Social-Psychological Origins of Feelings of Presence:

Creating Social Presence with Machine-Generated Voices

RESEARCH NOTE

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Abstract

We demonstrate, via two experiments (N = 72 and N = 80) done in e-commerce contexts, that social responses to technology influence feelings of social presence. Users are shown to feel stronger social presence when they hear a computer-synthesized voice that manifests a personality that: a) is similar to the user as compared to dissimilar to the user's, b) is consistent with the text's personality (Experiment 2), and c) is extroverted as compared to introverted.

Keywords: social presence, presence, telepresence, similarity-attraction, consistency-attraction, computers are social actors, media equation

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Researchers have begun to realize that the feeling of presence is at the heart of all mediated vicarious experiences, from reading a novel (Gerrig, 1993) to riding an immersive VR simulator (Heeter, 1992), because presence is at the heart of humans' desire to use media to move beyond the limits of body and the sensory channels (Biocca, Kim, & Levy, 1995). As a result, the concept of presence has become central to theorizing about advanced human-computer interface such as virtual reality (VR) systems (Biocca, 1997; Held & Durlach, 1992; Lombard & Ditton, 1997; Loomis, 1992; Sheridan, 1995; Snow, 1996; Steuer, 1992; Whitmer & Singer, 1998), as well as traditional media such as television, film, and books (Ditton, 1997; Kim & Biocca, 1997; Lombard, Reich, Grabe, Bracken, & Ditton, 2000).

After an extensive review of presence-related concepts and their explications, Lombard and his colleagues define presence as "the perceptional illusion of nonmediation" (Lombard et al., 2000, p 77; for other definitions, see, e.g., Sheridan, 1993; Steuer, 1992; Whitmer & Singer, 1998). The term "perceptual" means that presence "… involves continuous (real time) responses of the human sensory, cognitive, and affective processing systems to objects and entities in a person's environment" (Lombard et al., 2000, p 77). By "illusion of nonmediation," they refer to a phenomenon in which "… 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" (Lombard et al., 2000, p 77).

Communication researchers and VR designers have tended to focus on *physical* presence (Barfield & Weghorst, 1993; Kim & Biocca, 1997; Lombard & Ditton, 1997; Reeves, Detenber, & Steuer, 1993, May; Slater & Usoh, 1993), the extent to which people feel that they are in a virtual world (Biocca, 1997; Heeter, 1992). However, an equally important dimension of presence is *social presence*, the sense that other intelligent beings co-exist and interact with you (Heeter, 1992), even if those beings are non-human and only seem intelligent (Biocca, 1997).

The possibility that social presence can also be created through agents or through the machine itself (e.g., computers, e-toys such as Sony's Aibo, bots, etc.) has tremendous theoretical and practical import. Theoretically, it suggests new line of thinking about our interaction with media (see Nass & Moon, 2000 and Reeves & Nass, 1996) and what it is to be human (Nass, 1997). Moreover, the growing trend of projecting oneself into mediated virtual environments (via agents and avatars) and increasing communication between projected selves (Maes, 1994; Turkle, 1995) has called for a systematic study of how people make sense of virtually presented others. Practically, the recent growth of multi-user computer games and anecdotal evidence indicate that users strongly prefer to interact with others (Heeter, 1992) across a wide range of media products (Reeves & Nass, 1996). Social presence has also been argued to facilitate persuasion (Fogg & Tseng, 1999) and sales in e-commerce (Moon, 1998).

The previous literature has suggested two types of variables that affect social presence: media variables and individual differences (e.g., Lombard & Ditton, 1997;

Lombard et al., 2000; Whitmer & Singer, 1998). As far as media variables, presence has been argued to be associated with the number of sensory dimensions and channels presented and engaged (Kim & Biocca, 1997; Lombard & Ditton, 1997; Steuer, 1992), image quality(Bocker & Muhlbach, 1993), image size (Kim & Biocca, 1997; Lombard et al., 2000), narrative quality (Rampoldi-Hnilo, Kind, Devries, Tait, & Besecker, 1997), production techniques (Zettl, 1990), sound fidelity (Reeves et al., 1993, May), and the presence of other people in the medium (Heeter, 1992). As far as user variables, researchers argue that presence is positively related to willingness to suspend disbelief (Lombard & Ditton, 1997; Lombard et al., 2000), prior exposure to media (Lombard & Ditton, 1997), gender (Kim, 1996; Lombard, 1995; Lombard et al., 2000), and mood, especially sensation-seeking mood (Apter, 1992).

