based initially on either personal observations or ideas that had been applied successfully to related topics, overlap to various extents (for details see Penner et al., 2005). In the present article, we focus mainly on the personality and emotion perspectives, examining whether prosocial tendencies (such as dispositional compassion) and emotions (such as personal distress) are associated with unobtrusively measured behavioral tendencies toward a needy person in an immersive virtual environment.

Batson (1991), who has studied empathy and other prosocial tendencies, drew an important distinction between (a) feeling personally distressed, guilty, or sad, which sometimes motivates helping as a way to reduce one's own distress, but sometimes causes a person to be intrusive or overwhelmed rather than truly helpful (see Cialdini, Brown, Lewis, Luce, & Neuberg, 1997, and Piliavin et al., 1981, for examples), and (b) feeling empathic, sympathetic, and compassionate, which motivates truly altruistic behavior. This distinction has proven useful in our own studies of the effects of attachment security and insecurity on helping and reasons for helping (e.g., Mikulincer et al., 2005) and, therefore, will be applied here.

THE PRESENT RESEARCH

Despite the many studies of prosocial tendencies and helping behavior, several issues remain to be clarified. Many researchers have relied on self-reports of willingness to help, and many of the behavioral studies have measured help versus no-help decisions in complex situations, either in the real world or in laboratory situations that required confederates to act similarly in situation after situation with different research participants. It has been difficult both to measure subtle inclinations to help, which probably vary continuously rather than being truly dichotomous, and to get live confederates to act exactly the same way across experimental sessions.

The present research was designed to explore the possibility that IVET could begin to overcome these limitations by creating events that are more realistic than written scenarios yet more consistent across participants than flesh-and-blood confederates. Moreover, in a three-dimensional virtual environment, in which a participant can walk around in a realistic world, it is possible to measure subtle behavioral reactions without requiring a dichotomous (help, don't help) decision. It is also possible to see how individual differences, based on self-report measures, relate to behavioral tendencies. More generally, the present research explored the continuing question of whether predictions based on research done in the physical world would apply to behavior within a virtual environment.

Study 1

The aims of Study 1 were to examine whether a virtual person in need would elicit any reaction from participants in an IVE and whether these reactions would be related to prosocial traits (e.g., compassion, empathy) and self-reported emotional reactions (e.g., empathic concern, personal distress, anger). Because this was the first study of inclinations to help in an IVE (as far as we know, except for Blair et al., 2005, who operationalized "virtual environment" differently), we were uncertain whether participants would perceive agents (virtual people) as part of a game and, thus, be unlikely to empathize with or wish to help them. Although behavioral measures can be taken in VEs (as we show in Study 2), in Study 1 we collected only verbal reactions to see if a needy virtual person elicited any reactions at all, especially prosocial ones.

We measured expressions of care and any indications that a participant was inclined to intervene or help. Based on previous studies demonstrating that people classified as having a "prosocial" tendency (e.g., people high on altruism, empathy, or compassion) show greater concern for the common good of others (e.g., Van Lange, De Bruin, Otten, & Joireman, 1997), we expected dispositional compassion to be positively correlated with expressions of care and inclination to help a virtual needy person.

Method

Participants. Thirty-seven undergraduate students (17 women, 20 men) participated in the study for course credit. Their ages ranged from 18 to 23 years (median = 18). Fifty-three percent described themselves as Caucasian, 25% as Latino, 14% as Asian or Asian-American, 5% as African-American, and 3% as "other or mixed ethnicity."

Procedure and Materials. Upon arriving individually at the lab, each participant completed a consent form explaining that he or she would experience an IVE and then be asked to report on the experience. After providing consent, each participant was told that the IVE equipment would create the experience of being on an urban sidewalk lined with shops. The participant's task was to familiarize him- or herself with the environment while sitting at a bus stop watching the people and traffic, so that it would be possible later to answer questions about the experience. The experimenter then helped the participant put on a head-mounted display (HMD), which the participant adjusted for optimal fit. The HMD portrayed the virtual world.

