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# Presence and Television
## The Role of Screen Size

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*Film and a number of emerging entertainment technologies offer media consumers an illusion of nonmediation known as presence. To investigate the possibility that television can evoke presence, 65 undergraduate students were shown brief examples of rapid point-of-view movement from commercially available videotapes on a television with either a small screen (12 inches [30.5 cm], measured diagonally) or a large screen (46 inches [116.8 cm]). Participants' responses were measured via a questionnaire and a computer-based recording of arousal (electrodermal activity). Viewers of both televisions reported an enjoyable sense of physical movement, excitement, involvement, and a sense of participation. Furthermore, as predicted, participants who watched the large screen television thought the movement in the scenes was faster, experienced a greater sense of physical movement, enjoyed the movement to a greater extent, found the viewing experience more exciting, and were more physiologically aroused. Practical and theoretical implications are discussed.*

"I next try to ski. . . . There is only snow and danger, all on an enormous screen that gives the feel of three dimensions and reality. I race off, gathering speed by the

second. I have no idea how to stop. I'm shaking with nervousness. It doesn't seem like a game. I hit a tree, I go under the slalom, I roll head over heals. There is a terrible sound each time I crash, and the whole machine shudders. I feel like crying."

—Martin, 1996, p. C1 (review of XS New York virtual reality arcade)

"It's hard to beat the thrills of "Grand Canyon: The Hidden Secrets," the IMAX film that rides the Colorado River rapids slicing through nature's most majestic chasm.... So effective are the film's you are there perspectives that you wipe away imagined white-water from your brow when you're not holding on to your armrest for dear life."

—Rickey, 1994, p. W5

"[The film "Twister"] brings screen fiction unnervingly close to virtual reality.

—Ryan, 1996, p. W3

These and other comments suggest that media users today want, and get, more than just intriguing characters and thought-provoking stories. They get visceral responses, thrills, a feeling of physical movement, a sense of danger—something very much like the experience of skiing down a snowy mountain or white-water rafting through a canyon. Throughout most of human history this kind of media experience, one that seems to be not mediated, was unavailable, even unimaginable. But recently virtual reality, simulation rides, advanced film formats, video conferencing, and other emerging technologies have been created expressly to provide users with this illusion of nonmediation. These technologies are in their infancy, but already we can see their potential—scholars and researchers are exploring the characteristics of the form and content of these new media, and the characteristics of media users, that contribute to this illusion, identified formally as a sense of "presence."

In the late 1990s sophisticated virtual reality systems and other new media are typically expensive and used primarily by engineers and researchers rather than the public. But although these media may be most capable of generating a sense of presence, some (Lombard & Ditton, 1997; Reeves, 1991; Reeves, Detenber, & Steuer, 1993; Reeves & Nass, 1996) argue that common media such as film, and the most dominant medium today—television, also can evoke this kind of participatory experience. The study reported here examined the potential of television to generate a sense of presence and the influence of a key variable identified in other studies—image size—on presence responses.

## Presence

The term *telepresence* was first used by Marvin Minsky (1980) to refer to teleoperation technology that provides the user with a "remote presence" in a different location via feedback systems that allow him or her to "see and feel what is happening" there. The term was adapted and shortened when the journal *Presence* (MIT Press) was founded in 1992 to provide a forum for "current research and advanced ideas on teleoperators and virtual environments" (subscription request page, Vol. 2, No. 3). In a recent review, Lombard and Ditton (1997) identified six different conceptualizations of presence found in a diverse set of literatures, including presence as social richness (the "warmth" or "intimacy" possible via a medium), realism (perceptual and/or social), transportation (the sensations of "you are there," "it is here," and/or "we are together"), and immersion (in a mediated environment). They incorporate all of these in a single conceptual definition of presence: "the perceptual illusion of nonmediation" ("Presence Explicated" section; par. 1). The term *perceptual* indicates that this phenomenon involves continuous (real time) responses of the human sensory, cognitive, and affective processing systems to objects and entities in a person's environment. An "illusion of nonmediation" occurs when a person fails to perceive or acknowledge the existence of a medium in his or her communication environment and responds as he or she would if the medium were not there.[1]

A large number of factors have been identified as potentially important to producing presence in media users. Characteristics of media form include the number and consistency of sensory outputs (Barfield & Weghorst, 1993; Kim, 1996; Short, Williams, & Christie, 1976; Steuer, 1995; Zeltzer, 1992), image size and quality (Bocker & Muhlbach, 1993; Heeter, 1992; Lombard, 1995; Lombard, Ditton, Grabe, & Reich, 1997; Neuman, 1990; Reeves et al., 1993; Zeltzer, 1992), audio fidelity (Reeves et al., 1993), visual and aural dimensionality (Hatada, Sakata, & Kusaka, 1980; Reeves et al., 1993), subjective camera techniques such as direct address (Horton & Wohl, 1956), and a number of variables related to interactivity (Biocca & Delaney, 1995). Key characteristics of content include social realism (i.e., believability) (Ditton, 1997), use of media conventions (Lombard & Ditton, 1997), and the nature of the task or activity (Heeter, 1992; Perse & Courtwright, 1993; Rice, 1992; Short et al., 1976). The media user is important too; his or her willingness to suspend disbelief (Lombard & Ditton, 1997), knowledge of and prior experience with the medium (Held & Durlach, 1992), age, and gender may all serve to encourage or discourage presence.

The potential consequences of presence are as diverse as the causes and include physiological arousal (Heeter, 1995; Lombard et al., 1997),

feelings of self-motion (vection) (Parker, 1971), motion sickness (Biocca, 1992), enjoyment (Heeter, 1995), involvement (Heeter, 1995), improved task performance and skill training (Azar, 1996; Held & Durlach, 1992; Pausch, Shackelford, & Proffitt, 1993), psychological desensitization (Rothbaum et al., 1995), persuasion (Kim, 1996), distorted memory and social judgments (Ditton, 1997), and more intense parasocial relationships (Lombard & Ditton, 1997).