A Missing Set of Variables

There is a third set of variables that have not been explored in previous studies of presence: People's *social* responses to media (Reeves & Nass, 1996). Under the Computers are Social Actors paradigm (Nass & Moon, 2000; Reeves & Nass, 1996), researchers have consistently demonstrated that individuals unconsciously attribute human characteristics (e.g., gender, ethnicity, etc.) to media and media representations and apply social rules and expectations when they interact with media. The application of these social categories and rules affect judgments about and processing of the artifact. The primary characteristics of media that seem to cue these social responses are the use of language (Clark, 1999), interactivity (Nass & Moon, 2000), and voice (Nass & Steuer, 1993).

Of most relevance to the present research, a series of studies have demonstrated that people respond to media representations as if they had a personality. Characteristics of textual content (Moon & Nass, 1996; Nass, Moon, Fogg, Reeves, & Dryer, 1995), character appearance (Isbister & Nass, 2000), and character behavior (Ball & Breese, 2000; Reeves & Nass, 1996) have been shown to cue the classification of personality. Importantly, users go beyond identification to apply a wide variety of rules about how to *respond* to personality.

Despite the breadth and depth of these responses to media, the literature has never determined whether social characteristics of media would influence feelings of social presence. In this paper, we address this limitation by exploring the effects of aspects of technology that suggest personality on feelings of social presence. To demonstrate the strength of these effects, we explore personality and social presence using *synthetic speech,* speech that is clearly not human.

Based on the Computers Are Social Actors argument, this paper proposes that people will *interpret* and *respond* to the non-verbal cues of synthesized speech in the same way as they would to real human speech. Our primary hypothesis is that people's social responses to synthesized speech would affect their feeling of social presence of the virtual actors who (ostensibly) created the content (cf. Clark, 1999). In two experiments, we test the effect of three aspects of social interactions on social presence: 1) similarity-attraction, 2) consistency-attraction, and 3) greater social presence of extroverted people.

Social Rules and Social Presence

Similarity-Attraction

Similarity-attraction predicts that a person will be more attracted to others who match their personalities than to those who mismatch. Similarity-attraction is an extremely robust finding in both human-human and human-computer interaction (see Nass et al., 1995 and Nass & Moon, 2000 for reviews). Attraction, in turn, leads to a desire for interaction and increased attention in both human-human (Berscheid & Walster, 1969; Hartz, 1996; McCroskey, Hamilton, & Weiner, 1974) and human-computer interaction (Suler, 1999). This focused and selective attention should lead to increased feeling of presence (Fontain, 1992; Whitmer & Singer, 1998). Thus, in the context of the present studies, we predict that:

Hypothesis 1. Users hearing a computer voice manifesting a personality similar to themselves will feel more social presence than those who hear a computer voice manifesting a dissimilar personality.

Consistency-Attraction

Consistency attraction predicts that people will like and prefer those who shows behavioral consistency, as it leads to predictability and decreases cognitive load (Fiske & Taylor, 1991). In particular, people are sensitive to discrepancies between verbal (textual) and non-verbal (personality) cues (Ekman & Friesen, 1974). Of course, traditional media content creators have long been concerned with establishing consistency in all aspects of the presentation (Field, 1994; Isbister & Nass, 2000; Thomas & Johnston, 1981). In virtual environments, people also prefer to interact with an object

designed in a consistent way (Hoffman, Prothero, Wells, & Groen, 1998), likely because it reduces cognitive load and decreases disbelief.

The reduced cognitive load and decreased disbelief associated with consistency may make it easier for users to become deeply engrossed in the virtual environment and increase feelings of social presence. Thus, virtual actors that exhibit consistency between the words they say and their vocal characteristics may be perceived as being more present than inconsistent actors. Thus, we predict the following:

Hypothesis 2. Users hearing a computer voice manifesting vocal characteristics consistent with the content will feel more social presence than those who hear a computer voice exhibiting inconsistency between vocal features and content.