Within the IVE, participants found themselves at a bus stop on a fairly busy street. While they sat there, exploring the environment visually, a blind man walked across the street in front of the bus stop, and a car driving by accidentally knocked his white cane out of his hand. While walking briefly without his cane, the blind man fell to the ground and then, while remaining on his knees, groped the ground in search of the cane. A minute later the blind man started calling for help (crying, "Help I'm blind, can you please help me find my cane?"). After 20 seconds, the scenario ended. Participants' reactions to these events were recorded for later analysis. On average, people stayed in the IVE for 4 minutes. At the end of that time, they were asked to remove the HMD. After a short break and the completion of a few distracter tasks, they completed a computerized version of the self-report questionnaires. Finally, they were probed for impressions, debriefed, and thanked for participating.

Self-Report Measures. Two measures were used to assess participants' dispositional prosocial or compassion-related tendencies. The compassion subscale of the Dispositional Positive Emotion Scales questionnaire (DPES; Shiota, Keltner, & John, 2006) is a 5-item, self-report measure of dispositional compassion, which is one part of a 38-item instrument designed to measure hedonically positive emotions including compassion, joy, contentment, pride, love, amusement, and awe. People report their level of agreement with each statement on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The compassion subscale contains items such as "When I see someone hurt or in need, I feel a powerful urge to take care of them"). In the present study, Cronbach's alpha (α) for the compassion scale was .84.

We also administered the Interpersonal Reactivity Index (IRI; Davis, 1983), which contains four 7-item scales, each assessing a separate aspect of dispositional empathy: empathic concern (EC, $\alpha = .83$ in our sample), the tendency to feel compassion and care; perspective-taking (PT, $\alpha = .81$), the ability to take someone else's point of view; fantasy (FS, $\alpha = .76$), the tendency to be absorbed in stories, fantasies, or films; and personal distress (PD, $\alpha = .49$), the tendency to feel distressed in the face of someone else's suffering. Sample items include: "I often have tender, concerned feelings for people less fortunate than me" (EC); "I sometimes try to understand my friends better by imagining how things look from their perspective" (PT); "I daydream and fantasize, with some regularity, about things that might happen to me" (F); and "Being in a tense emotional situation scares me" (PD). Participants reported their level of agreement with each statement on a 7-point scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*.)[1]

IVE Hardware and Software.[1] The immersive virtual environment was rendered through a Virtual Research (Model V8) stereoscopic head-mounted display. The display was projected with 680 × 480 dpi resolution LCD panels. The refresh rate was 60 Hz, the horizontal span was approximately 50 degrees, and the vertical span was approximately 38 degrees. We used Vizard 2.5 software to render the street scenes and virtual people. Participant head movements were tracked using a Worldviz Precision Position Tracker system. Head orientation was tracked using an Intersense (Model IS300) sensor. Tracking data allowed the virtual scene to change appropriately when participants moved their heads.

Virtual Environment and Agents. The sidewalks in the virtual street scenes were approximately 20 feet long and 10 feet wide. The three-dimensional visual representation of the scene was accompanied by stereo sound, which conveyed people's voices and ambient street noise. Human representations (agents) populated both the street and the shops in the virtual world. The agents had photorealistic heads created using Biovirtual 3DMeNow Professional software. The agents' actions were controlled through programming and were not interactive (i.e., the agents behaved in the same ways for all participants).

Participants' reactions (e.g., verbal reactions, movements, and noises) when the blind man lost his cane were recorded and coded. Two independent raters (psychology graduate students) rated the reactions on a scale ranging from (−1) (*reacted in a negative, derogatory way; e.g., made fun of the whole thing*), through 0 (*no reaction*), 1 (*slightly empathic*), and 2 (*empathic*), to 3 (*being highly compassionate, expressing a desire to help*). Because the two sets of ratings were highly correlated (interrater reliability based on Cohen's, 1968, kappa was .82, $p < .001$), we created a single prosocial tendency score for each participant by averaging the two ratings. This score served as the dependent measure in Study 1.