## Presence and Television

Television seems very unlike the advanced technologies that originally led to the investigation of presence and therefore unable to evoke presence in viewers. Traditionally, research and theory regarding TV have focused on its ability to bring ideas and messages into our homes, not its ability to provide this type of "real" experience. However, some scholars (Lombard & Ditton, 1997; Reeves, 1991; Reeves et al., 1993; Reeves & Nass, 1996) have argued that television, especially today's technologically advanced television presentations with large high-resolution images and high-fidelity stereo surround sound, can evoke presence (although not all of the authors use that term). For example, Reeves (1991) argues that television can "create a sense of 'being there' [in which] . . . our bodies and minds respond to the images on the screen as if they were actual people, places, and events" (p. 2).

Television's ability to evoke presence suggests important theoretical and practical implications. A greater understanding of presence and television can help us enhance our theory and research concerning media uses and influences. For example, Shapiro and Lang (1991) used a model of memory developed by Johnson (1983) to explain how people incorporate information from television into their judgments about the "real" world. They suggest that mediated experiences that closely mimic nonmediated ones cause difficulties for the reality-monitoring process so that when memories are retrieved, mediated and nonmediated experiences are confused (Ditton, 1997, found tentative empirical support for this idea). Presence may be relevant to several other mediaeffects. For example, when mediated violence is experienced as if it was nonmediated, it may be more arousing, seem more "realistic," and be more likely to desensitize viewers (See Yoichi, 1997). Viewers who seem to experience rather than simply observe mediated news events may perceive news presentations as more credible. Advertising that allows media consumers to experience using a product and/or the benefits of that use may increase the perceived value of the product. And viewers may develop more intense parasocial relationships (Horton & Wohl, 1956) with characters and personalities who seem to visit their living rooms via television (Also see Kim, 1996 and Lombard & Ditton, 1997). From a practical perspective,

a better understanding of what presence is, what encourages and discourages it in viewers, and its effects, should be of great interest to those who plan, pay for, and create television programming and advertising. Equipment manufacturers could also save valuable time and money and improve the end-product in the design of television broadcast equipment and television receivers (which is currently based largely on trial and error, lore, and "seat of the pants" exploration; see Huston-Stein & Wright, 1979). Presence in other media (e.g., virtual reality, simulation rides) is enhancing a variety of outcomes, especially entertainment and delight, that the public seeks and for which it is eager to pay (e.g., Brown, 1998; Showscan, 1994); some of the same popularity and financial success is possible if the dynamics of presence are used in television.

It is difficult to test claims that any medium, and especially television, evokes presence. Research on the concept has been fragmentary and unsystematic and we still know relatively little about its causes and consequences. Although some (Barfield & Webhorst, 1993; Barfield, Zeltzer, Sheridan, & Slater, 1995; Prothero, Parker, Furness, & Wells, 1995; Sheridan, 1992) have advocated a standardized operational definition for use in studies of presence, no such measure has yet been created, much less confirmed as valid and reliable. The challenge is to unobtrusively measure, either during or following media use, a set of responses that are thought to parallel those found in an equivalent nonmediated experience.

A handful of studies have examined presence in the context of television viewing. In most cases, this has been as a part of a larger study about a variety of effects of image size—the assumption has been that a larger image fills a greater percentage of the viewer's visual field and is therefore more immersive and so more likely to evoke presence (Reeves & Nass, 1996). Few conclusions can be reached about television and presence from these studies for four reasons. First, in many cases the presentation did not correspond to the typical television viewing experience. For example, Lombard (1995) and Reeves et al. (1993) had individuals view images projected onto part of a white film screen, Lund (1993) showed film clips without audio, and Neuman (1990) used a wall-sized (180-inch [457.2 cm]$^2$) display with advanced resolution (3,000 lines). Second, the content and presentation characteristics, particularly image size, have not been varied systematically across the studies. For example, it is nearly impossible to compare responses to segments from action films projected onto a film screen to create a 35-inch (88.9 cm) ("small") image (in Reeves et al., 1993) with responses to a complete infomercial for exercise equipment presented on a 9-inch (22.9 cm) ("small") television (in Kim, 1996).

The third reason why it is difficult to draw conclusions from studies of television and presence is that different, and often inappropriate,

measures of presence have been used in each of the studies. In most cases, participants are asked in an explicit manner to report the extent to which they felt a sense of presence during viewing. Participants assess a "sense of realism" (Neuman, 1990) or "reality or presence" (Lund, 1993), agree or disagree with statements such as "I felt like I was a part of the action" (Reeves et al., 1993) or "The TV-generated world seemed to me somewhere I visited rather than only something I saw" (Kim, 1996), or answer questions such as "How much of a sense of participation in the scene did you feel?" (Ditton, 1997). Other researchers have constructed more implicit measures of presence. Lombard et al. (1997) used content-specific questions such as "How hot was the fire?" after participants watched a scene that depicted a fire. Although all of these measures might be appropriate for users of virtual reality, they are likely to seem odd and unnatural in the context of television viewing and therefore prompt reactive responses. An exception may be Lombard's (1995) attempt to replicate findings from the interpersonal (nonmediated) communication literature in the context of mediated experience by having participants evaluate characteristics (e.g., pleasantness) of people they watched in different-size images from different viewing distances (nevertheless, the use of images projected on a white film screen and the within-subject design in that study remain problematic).