Extroversion and Social Presence

In addition to the interactions between voice personality and user personality and voice personality and content, there can also be a main effect for voice personality. Extroverts are more socially present, as they have louder voices (Nass & Lee, in press), speak more (Reeves & Nass, 1996, chap. 7), take up more physical space with broader gestures and body postures (Isbister & Nass, 2000), and initiate more conversations (Murray, 1990) than introverts. This leads to the following:

Hypothesis 3. An extrovert voice will induce a stronger feeling of social presence than an introvert voice.

Gender

Some research studies have suggested that there are gender differences in presence judgment. For example, Reeves, Detenber, and Steuer (1993, May) found that

large screens increase female participants' feeling of presence, whereas small screen increase male participants' feeling of presence. Hence, we will determine whether gender affects the perceived presence of computer-synthesized speech.

Experiment 1

Overview

This experiment was a 2 (Participant Personality) x 2 (Computer Voice Personality) between-subject factorial design. Among numerous dimensions of personality that have been identified (e.g., Murray, 1990; Wiggins, 1979), we focus on the extroversion/introversion dimension, because this dimension is most strongly marked by paralinguistic cues (Isbister & Nass, 2000).

Method

Participants

Several weeks prior to the study, a web-based personality survey was administered to students who registered for a large introductory communication course. Both Myers-Briggs (Murray, 1990) and Wiggins (1979) personality tests were administered to maximize the likelihood of correctly assessing the personality of students. From a total of approximately 150 undergraduate students, a total of 72 participants—36 extrovert and 36 introvert students who had the most extreme scores on the two scales— who had English as a first language were invited to participate in the study. Participants were randomly assigned to condition, with gender approximately balanced across conditions.

Procedure

This experiment was executed in the context of a book-buying web site that presented five different books, all on the same web page.[1] The web page had a visual interface based on Amazon.com's book descriptions. Instead of having the book description in text, there was a link to an audio (.wav) file; participants clicked on the link to play the review. Participants read the instruction on the web page and heard five book descriptions in the same voice. After hearing the book descriptions, participants were presented with a web-based questionnaire regarding the feeling of social presence. Finally, all participants were debriefed and thanked.

Each participant was assigned to a computer equipped with a headphone and an Internet Explorer 4.0 browser. Participants were instructed to use the headphones during the whole experiment and not to adjust the volume level of either the headphone or the computer.

Manipulation

Four voice parameters were simultaneously manipulated to instantiate the personality of the voice. The extrovert voice had a speech rate of 216 words per minute, the original volume level; a fundamental frequency of 140Hz; and a pitch range of 40Hz. The introvert voice had a speech rate of 184 words per minute; the volume level set at 15% of the original; a fundamental frequency of 84 Hz; and a pitch range of 16 Hz (see Nass & Lee, in press for a justification of the above voice parameters).

Measures

All measures were based on items from the web-based, textual questionnaires. Participants used radio buttons to indicate their responses. Each question had an independent, ten-point Likert scale.

Extrovertedness/Introvertedness of the voice was an index composed of ten Wiggins (1979) personality adjective items: Cheerful, Enthusiastic, Extroverted, Introverted (reverse coded), Inward (reverse coded), Jovial, Outgoing, Perky, Shy (reverse coded) and Vivacious (Cronbach's *alpha*= .89). The question asked "How well do the following adjectives describe the voice," followed by a scale ranging from "Describes Very Poorly" (1) to "Describes Very Well (10). The higher the score, the more extrovert the voice.

Social presence was an index composed of following four questions: 1) While you were hearing the reviews, how much did you feel as if someone talking to you?, 2) How involving was the whole hearing sessions?, 3) While hearing the reviews, how vividly were you able to mentally imagine the source of voice?, and 4) How much attention did you pay to what was being said? The response scale for each question was anchored by "Not at all" (1) and "Very Much" (10). The index was highly reliable (*alpha* = .89).

Results

All analyses are based on a full-factorial 2 (user personality) x 2 (computer voice personality) ANCOVA using gender as a covariate.