Results

About half (46%) of the participants reacted in some way to the virtual person in need, and more than one-third (36.2%) reacted with explicit concern for and/or compassion toward the fallen blind man (offering help, trying to get closer, expressing concern verbally). These numbers are compatible with previous findings concerning the proportion of people who help someone in need in the real world. For example, Gueguen and De Gail (2003) found that a positive mood induced by a smile caused 29.5% of participants to provide help to a confederate who had dropped computer diskettes on the floor and was trying to pick them up while also holding bags full of groceries. The similar percentages in our study and the study by Gueguen and De Gail suggest that IVET may be capable of arousing emotions and behavioral tendencies toward virtual people in need similar to those aroused toward needy people in the real world.

We used hierarchical regression analysis to examine associations between the individual-difference measures of dispositional compassion and prosocial tendencies, on the one hand, and the coded reaction to the fallen blind man, on the other. (The zero-order correlations among all of the variables are shown in Table 1.) In the first step of the regression analysis, we entered the DPES compassion score and on the second step we entered the four IRI factor scores.[2]

The regression analysis revealed, as expected, a main effect for the DPES compassion score, $\beta = .38$, $p < .05$ ($R^2 = .15$ for this first step), such that

TABLE 1 Zero-Order Correlations Among Variables in Study 1

Variables	1	2	3	4	5	6
1. DPES compassion	1.00	.09	.43**	.69**	−.23	.38*
2. IRI fantasy		1.00	.00	.22	.41*	.13
3. IRI perspective taking			1.00	.49**	.24	.06
4. IRI empathic concern				1.00	.12	.23
5. IRI personal distress					1.00	−.05
6. Responses to the blind man						1.00

*$p < .05$, two-tailed. **$p < .01$, two-tailed.

being higher on the compassion dimension was associated with expressing more concern for the fallen blind man ($M = .64$, $SD = 1.05$) as compared with being low on compassion ($M = .42$, $SD = 1.02$). No other main effects were significant. This result suggests that dispositionally compassionate people react in a more sympathetic way toward a virtual person in need. This made it seem worthwhile to study the effects of compassion further in the virtual environment, which was the purpose of Study 2. We also should mention that although the IRI empathic concern scale was highly correlated with the DPES compassion subscale, $r = .69$, as shown in Table 1, it did not produce a significant unique effect when entered into the regression equation in conjunction with compassion (probably because of the overlap between the two scales), nor did the personal-distress factor.

Study 2

In Study 2 we tested the same hypotheses, this time taking advantage of the behavioral measurements inherent to IVET. In particular, we measured participants' proxemic behaviors including translation (i.e., movement paths) and head orientation while moving among virtual others in the IVE. Reactions such as looking toward rather than away from the person in need (suggesting approach vs. avoidance; e.g., Goffman, 1963; Patterson & Tubbs, 2005), actually approaching the person, and spending more time near the person were used as potential behavioral indicators of willingness to interact with and help the needy person. The specific dependent variables in Study 2 were participants' location relative to the target person and head orientation (looking at or away from the person).

To control for alternative explanations based on the type of needy virtual person we included in our scenario, we changed the needy agent in Study 2. Instead of the blind man, we used a beggar, or panhandler (see Figure 1), to whom some people might react not just with disinterest, but also with disgust, contempt, or fear (personal distress). Getting similar effects of compassion with a different agent would add to our confidence concerning the generalizability of our findings.

As mentioned above, our two dependent variables were *looking at the needy person* and *getting closer to and staying near him* (decreased personal distance). Previous studies have shown that emotions such as empathy and compassion shape people's physical and social distance from someone who elicits an emotional reaction (e.g., Weiner, 1995, 1996). Physical and social distance are usually related (e.g., Kaitz, Bar-Haim, Lehrer, & Grossman, 2004) and both are negatively associated with prosocial tendencies. Werner (2005), for example, found that prosocial emotions were inversely correlated with self-reported social distance from a person with Alzheimer's disease and positively correlated with willingness to spend an evening socializing with the person. Similarly, Strayer and Roberts (1997) found that children were willing to get physically closer to people with whom they empathized. Based on such studies (as well as Goffman, 1963, and Patterson & Tubbs, 2005), we hypothesized that the higher a person's score on the dispositional compassion measures, (a) the more he or she would look at the virtual needy person and (b) the closer to the needy person he or she would approach and stay.