The fourth and final reason why it is difficult to draw conclusions from these studies is that they provide only weak statistical evidence. Neuman (1990) reports that at the highest level of resolution (3,000 lines), a wall-sized (180-inch [457.2 cm]) display yielded reports of a dramatically increased "sense of realism" over a 35-inch (88.9 cm) display, but no statistical evidence is presented. In the Reeves et al. (1993) study, participants who watched clips from action films on a 70-inch (177.8 cm) screen reported significantly greater agreement with the statement "I felt like I was a part of the action" than participants who watched a 35-inch (88.9 cm) image, but no differences were found for items related to the excitement, pace of action, and realism of the film clips. Kim (1996) showed participants an infomercial on either a 9-, 20-, or 32-inch (22.9, 50.8, or 81.3 cm) television screen and found no differences for presence ("I felt I was in the world television created" and "The TV-generated world seemed to me somewhere I visited rather than only something I saw"). Lombard et al. (1997) had participants watch segments from a variety of current television fare on either a small (12-inch [30.5 cm]) or large (46-inch [116.8 cm]) television screen and, using the more implicit measures described above, found a subtle but statistically significant effect in which the evaluative responses to the larger screen, and therefore larger objects and people, were more intense (as would be expected in a nonmediated setting) than those to

the small screen. The commercials and programs that evoked more intense responses in viewers of the large screen television contained more and shorter shots; sudden movement, especially from point-of-view camera angles; and impacts. Lombard (1995) found support for predictions based on Burgoon's Nonverbal Expectancy Violations Model (Burgoon, 1978; Burgoon & Walther, 1990) regarding perceptions and behaviors related to apparent interpersonal distance when participants watched professional and attractive news anchors deliver stories projected on a large (42-inch [106.7 cm]) white film screen, a 26-inch (66 cm) monitor, and a 10-inch (25.4 cm) monitor. When participants watched the largest images, they reported more positive emotional responses to the anchors and to the viewing environment, and then selected a viewing position that represented a smaller withdrawal from the encounter, than when the people appeared on the smaller screens.

Although no theoretical basis has been proposed for its inclusion, gender has been evaluated as an independent variable in most of the studies of presence and television. The nature of stimuli presented may explain some of the results; for example, men have reported more enjoyment than women for scenes from action films (Reeves et al., 1993), whereas women have reported greater liking than men for a 15-minute infomercial for exercise equipment (Kim, 1996). The pattern of interactions between participant gender and screen size in the studies is contradictory but suggests that women may respond more to the screen size manipulation with regard to presence. For example, Lombard (1995) found that women had significantly stronger emotional responses (indicating presence) to larger images, whereas men showed little change. In Reeves et al.'s (1993) study, female participants were more likely to agree that they felt like they were "part of the action" when they viewed the large rather than the small screen, whereas the reverse was the case for male participants.

Together, these results suggest that television may be able to evoke presence in viewers, that larger television images may evoke greater presence, and that gender may play a role, but these claims have not been specifically or adequately tested. The significance of television evoking presence has been discussed. Results confirming the role of image size in generating presence would also have important implications. Big-screen televisions are increasingly available, affordable, and popular (Pressler, 1996; Staff, 1993) and "bigger pictures are the essence of HDTV" (Thorpe, 1989), which is to be phased in during the next 9 years (Krantz, 1997). If people increasingly view large images at home, they may experience presence with increasing frequency as well.

An effective test of these claims requires the use of presentations that correspond to typical televiewing and stimuli that are most likely

to evoke presence responses (those likely to occur in the equivalent nonmediated experience) while allowing for measures that seem natural and reasonable to participants in the context of television viewing and that therefore will be nonreactive. Past research (Alexander & Barrett, 1975; Lombard et al., 1997; Parker, 1971)[3] suggests that the most appropriate stimuli would be content that features the rapid point-of-view movement camera technique. A point-of-view shot refers to a film or video segment in which it is implied that the camera represents the eyes of a participant in the portrayed event or situation (Zettl, 1990).[4] Point-of-view *movement* refers to the use of a moving camera to mimic for the viewer the nonmediated movement of a person or object through an environment. Rapid point-of-view movement is common in virtual reality, simulation rides, and action-adventure films; on television, it is common in action-adventure programs, music videos, commercials, and sports coverage.[5] Content that features this technique seems more likely than any other to evoke presence in viewers and also allows for nonreactive measures of presence responses based on the correspondence between the nonmediated experience and the mediated experience presented on the screen (e.g., "How fast was the movement?" and "How much of a sense of physical movement did you feel?").

## Hypotheses

The preceding discussion provided the foundation for the following hypotheses.

H1. Viewers of scenes featuring rapid point-of-view movement on television, regardless of screen size, will report a variety of responses that indicate presence, including a sense of physical movement, queasiness, excitement, involvement, enjoyment, and participation.

H2. Viewers of scenes featuring rapid point-of-view movement on a large-screen television will be more aroused and will report a variety of responses that indicate presence, including a sense of physical movement, queasiness, excitement, involvement, enjoyment, and participation, that are more intense than will viewers who watch these scenes on a small-screen television.

H3. Presence responses of male viewers and female viewers to scenes featuring rapid point-of-view movement, and to the presentation of the scenes in large and small screen formats, will differ.

## METHOD

### Overview

Sixty-five viewers watched 10 short scenes from rental videotapes that featured rapid point-of-view movement. The independent variables were screen size (small and large) and participant gender. The small-screen television was a cathode-ray tube, direct-view television with a 12-inch (30.5 cm) screen. The large-screen television was a rear-projection television with a 46-inch (116.8 cm) screen. The experimental design was between subject: Approximately half of the participants watched the small-screen television (male = 17, female = 15), and about half the participants watched the large-screen television (male = 18, female = 15). Participants viewed individually and the television sets were switched after about every 15 viewers had participated. After each scene, a set of questionnaire items measured a variety of evaluative presence responses and physiological arousal was recorded by a computer during the entire session.