The manipulation was successful: The extrovert computer voice was perceived as being more extroverted (M = 4.86) than the introvert computer voice (M = 3.34), $F(1, 67)$

= 23.7, $p < .001$, $\eta^2 = .26$. There was neither a main effect of user personality nor an interaction effect.

Hypothesis 1 was supported. We found a significant cross-over interaction between computer voice personality and subject personality for social presence, such that respondents felt stronger social presence when they heard a computer voice manifesting a personality similar to their own, $F(1, 67) = 11.1$, $p < .001$, $\eta^2 = .14$. Specifically, introverts felt stronger social presence when they heard the introvert voice ($M = 4.1$, *S.D.* = 1.4) than when they heard the extrovert voice ($M = 3.8$, *S.D.* = 1.2), while extroverts felt more social presence when they heard the extrovert voice ($M = 4.3$, *S.D.* = 1.8) as compared to the introvert voice ($M = 2.4$, *S.D.* = 0.9).

Consistent with Hypothesis 3 (Hypothesis 2 is examined in Experiment 2), a significant voice personality main effect was also found, $F(1, 67) = 6.65$, $p < .05$, $\eta^2 = .09$: The extrovert voice ($M = 4.1$, *S.D.* = 1.5) produced more feeling of social presence than the introvert voice ($M = 3.2$, *S.D.* = 1.4). There was no main effect of user personality for social presence.

Gender did not have a significant effect, either as a covariate or as a third factor.[2]

Experiment 2

Overview

In the first experiment, we used personality-neutral content to control the influence of the verbal channel on users' psychological responses to computer-synthesized speech. However, a great deal of computer and Web content, especially emails, personal narratives, and highly branded content, manifest a clear personality via text. Will inconsistencies between the voice and the content affect social presence? In

this experiment, we replicate and extend the ideas behind the first study by examining both similarity-attraction and consistency effects in a context in which both the linguistic cues manifested by text input and the paralinguistic cues conveyed by TTS output provide personality cues.

This second study was executed in the context of an online auction website. Each web page had an identical visual interface based on E-Bay's auction item descriptions.[3] Each page included the names and pictures of 9 antique or collectible auction items (e.g., 1963 classic lamp, 1920s radio, 1968 Russian circus poster, etc.). Instead of having the item description in text, there was a link to an audio (.wav) file for each item; clicking on the link played the description of the item; all descriptions for a given participant were read with the same voice.

Method

Participants

Procedures for identifying extrovert and introvert participants were identical to Experiment 1. From two undergraduate introductory classes, a total of 80 participants—40 extrovert and 40 introvert students—were invited to participate in the study. Gender was approximately balanced and all participants were native speakers.

Procedure

All participants were randomly assigned to condition in a 2 (participant personality: extrovert vs. introvert) by 2 (computer voice personality: extrovert vs. introvert) by 2 (text personality: extrovert vs. introvert) balanced between-subject design.

Manipulation

The personality of voice was manipulated as in Experiment 1. The extroversion or introversion of item descriptions was operationalized by manipulating the phrasing of the description. Following previous studies (e.g., Isbister & Nass, 2000), the introvert description was relatively short and used weaker language expressed in the form of suggestions. Conversely, he extrovert description was relatively lengthy and used strong and friendly language expressed in the form confident assertions. For example, the extroverted description of the lamp read:

> *This is a reproduction of one of the most famous of the Tiffany stained glass pieces. The colors are absolutely sensational! I am sure that this gorgeous lamp will accent any environment and bring a classic touch of the past to a stylish present. It is guaranteed to be in excellent condition! I would very highly recommend it.*

Conversely, the introverted description of the lamp read:

> *This is a reproduction of a Tiffany stained glass pieces. The colors are quite rich. The hand-made copper-foiled stained glass shade is about six and one-half inches in diameter and five inches tall.*

Measures

Extrovertedness/Introvertedness was computed as in Experiment 1. It was used for personality assessments of the TTS voice (Cronbach's *alpha* = .92), and the narrated text (*alpha* = .90).

Social presence was measured as in Experiment 1; the index was reliable (*alpha* = .77).