Method

Participants. Seventy undergraduate students (28 women, 42 men) participated in the study for course credit. Their ages ranged from 18 to 22 years (median = 18). Sixty-four percent were Caucasian, 17% were Latino, 9% were Asian or Asian-America, 7% were African-American, and 3% reported having "other or mixed ethnicity."

Procedure and Materials. As in Study 1, upon arriving at the lab, participants completed a consent form explaining that they would experience an IVE and then be asked to report on their experiences. After providing consent, they were told that the IVE equipment would simulate the experience of being on an urban sidewalk lined with shops. Their task was to familiarize themselves with the environment by walking up and down the sidewalk, so that later they would be able to answer questions about their experience and the environment. Two lampposts at either end of the sidewalk marked the outer boundaries of the virtual space. After explaining this, an experimenter helped a participant put on a HMD, which he or she could adjust for comfort. The participant was free to walk around a 9.3-×-4.4 meter empty room, which seemed to the participant to move him or her through the virtual environment.

Within the IVE, each trip up and down the virtual sidewalk constituted a trial. On each trial of the two experimental ones, the arrangement of shops was randomly altered. In addition to the people who randomly appeared inside the shops, one virtual person (hereafter called an agent) appeared along the sidewalk on each experimental trial. The two agents were (a) an elderly male beggar, or panhandler (dressed in patched, partly torn clothes, asking for help and money), and (b) a businessman (dressed in a business suit, who at one point talked on his cell phone to control for the fact that the beggar also talked). The two figures were similar in height, body weight, ethnicity, gender, and overall movement.

Although the order of trials (each with its corresponding virtual person and array of shops) was counterbalanced, the placement of the critical agents along the sidewalk was always the same (to control for angle of vision). Overall, participants stayed within the IVE as long as it took them to get oriented and complete the two experimental trials (approximately 4 minutes). They were then allowed to remove the HMD and relax during a short break, after which they were asked to complete a series of computerized questionnaires. The initial questionnaires served as a distracter to prevent participants from readily associating their behavior in the IVE with the self-report battery. Finally, they were probed for impressions, debriefed, and thanked for participating.

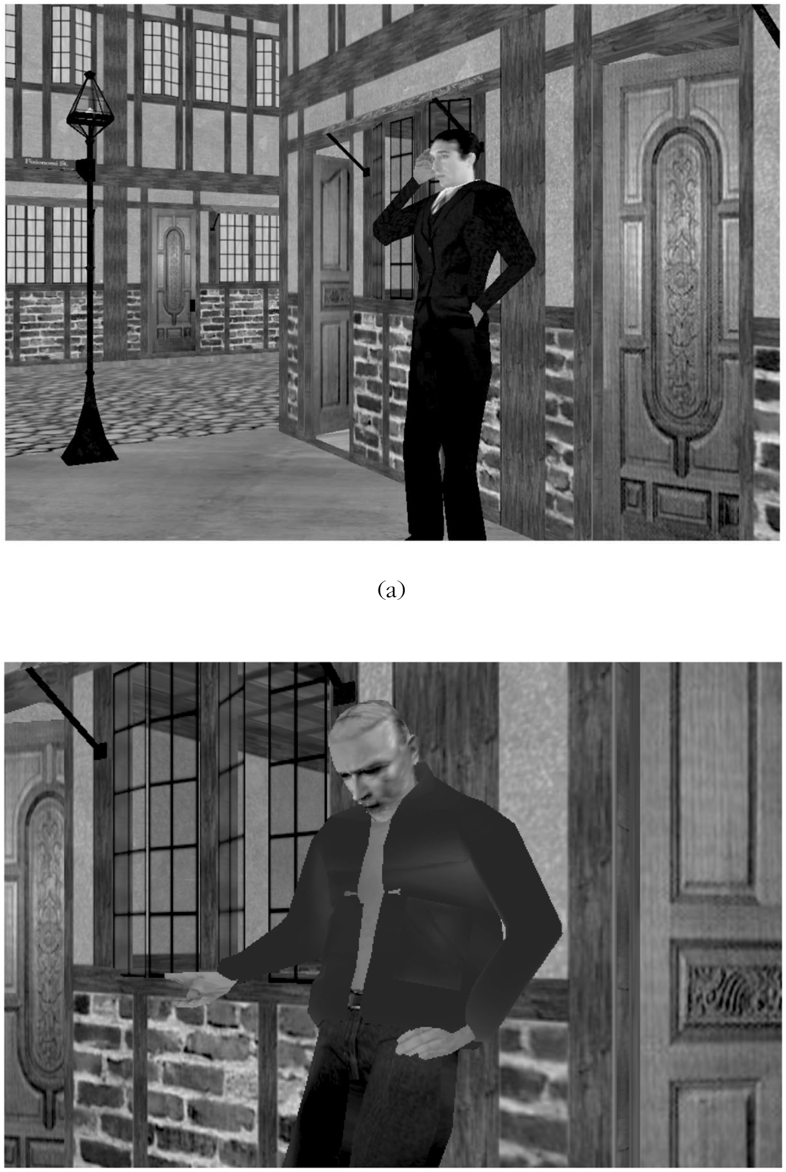
Self-Report Measures. The measures were similar to the ones used in Study 1: (a) the DPES compassion subscale (Shiota et al., 2006), with an alpha coefficient of .79 in this study, and (b) the IRI scales (Davis, 1983), with alphas in Study 2 as follows: empathic concern, .83, perspective-taking, .65, fantasy, .86, and personal distress, .80.