### Stimulus Preparation and Description

Members of the research team rented and reviewed approximately 30 videotapes from a variety of genres (e.g., adventure, mystery, drama, sports, documentary, comedy, etc.). Ten scenes containing rapid point-of-view movement were selected, including portrayals of activities such as riding a roller coaster, bobsledding, driving an all-terrain vehicle, flying a fighter jet, windsurfing, parachuting, driving in the Indianapolis 500, and flying a biplane. Scenes that could have reduced presence because they reminded viewers that they were watching a created message—for example, scenes that featured graphics or special effects and scenes that featured well-known film and television personalities—were avoided (Lombard & Ditton, 1997).

Two stimuli tapes were individually assembled with a Panasonic AG 750 VHS editing system. Both tapes began with a scene from a National Geographic documentary about birds that featured non-point-of-view movement (this served as a practice scene). For the first tape, the order of the remaining scenes was determined by using a random assignment procedure. This order was reversed for the second tape to control for the effects of order. The scenes were between 39 and 143 seconds long, and they were separated by 55 seconds of tape containing a black picture and no sound. A 1-second tone was inserted 5 seconds before each scene to alert participants that the scene was about to begin. See Table 1 for a complete description of the stimuli.

**TABLE 1**
**Description of Stimuli, in Presentation Order[a]**

| *Genre* | *Title* | *Description of content* | *Length* | *Distributor* | *Year* |
|---|---|---|---|---|---|
| Documentary | *America Screams!* | A point-of-view camera perspective from a roller coaster as it travels inclines, declines, and sharp curves. | 1:16 | Rhino Home Video | 1990 |
| Adventure | *Warbirds* | The camera provides the cockpit perspective of a fighter jet pilot engaging in combat, as he flies close to the ground, takes sharp turns, and passes close to other aircraft. | 1:07 | Vidmark Entertainment | 1988 |
| Documentary | *To Fly* | The camera travels along as a biplane makes a full loop and flies upside down near the ground. | 0:57 | Conoco | 1976 |
| Sports | *The Impact Zone* | The camera provides the perspective of a person windsurfing on the ocean. As he moves over and around the waves, water occasionally hits the camera lens. | 1:43 | MVP Productions | 1987 |
| Sports | *Speed Freaks* | The camera takes the perspective of the driver of an off-road vehicle speeding across rough terrain. | 0:57 | Simiter Entertainment | 1988 |
| Sports | *On the Edge* | A bobsledding sequence in which the perspective is from over the shoulder of the front sledder. | 0:55 | The Time Inc. Magazine Company | 1991 |
| Documentary | *To Fly* | The camera perspective is that of a biplane pilot flying low across land, suddenly crossing the edge of a cliff, and then flying along a rocky coastline. | 0:40 | Conoco | 1976 |
| Sports | *On the Edge* | Parachutists jump from a high cliff and the camera takes their perspective as they free-fall and land. | 1:02 | The Time Inc. Magazine Company | 1991 |
| Adventure | *Runaway Train* | A chase scene featuring point-of-view movement from a train as it travels snow-covered terrain and passes through tunnels. | 0:46 | The Cannon Group: MGM/UA | 1985 |
| Sports | *Live and Drive the Indy 500* | An over-the-shoulder perspective of a race car driver as he races around the track at the Indianapolis 500. | 0:57 | CBS Fox Video | 1989 |

a. Presentation order was reversed (with the exception of the practice scene) for half of the participants.

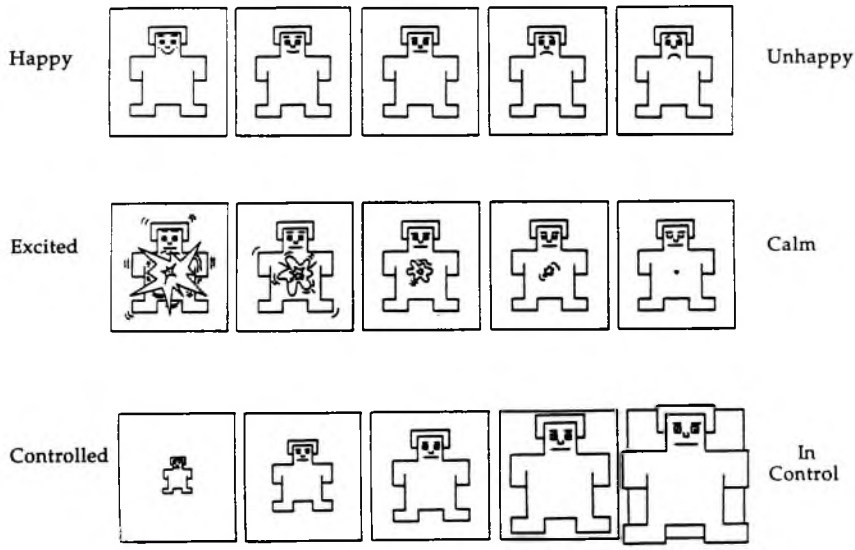


**Figure 1:** **The Self-Assessment Manikin (SAM) Measure Scales (valence, arousal, and dominance; pole labels added)**

## Dependent Measures

The dependent variables were a variety of evaluative presence responses, measured via a paper-and-pencil questionnaire, and physiological arousal, measured via a computer-based recording of electrodermal activity.

The participants completed two pages of questionnaire items immediately after viewing each scene. The first page consisted of the Self-Assessment Manikin (SAM) rating system (see Figure 1), which measures three dimensions of emotional response: valence, arousal, and dominance (Hodes, Cook, & Lang, 1985; Lang, 1980). The SAM scales have been shown to be both highly reliable and highly correlated with traditional measures of emotional response and physiological activity (Lang, Greenwald, Bradley, & Hamm, 1993). The order of the three sets of SAM figures was randomly varied across scenes.