Results

All analyses were based on a full-factorial 2 (Subject personality) X 2 (Computer voice personality) X 2 (Text personality) ANCOVA model with gender as a covariate. The manipulations were successful: The extrovert computer voice was perceived as being clearly more extroverted ($M = 5.54$) than the introvert computer voice ($M = 4.18$), $F(1, 71) = 21.23$, $p < .001$, $\eta^2 = .23$. Similarly, the extrovert text was perceived as being clearly more extrovert ($M = 6.37$) than the introvert text ($M = 4.56$), $F(1, 71) = 57.2$, $p < .001$, $\eta^2 = .45$.

Replicating the result of Experiment 1, Hypothesis 1 was supported. There was a significant cross-over interaction between computer voice personality and subject personality for social presence, such that respondents felt stronger social presence when they heard a computer voice manifesting a personality similar to their own, $F(1, 71) = 15.8$, $p < .001$, $\eta^2 = .18$. For the extrovert voice, extrovert participants ($M = 6.0$, *S.D.* = 1.6), found the voice to be more present than introvert participants ($M = 4.8$, *S.D.* = 1.3), while for the introvert voice, introvert participants ($M = 4.8$, *S.D.* = 1.0) found the voice to be more present than extrovert participants ($M = 3.8$, *S.D.* = 1.3).

Hypothesis 2 was also supported: There was a significant cross-over interaction between computer voice personality and text personality for social presence, $F(1, 71) = 11.3$, $p < .001$, $\eta^2 = .14$. The introvert voice narrating introvert text ($M = 4.6$, *S.D.* = 1.4) created greater social presence than when narrating extrovert text ($M = 3.9$, *S.D.* = 1.0). Conversely, the extrovert voice narrating extrovert text ($M = 6.0$, *S.D.* = 1.2) induced greater social presence than when narrating introvert text ($M = 4.9$, *S.D.* = 1.7).

Consistent with Hypothesis 3, a significant voice main effect was also found, such that the extrovert voice ($M = 5.4$, $S.D. = 1.5$) produced more feeling of social presence than the introvert voice ($M = 4.3$, $S.D. = 1.2$), $F(1, 71) = 17.91$ $p < .001$, $\eta^2 = .20$

Similar to Experiment 1, we did not find any significant effects for gender, either as a covariate or as an independent factor.

Discussion

Both Experiment 1 and Experiment 2 provide a convincing evidence that social aspects of media can affect social presence. In both experiments, a voice that suggested an extrovert personality induced a greater sense of social presence than a voice that sounded like an introvert, even when the voices were clearly synthetic. Similarly, users felt stronger social presence when they heard a computer voice manifesting a personality similar to their own (similarity-attraction) than when the voice did not match their personality. The second experiment demonstrated that consistency between media personality and content can also affect feelings of social presence.

The present research provides strong support for the applicability of social rules and heuristics to the domain of social presence research. Cues of humanness (e.g., language and voice (Nass & Gong, 2000; Nass & Moon, 2000) are sufficient to encourage individuals to mindlessly apply social rules when assessing social presence. Despite knowing that computers do not have personality in any human sense, and despite being confronted with a voice that was obviously not human, participants in both Experiment 1 and Experiment 2 applied social categories and heuristics to computer-synthesized voices in assessing the degree of social presence in their media/computer use activities.

Unlike previous studies reporting gender difference in the feelings of presence, we did not find gender differences. One possible reason for the absence of gender differences is that previous research has focused on visual and audio stimuli, while this study focused solely on audio stimuli. Future research should determine if modality interacts with gender.

In sum, the present research suggests that attempts to predict social presence require a more complex and nuanced view than a listing of cognitively-oriented technology differences and user differences. First, research must examine characteristics of technology that implicate *social* rules and heuristics as well as processes of perception and cognition. Second, researchers must examine the *interaction* between technological differences, user differences, and social differences. While this added complexity presents a problem for researchers, it also represents enormous opportunities for theorizing and experimentation.

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Footnotes

1 The website can be found at [OMITTED TO PRESERVE ANONYMITY].

2 We also conducted a full- factorial 2x2x2 ANOVA with gender as the third variable. Gender was not significant in any way, and the other effects were unchanged.

3 The website can be found at [OMITTED TO PRESERVE ANONYMITY].