IVE Hardware and Software. We used the same hardware and software as in Study 1, but this time we collected data concerning the participants' locations in the room and their head orientations (see details below).

Environment and Agents. The sidewalks and the virtual street scenes were modified versions of the ones used in Study 1. The new agents had more photorealistic heads created with Biovirtual 3DMeNow Professional software (see Figure 2).

Proxemics. During the task, the computer system sampled and recorded participants' body location and head orientation at 8 Hz. Location was indexed by the three-dimensional polar coordinates (x, y, and z) of the participant's viewpoint in the immersive environment. Head orientation was indexed by a sensor on top of the HMD. We were interested in two proxemic variables: amount of time spent near the target agent (beggar or businessman) and head orientation. We used the first measure to gauge the participant's willingness to approach and stay close to the agent. We used the second measure to gauge whether the participant was focusing his or her attention on the agent (possibly making eye contact), which we interpreted as an approach tendency, following Goffman (1963) and Patterson and Tubbs (2005).

Time Spent Near the Agent. Time spent near the agent was calculated as the amount of time the participant spent within 1.5 meters of the beggar or the businessman. This measure captures both a participant's willingness to get close to the agent and stay fairly close to him. We predicted that this willingness to get close and stay close to a needy agent would indicate a



(a)

(b)

FIGURE 2 The virtual businessman (in panel a) and the beggar (in panel b).

prosocial response, especially in the case of the needy beggar, who might cause some participants to distance themselves from a person who seemed disgusting. Because being close to someone does not necessarily require looking at him or her, we also measured head orientation toward or away from the agent.

Head Orientation. During each trial, the degree to which a participant oriented toward the agent was sampled every third of a second (i.e., 3 Hz). For each head-orientation sample, the degree to which the agent fell within the participant's field of view was calculated. This was done by measuring the minimum distance between the pixels depicting the agent's head and the center of the image rendered in the HMD. This distance was normalized so that the center of the field of view was zero and the outside frame of the HMD was one unit away. This normalized value was then subtracted from one. The resulting values fall within a continuous range from 1 (where the agent's head appears in the center of the HMD's field of view) to 0 (where the agent's head appears outside the HMD's field of view. (This method was originally devised by Bailenson, Yee, Merget, & Schroeder, 2006.) The values for a given trial were averaged to produce a score for orienting toward the agent during that trial.