The second page of questions for each scene consisted of ten 10-point semantic differential items (1 = *None* or *Not* ____, 10 = *Very Much* or *Very* ____; rather than numerical labels, the response options appeared as a series of progressively larger dots from left to right). The questions, in the order they appeared, were as follows: "How fast was the movement in the scene?," "How much of a sense of physical movement did you feel?," "How much did you enjoy this sense of movement?," "How

close to the [ground did the plane fly]?,"[6] "How tiring was it to watch the scene?," "How exciting was the scene?," "How involved were you while watching the scene?," "How much of a sense of queasiness did you feel?," "How dangerous did this activity seem?," and "How much did it feel like it was happening to you?" (an explicit measure of presence).[7]

After the presentation, the participants completed items on the last two pages of the questionnaire. Participants were asked to provide an overall evaluation of the viewing experience and of the quality of the television picture and report their prior participation in each of the activities portrayed in the scenes; the screen size of the television they watched most often; the distance from which they typically watched that television; and their age, race, and gender.

Physiological responses to the stimuli were obtained through a computer-based instrument that measures changes in the electrical properties of a person's skin (electrodermal activity [EDA] or more specifically, skin conductance level [SCL]), which is a covert indication of the participant's arousal (anxiety, nervousness, and stress) in response to a stimulus (Mehler, Miller, Antonucci, & Cochran, 1986).

## Participants

The 65 undergraduate students who participated in the experiment were between 17 and 43 years of age ($M$ = 20.7, $SD$ = 4.2, $Mdn$ = 19.0). Thirty participants were women and 35 were men. Sixty percent ($n$ = 39) were White, 30.8% ($n$ = 20) were African American, and the remainder were Asian and Hispanic.

## Procedure

Each participant was met by the experimenter and escorted into a carpeted, 11-by-22 foot (335-by-671 cm) room that contained a television, a video cassette recorder, and a comfortable chair that faced the television screen. Various amenities, such as a decorative table lamp and pictures on the walls, made the environment similar to a living room. In both screen-size conditions the chair was placed at 5 feet 10 inches (177.8 cm) from the front of the screen.[8]

The experimenter explained that the participant would be viewing several short scenes from rental videotapes, that each scene would be followed by approximately a 1-minute pause during which the screen would be dark, and that during this time the participant was to answer the two pages of questions on the questionnaire regarding what had just been seen. The experimenter emphasized that there were no wrong answers and that the participant was not to look at the questions

before viewing the scene. Two round, 0.4-inch (1 cm) sensors, each cleaned with alcohol and then covered with a small amount of conductive electrolyte gel, were attached to the ring and middle fingers of the participant's nondominant hand and one small strip of surgical tape was used to secure connecting wires to the participant's palm (to reduce sensor movement that might disturb proper measurement). The participant was assured that the sensors would not affect him or her in any way. The experimenter explained the format of the questions, told the participant that a tone would sound 5 seconds before the beginning of each scene, and instructed the participant to complete all of the pages of the questionnaire before removing the sensors and informing the experimenter that he or she was finished. The experimenter then gave the participant a clipboard along with a questionnaire and pen, turned on a small reading light attached to the clipboard, started the presentation, activated the electrodermal activity instrument, and left the room. The entire procedure took about 35 minutes.

### Apparatus

The small cathode-ray tube television was an NEC model PM-1271A with a 12-inch (30.5 cm) screen. The rear-projection television was an RCA model P46728W/C; it had a 46-inch (116.8 cm) screen and was set in a freestanding wooden cabinet. To control for extreme differences in sound quality between the two televisions, the monophonic setting was used for the large-screen television (the small-screen television produced only monophonic sound). A Realistic sound-level meter (model 33-2050) was used to set the sound level for both televisions at a comfortable level (75 decibels) (Alten, 1990). The brightness, color, and contrast settings for the two televisions were adjusted for optimal picture quality. A Sony SLV-555UC (consumer model) video cassette recorder was used to play the stimulus tapes.

The electrodermal data were gathered with the Biofeedback Microlab system, designed by the Human Relations Media Software division of Queue, Inc. The system consisted of an interface card installed in an IBM-compatible computer, custom software, an interface unit, two sensors with Velcro straps, and conductive electrolyte gel. The system continuously samples the SCL data and provides aggregated data once per second.[9]

## RESULTS

To test the first hypothesis, that viewers will report a variety of responses indicating a sense of presence when they watch rapid point-

of-view movement on any size television screen, an additive index based on all questionnaire items across all 10 rapid point-of-view movement scenes was constructed (Cronbach's alpha = .94). If the participants' responses to the questionnaire items indicated that they experienced a sense of presence, the mean response on this index should be significantly different from the low end of the 10-point response scale; given response biases that might lead participants to avoid the low end of the scale, a more conservative test requires the mean response on the index to be significantly different from the midpoint of the scale (5.5). The mean for the index was 6.03, meeting the criteria of the more conservative test ($z = 5.3$, $p < .001$). Separate indices were also constructed for each questionnaire item across the 10 rapid point-of-view movement scenes. These 13 indices are all reliable (Cronbach's alpha $\geq .70$); means and standard deviations for all of the indices are presented in Table 2. Participants reported that the movement in the scenes was fast ($M = 7.78$), that they felt a strong sense of movement while they watched ($M = 7.03$), that they enjoyed this sense of movement ($M = 6.42$), that the scenes were exciting ($M = 6.56$) and involving ($M = 6.77$), and even that it felt like what they saw on the screen was happening to them ($M = 5.61$). Although comparable responses to other types of mediated and nonmediated experiences are not available, the results suggest that participants at least experienced some substantial sense of presence, one not likely provided by less vivid and more representational/symbolic media (e.g., written or spoken narrative).

The second hypothesis, that viewers will report more intense presence responses when they watch rapid point-of-view movement on a large television screen than when they watch the same content on a small television screen, was tested via a two-way (Screen Size $\times$ Subject Gender) analysis of variance (ANOVA)[10] in which the dependent variable was the additive index based on all questionnaire items. The results revealed a significant effect for screen size, $F(1, 61) = 4.63$, $p = .035$, partial $\eta^2 = .071$; $M$(large) = 6.23, $M$(small) = 5.83. The individual presence responses were examined using separate ANOVAs for indices based on each questionnaire item across the rapid point-of-view movement scenes. As indicated in Table 2, the mean responses are higher for participants who watched the large-screen television than for those who watched the small-screen television in all but two cases (the SAM measure of dominance and the question concerning the extent to which viewing was tiring). The differences were significant ($p < .05$) for five of the indices: Participants who watched the large screen reported that the movement in the scenes was faster, that they felt a greater sense of physical movement, that they enjoyed this sense of movement more, that the vehicle on the screen came closer to the terrain, and that the scene was more exciting. The difference for a sixth

**TABLE 2**
**Reliability, Means, Standard Deviations, and Analysis of Variance (ANOVA) Results for Indices Created From Self-Assessment Manikin (SAM) Measures and Other Questionnaire Items Across All Rapid Point-of-View Movement Video Scenes**

| | | | *Means and ANOVA results*[a] | | | |
|---|---|---|---|---|---|---|
| | | | *Screen Size* | | *Gender* | |
| *Index* | *Cronbach's Alpha* | *Overall Means* | *L* | *S* | *M* | *F Interaction* |
| Affect valence (SAM)[b] | .74 | 6.02 | 6.05 > | 5.99 | 6.23 > | 5.77[†] |
| | | (0.99) | (1.09) | (0.89) | (1.05) | (0.87) |
| Arousal (SAM)[b] | .84 | 5.42 | 5.67 > | 5.16 | 5.57 > | 5.24 |
| | | (1.42) | (1.36) | (1.46) | (1.28) | (1.58) |
| Dominance (SAM)[b] | .85 | 4.91 | 4.87 < | 4.96 | 4.81 < | 5.04 |
| | | (1.63) | (1.49) | (1.78) | (1.67) | (1.60) |
| Speed of movement | .78 | 7.78 | 8.08 > | 7.47* | 7.72 < | 7.85 |
| | | (0.99) | (0.95) | (0.95) | (1.07) | (0.91) |
| Sense of physical movement | .81 | 7.03 | 7.36 > | 6.69* | 7.19 > | 6.84[†] |
| | | (1.43) | (1.13) | (1.63) | (1.31) | (1.56) |
| Enjoyment of movement | .77 | 6.42 | 6.75 > | 6.07* | 6.87 > | 5.89** |
| | | (1.45) | (1.32) | (1.51) | (1.13) | (1.61) |
| Relationship of "participant" with terrain | .70 | 7.48 | 7.77 > | 7.18* | 7.54 > | 7.41 |
| | | (1.06) | (0.97) | (1.07) | (0.99) | (1.15) |
| Tiring to watch scene | .78 | 3.70 | 3.70 < | 3.71 | 3.58 < | 3.85 |
| | | (1.46) | (1.49) | (1.45) | (1.26) | (1.67) |
| Excitement of scene | .73 | 6.56 | 6.97 > | 6.14** | 6.65 > | 6.46** |
| | | (1.31) | (0.98) | (1.48) | (1.07) | (1.56) |
| Involvement during viewing | .72 | 6.77 | 6.88 > | 6.66 | 6.81 > | 6.72[†] |
| | | (1.36) | (1.33) | (1.40) | (1.41) | (1.32) |
| Sense of queasiness | .88 | 3.86 | 3.97 > | 3.74 | 3.74 < | 4.00 |
| | | (2.06) | (2.22) | (1.90) | (1.82) | (2.33) |
| Danger of activity | .77 | 6.85 | 7.12 > | 6.57[†] | 6.52 < | 7.23* |
| | | (1.40) | (1.22) | (1.53) | (1.36) | (1.36) |
| Feel like participant | .79 | 5.61 | 5.79 > | 5.41 | 5.65 > | 5.55[†] |
| | | (1.59) | (1.62) | (1.55) | (1.51) | (1.69) |
| All indices | .94 | 6.03 | 6.23 > | 5.83* | 6.07 > | 5.99* |
| | | (0.84) | (0.72) | (0.91) | (0.73) | (0.96) |

NOTE: L = large screen size; S = small screen size; M = male participant gender; F = female participant gender.
a. The assumption of homogeneity of variance was tested and found to be warranted for all analyses via the $F_{Max}$ test (Tabachnick & Fidell, 1995).
b. These measures are on a 9-point scale (see description of SAM measure in text); all others are on a 10-point scale (1 = *none* or *not* ___, 10 = *very much* or *very*___ ).
$^{\dagger}p < .10$. $^{*}p < .05$. $^{**}p < .01$.

item approached significance: Viewers of the large screen also perceived the activities they saw in the scenes as more dangerous ($p < .095$).

To analyze the participants' electrodermal activity (SCL),[11] which was recorded in a unit called a micromho (one-millionth of one amp of current per volt), mean values were calculated for each participant for the period of time during which each scene was being viewed. A two-way multivariate analysis of covariance (MANCOVA), in which the dependent variables were the mean SCL values for each point-of-view scene and the covariates were the SCL values obtained 2 seconds prior to the beginning of each corresponding scene, revealed a significant difference based on screen size favoring the large screen, $F(1, 57) = 4.39$, $p = .041$; partial $\eta^2 = .071$; $M$(large) = 36.8, $M$(small) = 35.3.

The third hypothesis, concerning differences in responses of male and female participants, also received support. As indicated in Table 2, male participants reported that they enjoyed the sense of movement in the scenes significantly more than female participants, $F(1, 61) = 8.45$, $p = .005$; partial $\eta^2 = .122$, whereas female participants perceived the activities in the scenes as more dangerous, $F(1, 61) = 4.61$, $p = .036$; partial $\eta^2 = .07$. And a recurring pattern of interactions was found between participant gender and screen size in which female participants had a greater response to the screen-size manipulation, reporting more intense responses to the large screen, whereas male viewers showed relatively little change. The pattern emerged in the ANOVA for the summary index created from all of the questionnaire items, $F(1, 61) = 4.22$, $p = .044$; partial $\eta^2 = .065$ (see Figure 2), and in the means for 11 of the 13 questionnaire indices. It is significant or approaches significance ($p < .08$) for indices based on the items related to perceived sense of movement, excitement, involvement, and participation (see Table 2).