Results

To identify the possible predictors of what we defined as prosocial responses, we first conducted a repeated measures analysis to examine whether people differed in their reactions to the virtual needy beggar and the virtual businessman (the control figure). Figure (beggar vs. businessman) and index type (eye gaze vs. time spent near) served as the within subject variables (see Table 2 for means and *SD*s). The analysis revealed a main effect for figure, $F(1, 69) = 5.78$, $p < .05$, $\eta^2 = .08$, such that reactions (gazing at the figure and time spent near him) were stronger with respect to the needy person ($M = 4.32$) as compared with the control person ($M = 3.84$). The analysis also revealed a main effect for index type, $F(1, 69) = 283.33$, $p < .001$, $\eta^2 = .80$, such that people spent more time near the figures ($M = 8.06$) than gazing at them ($M = .11$). Finally, the analysis also revealed a two-way interaction between figure and index type, $F(1, 69) = 5.52$, $p < .05$, $\eta^2 = .07$. Least significant difference (LSD) pairwise comparisons revealed that,

TABLE 2 Means and SDs of Proxemic Indexes in Study 2 as a Function of Figure (Beggar vs. Businessman) and Type of Index (Time Spent Near the Virtual Person Versus Time Gazing at the Virtual Person)

	Beggar	Businessman
Time spent near person		
Mean	8.52	7.59
SD	4.48	4.10
Gazing at the person		
Mean	0.11	0.09
SD	0.06	0.06

Note. For both dependent variables the means were significantly different from each other ($p < .05$).

in the case of both indexes, reactions toward the beggar were stronger (or longer lasting); but the time-spent index produced a bigger difference than the gazing index (although both $p < .05$).

To identify predictors of prosocial responses, we then conducted four hierarchical regression analyses, two for each agent (beggar, businessman). For each agent, one analysis examined the effects of the independent variables (the prosocial dispositional tendencies) on *looking at the agent* (based on head orientation), and a different analysis examined the effects of the independent variables on *time spent near the agent*. In the first step of each regression analysis we entered the DPES compassion score, and in the second step we entered the four IRI scores. (The zero-order correlations between the predictor and outcome variables are shown in Table 3.)

The regression analysis for *looking at the beggar* revealed, as expected based on our hypothesis and the results of Study 1, a main effect for DPES compassion, $\beta = .25$, $p < .05$ ($R^2 = .03$ for that step), such that being more dispositionally compassionate was associated with looking longer at the beggar. No other main effects were significant.[3]

The regression analysis for *staying near the beggar* revealed, also as predicted, a significant main effect of DPES compassion, $\beta = .28$, $p < .05$ ($R^2 = .13$ for that step), indicating that being more dispositionally compassionate was associated with staying close to the beggar. There was also a main effect for the tendency to feel personal distress (assessed by the IRI personal distress scale), $\beta = -.39$, $p < .01$, such that more personally distressed individuals spent less time near the beggar. No other main effects were significant.[4]

The regression analysis for *looking at the businessman* (who was included as a control target person) did not yield any main effects (the betas for the DPES compassion and IRI empathic concern scales were .03 and .10, respectively). The regression analysis for *staying near the businessman* also did not yield main effects for either DPES compassion or IRI empathic concern (βs = .15 and .26, respectively). It did, however, reveal a main effect for the IRI personal distress scale, $\beta = -.30$, $p < .05$ (R^2 change on that step = .11), such that the more distressed a participant felt, the less time he

TABLE 3 Zero-Order Correlations Between Predictor and Outcome Variables in Study 2

	Looking at beggar	Time near beggar	Looking at businessman	Time near businessman
DPES compassion	.25*	.28*	.03	.15
IRI fantasy	.19	.12	.21	.14
IRI perspective taking	.15	.05	.29*	.15
IRI empathic concern	.23	.28*	.11	.22
IRI personal distress	−.02	−.26*	−.09	−.22

*$p < .05$, two-tailed.

or she spent near the businessman. No other main effects were significant. Comparing the results of the businessman analyses with the ones for the beggar, we see that reactions to the businessman were influenced mainly by personal distress, whereas reactions to the beggar were influenced by both compassion and personal distress. In the case of both agents, personal distress seemed to cause people to back away or stay away from the agent, but the effect was stronger in the case of the beggar.[5]