## Additional Analyses

After all viewing was completed, participants reported that they had enjoyed watching the scenes ($M = 6.86$ on a 10-point scale [1 = *not at all*, 10 = *very much*]), but there were no significant differences in enjoyment based on screen size or participant gender.

The viewing distance for the study (5 feet, 10 inches [177.8 cm]) was selected to produce comfortable viewing for participants in both the large- and small-screen conditions. After viewing, participants who had watched the small-screen television reported that they would have preferred to sit slightly closer to the television ($M = 4.19$, $SD = 1.60$, on a 10-point scale in which 1 represents movement closer and 10 represents movement further away). Participants who had watched the large-screen television would have preferred to sit slightly farther away

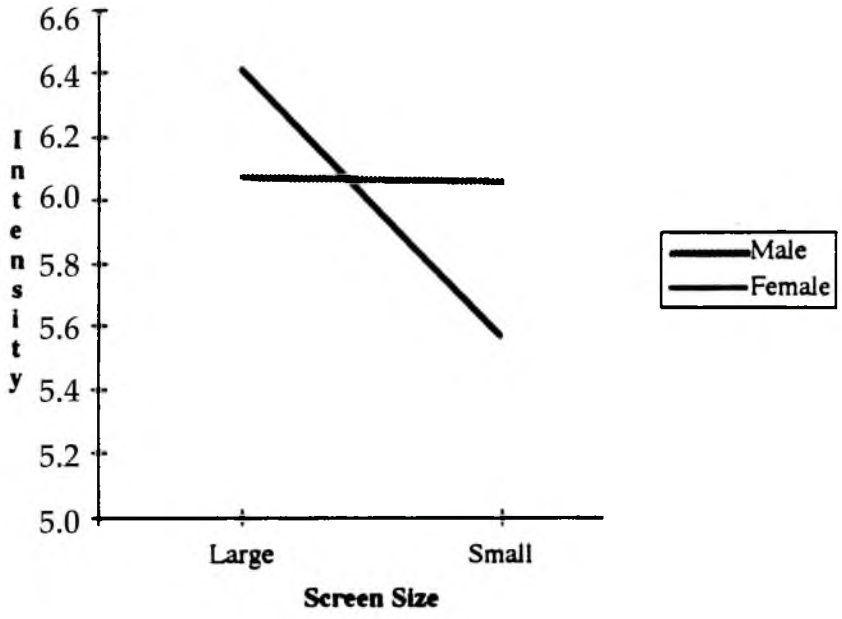


Figure 2: Screen Size × Subject Gender Interaction for Additive Index of All Questionnaire Items

($M = 5.60$, $SD = 1.80$). Although this difference was significant, $t(63) = 3.35$, $p = .001$, $r^2 = .15$, it appears that the viewing distance was optimum given the constraints provided by the screen-size manipulation. When preferred viewing distance was controlled in the analyses (via ANCOVA), the pattern of results was unchanged, even though in some cases significance values were increased.[12] There was no difference in participants' evaluations of the picture quality of the two television sets, which was judged to be quite good ($M = 8.52$, $SD = 1.60$).

Indices based on the set of questionnaire items for each of the 10 individual video segments were reliable (Cronbach's alpha $\geq .69$), and the means for the large-screen condition were higher for all of the scenes except the one featuring a roller coaster. ANOVAs were conducted for these indices with stimuli presentation order included among the independent variables. Order was significant for four of the segments, of which only two were contiguous and/or at the beginning or end of the presentation; the primary results were largely unchanged when these two segments were removed from the analyses.

## DISCUSSION

The results of this study demonstrate that at least under some circumstances and to some extent, a sense of presence can occur in the context of television viewing. Participants watching scenes from rental videotapes that featured rapid point-of-view movement reported an enjoyable sense of physical movement, excitement, involvement, and a sense of participation. Furthermore, as in other studies of presence, screen size seemed to play a critical role in generating these responses. Participants who watched the large-screen television thought the movement in the scenes was faster, experienced a greater sense of physical movement, enjoyed the movement to a greater extent, and found the viewing experience more exciting than participants who watched the same scenes on a small television screen. Participants who watched the large screen were also more aroused, as measured by electrodermal activity, during viewing.

As in previous studies (Lombard, 1995; Reeves et al., 1993), female participants responded differently to the presentation than male participants, reporting that the activities portrayed seemed more dangerous and the simulated movement less enjoyable, and responding more strongly to the screen-size manipulation for several presence measures. One explanation for these gender differences involves the nature of the television content shown, which featured sports and other recreational activities. Evaluation of an additive index based on a series of questions about the respondents' prior participation in the portrayed activities revealed that the male participants were more familiar with these activities in nonmediated experience, $t(45.5) = 2.72$, $p = .009$; $r^2 = .094$; males: $M = 5.77$, $SD = 3.42$; females: $M = 4.07$, $SD = 1.34$. Male participants were also used to watching larger television images, $\chi^2(1, N = 65) = 5.63$, $p = .017$, $\phi = .29$). Thus, their relative familiarity with the content and form of the mediated presentation may have led males to respond less intensely to the portrayals, especially those on the large screen (however, gender differences remained when these variables were included in the analyses).

A second possible explanation for the gender differences concerns more fundamental differences between males and females, specifically in their styles or modes of perception. Witkin's field independence/field dependence construct (Witkin & Goodenough, 1981) describes differences in how much individuals rely on visual information versus vestibular information (from receptors in the inner ear that produce the sense of equilibrium) in certain perceptual tasks. When processing visual information, field-dependent individuals rely more on the visual field (an external referent) than those who are field independent. Females tend to be more field dependent than males (Korchin, 1986;

Pizzamiglio & Zoccolotti, 1986) and therefore are more likely to be affected by manipulations of the visual field, such as a screen-size manipulation. Specifically, field-dependent participants are "particularly susceptible to visually induced illusions of self-motion" (Witkin & Goodenough, 1981, p. 10). Related to this explanation is Mehrabian's (1976) concept of stimuli "screening": Screeners impose a hierarchy of importance or pattern on complex stimuli to reduce the information to be absorbed. Males are said to screen and rapidly habituate to distracting, irrelevant stimuli more than females (Mehrabian, 1976). Because the image on a large television arguably presents a more complex and distracting stimulus than the image on a small television, perhaps male participants respond less to this increased visual complexity than female participants because they tend to be screeners. These explanations are highly speculative, of course; the gender differences found here and in previous studies warrant systematic research (e.g., individual-difference measures including field independence/dependence and screening should be included in future studies of presence).

A surprising result concerned participants' reported enjoyment. Participants who watched the large-screen television reported no greater enjoyment of the experience than participants who watched the small screen. Although it seems reasonable to expect viewers to enjoy watching a larger image, there is scant empirical evidence that this is the case. Neuman (1990) is one of the few to find a difference in enjoyment favoring larger screens, but the difference appeared only for high-resolution images (which suggests that the effect of screen size on enjoyment might become more pronounced with the arrival of advanced TV systems).

Several limitations in this study should be noted. Participants were all college students from a large urban university, most majoring in communication; the video scenes were short, taken out of their original context, and repeatedly highlighted one production technique; sensors were affixed to participants' fingers, creating a somewhat unusual viewing experience; and the instructions were necessarily lengthy.

## CONCLUSION

Most communication research and theory concerning television and other media focuses on the process by which consumers decode and interpret media "messages" (both intended, as in news stories and advertising, and unintended, as in the underrepresentation of minority groups on television). But the participants in this study did not just respond to the ideas or meanings they saw—they reported something approaching an experience of "being there," where "there" is the real-

ity portrayed in the images. Considered in the context of improvements in television production and presentation technology and consumer preferences for televisions with larger screens, these results suggest that television viewers will increasingly be able to experience presence in their own homes. In a few years, when high-definition television seems to literally bring us into the cross fire of a police shoot-out or the path of a tornado or any other situation, the television producer will need to develop new ways to maximize entertainment and information value without overwhelming the viewer, whereas the communication researcher will need to determine whether and how such experiences influence our perceptions and judgments about the nonmediated ("real") world and our behavior in it.

## NOTES

1. Although in one sense all of our experiences are mediated by our intrapersonal sensory and perceptual systems, *nonmediated* here is defined as experienced without human-made technology.

2. All references to television screen size refer to the diagonal measurement of the screen.

3. In a study of motion sickness, Parker (1971) showed participants a custom-made 8-minute video segment taken from the point of view of a driver of a car as it traveled a winding mountain road. Several participants became nauseous and could not complete the session. In a follow-up study, Alexander and Barrett (1975) explained their participants' less severe response to the same stimulus by noting that they presented it to the participants on a smaller screen than Parker had used in his study.

4. This is distinct from lens movement such as a zoom, horizontal and vertical camera movement such as a pan or tilt, movement of an object toward a motionless camera (e.g., a baseball thrown toward the camera), sudden movement of objects across the screen, and movement created by the shift of viewpoints through cutting (Zettl, 1990).

5. According to Neil Goldberg, ESPN's senior producer of motor sports, the use of footage from cameras placed on-board cars during races "has been a major part of the evolution of motorsports coverage and has . . . allowed people to cross the barrier from being just a spectator to being a participant" (Smith, 1998, p. E6).

6. This question was designed to measure the intensity of the relationship of the "participant" to the terrain. The other scene-specific questions were the following: "How tight were the roller coaster's turns?," "How close to the ground did the fighter jet fly?," "How rough was the sea?," "How bumpy was the ride?," "How close to the sides of the course did the bobsled get?," "How sudden was the drop from the cliff?," "How close to the side of the cliffs did the parachutists get?," "How close was the train to the side of the tunnel?," and "How close to the wall did the car get?"

7. All of the questions were considered appropriate and used for the practice video segment except the question regarding the danger of the activity.

8. The selection of viewing distance in this type of study is problematic. When viewing distance is varied across values of screen size, these two variables are confounded. When viewing distance is held constant, the proportion of participants' visual field occupied by the image is varied and creates a different confound. In this study, as in most previous studies of screen size, pretesting was used to identify a distance from which it was comfortable to view either television set.

9. The voltage signal is continuously integrated by electronic circuitry. When integrated activity reaches a particular level (10-100 cycles per second), information is sent to the computer, which measures the time taken to reach that level (P. Antonuci, author of Biofeedback Microlab software, personal communication, spring 1997).

10. The multivariate analysis of variance (MANOVA) procedure in Statistical Package for the Social Sciences (SPSS) was used.

11. Skin conductance level (SCL) data for 3 of the 65 participants, 1 male participant and 1 female participant in the large-screen condition and 1 male participant in the small-screen condition, were lost due to equipment failure.

12. Although viewers do generally watch larger images from greater distances (Nathan, Anderson, Field, & Collins, 1985), other research (Hatada, Sakata, & Kusaka, 1980; Yuyama, 1982) has shown that manipulations of image size and viewing distance that result in the same proportion of visual field occupied by the image have independent effects on presence responses, with large image size and large viewing distance (e.g., in an IMAX theater) producing a stronger "sensation of reality" than a small image and small viewing distance (e.g., in a virtual-reality head-mounted display), but more research is needed on the question.

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