GENERAL DISCUSSION

The two studies reported here were designed to explore the possibility that IVET, which combines some of the advantages of real-world and laboratory approaches to studying prosocial behavior, is a promising research tool. In particular, we were interested in determining whether social behavior and behavioral tendencies in a virtual environment could be predicted from dispositional measures of compassion and empathy. As expected, people's reactions to a virtual needy person were similar to reactions in real-world environments (e.g., Darley & Latane, 1968; Gueguen & De Gail, 2003). Moreover, people's behavior toward a needy person (but not toward a control figure) was associated with dispositional compassion, suggesting that behavior in an IVE can serve as an implicit, relatively objective, and unbiased measure of prosocial behavior.

The main goal of Study 1 was to examine whether people would have any kind of reaction to a virtual person. About half of the sample in Study 1 had some sort of reaction to the needy person, and about one-third of that sample reacted in a concerned, empathic way. This proportion is similar to those obtained in previous studies using other methods (e.g., Gueguen & De Gail, 2003), which generally find that between 20% and 30% of participants help a person in need.

The main goal of Study 2 was to replicate and extend the results of Study 1 using behavioral measures made available by the virtual-reality headpiece: looking at a virtual person and staying near him in the VE. We wanted to see whether dispositional variables could predict these behavioral reactions to a needy person. In fact, more compassionate people (compared with their less compassionate peers) were more inclined to look at and stay near a virtual beggar, and people who were inclined to feel personally distressed when seeing people in need were less likely to stay near the beggar. This suggests that prosocial tendencies assessed using IVET methods are sensibly related to prosocial dispositions. Compassion had a significant effect only when the target person was a needy beggar, not when he was a well-dressed businessman. Although not directly related to our research questions, we also replicated previous studies (e.g., Karniol, Gabay, Ochion, & Harari, 1998) that found no gender differences in prosocial behavior, again making it seem that a virtual environment and virtual people can generate findings concerning prosocial behavior that correspond with previous studies in actual environments.

Our findings also have implications when considered in the broader framework of media effects. Exposure to various kinds of behavior, including violence and sexual behavior, in movies, television programs, and computer games, is known to have negative effects, particularly on children (Anderson, Gentile, & Buckley, 2007). The addictive nature of television and the Internet for some users is likely to make these effects even stronger and more troubling (e.g., Buckley & Anderson, 2006; Linz, Donnerstein, & Penrod, 1984). Given the impact of experimental manipulations using IVET, it is likely that the psychological effects of continued use of this technology will be even more powerful, and the compelling nature of IVET may make it especially addictive (Blascovich et al., 2002; Persky & Blascovich, 2007). If people are regularly exposed to virtual worlds that encourage prosocial behavior, their powerful effects may be socially desirable and beneficial. But as IVET-based home entertainment becomes more widespread, it is likely that marketers of images of violence and intolerant sexuality will create software that encourages similar behavior in viewers. It, therefore, is important to study the emotional and behavioral effects of different kinds of virtual scenarios.

Our findings suggest that IVET might be used educationally and therapeutically to foster prosocial behavior. Some researchers have used entertainment media, such as video games, to increase healthy behavior. For example, Lieberman (1997) developed effective computer games to teach children with diabetes mellitus or asthma how to engage in healthy behavior specific to their medical condition. We believe IVET can be used in similar ways and for a wider range of behaviors—including prosocial ones.

There are obviously some limitations to our preliminary studies. First, it is not yet clear whether unhelpful people in our studies were truly unhelpful in general or simply did not find the virtual world sufficiently engaging. Future studies should examine this issue in greater depth. Second, participants in our studies could not actually help the person in need (e.g., by picking up the blind man's cane or giving money to the virtual beggar). Third, the generalizability of our results to the "real world" is unclear. There are obviously differences between an IVE and the actual physical world that might alter how a person behaves. For example, it has been suggested that the anonymity provided by the IVE makes one less concerned about social sanctions (McKenna & Bargh, 2000). Also, the fact that participants know at some level (depending on how immersed they are in the scenario) that the IVE and their virtual interaction partners are not physically real makes it unlikely that they will have precisely the same sensations and inclinations they would experience in similar but actual situations. While behavior in an IVE is more realistic than sitting in front of a computer monitor using a mouse to navigate an environment, it is still not the same as life itself. Fourth, as with many behavioral measures in other studies, we cannot be sure of the precise psychological meaning of looking at and staying near a virtual person in need, although the fact that the behavioral measures were predicted by self-reported dispositional compassion suggests that our interpretation is correct. Finally, completing the individual-difference measures after being exposed to the virtual environment, even given our intervening distracter tasks, might have created demand characteristics pushing toward a compassionate response to the self-report measures. If so, the effects were selective and did not extend to everyone, and the fact that we used dispositional measures seems likely to have reduced state demand effects. Still, all of these issues should be examined in future studies.

Despite these limitations, the use of IVET to study prosocial behavior, and other kinds of social behavior as well, seems promising. The methodology is capable of presenting a variety of life-like stimulus environments to people in a consistent manner, without the need for consistent human actors as confederates. This method will allow researchers to explore many aspects of social behavior in a way that is more realistic than verbal scenarios yet not as unmanageable or uncontrollable as field experiments. It also will allow the detailed assessment of human proxemics without the traditional need to have all reactions rated by trained human coders. IVET allows some of them to be measured quantitatively and directly. Finally, IVET also allows researchers to learn more about behavior in a virtual world with virtual people. Given the remarkable rise in online interactions via VEs (e.g., gaming, virtual chat rooms, virtual social communities such as FaceBook, MySpace, and Friendster) and the fact that these communities are often the initiation point of real relationships (including friendships and romantic relationships), it is important to understand how people experience and behave in such virtual worlds. IVET can provide some of this needed information.

Finally, it was our impression that many study participants got involved in the virtual environment without feeling self-conscious, as they might have felt if they had been moving around in a real urban environment and knew they were being watched. This possibility, combined with researchers' ability to vary the environment and the virtual agents' appearance, behavior, and demeanor systematically, makes IVET attractive for the study of prosocial and other forms of social behavior.

NOTES

1. All of the equipment mentioned in this article was assembled and distributed by Virtual Research Systems, Inc., 3824 Vienna Drive, Aptos, CA 95003.
2. The correlation between the DPES compassion measure and the IRI empathic concern score was high in both studies: $r = .69$, $p < .001$, in Study 1; $r = .72$, $p < .001$, in Study 2.

In contrast, neither of these variables was significantly correlated with personal distress, suggesting that, as Batson (e.g., Batson, Fultz, & Schoenrade, 1987) has claimed, the two tendencies are independent; that is, a person can be high on both empathic concern (or compassion) and personal distress, high on one and low on the other, or low on both.

3. Because there were no significant gender differences or interactions involving gender in either Study 1 or Study 2, we did not include gender in the regression analyses reported here.
4. The effects were similar when we controlled for time looking at the businessman.
5. The effects were similar when we controlled for time spent near the businessman.
6. Although the beta coefficient for compassion when predicting nearness to the beggar was significantly different from zero, $\beta = .28, p < .05$, whereas the one for the businessman was not, $\beta = .15$, the two betas were not significantly different from each other with our sample size. The fact that both are positive, with one being larger than the other, suggests that compassionate people have a positive orientation toward people in general, but that the difference between them and less compassionate people is stronger when the target person is in need. We also ran analyses predicting time spent near the virtual person and time looking at the person from compassion scores and type of person (beggar or businessman), with the latter being a within-subjects factor. This allowed us to specifically examine the compassion by type of person interaction. (For simplicity we ran these analyses using only one measure of compassion—the DPES compassion score.) The compassion by type of person interaction was marginally significant for the time looking at the person, $F(1, 68) = 2.90, p < .10$, but not for the time spent near the person. We then examined the correlation between time looking at the person and compassion scores for each target person separately. As expected only the correlation between time looking at the beggar and compassion was significant, $r = .25, p < .05$; whereas the correlation between looking at the businessman and compassion was not, $r = .03$, *ns*. These findings, although preliminary, strengthen our argument that the behavioral measures are indeed indicators of compassionate, prosocial behavior.

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