FORUM

Why Presence Occurs: Evolutionary Psychology, Media Equation, and Presence

Abstract

Despite the intense interest in the phenomena of presence, there have been limited attempts to explain the fundamental reason *why* human beings can feel presence when they use media and/or simulation technologies. This is mainly because previous studies on presence have focused on "what" questions—what are the causes and effects of presence?—rather than the "why" question. The current paper tries to solve this problem by providing an elaborated—and probably controversial—account of the fundamental presence-enabling mechanism. More specifically, it explains the modularity of human minds, and proposes that human beings can feel presence due to the automatic application of two types of causal reasoning modules—folk-physics modules for knowing about physical causation, and folk-psychology modules for knowing about social causation—when they respond to mediated and/or simulated objects. Finally, it explains the media-equation phenomena (in which media or computer users feel physical or social presence) according to the modularity argument.

1 Introduction

Presence is broadly defined as a "a psychological state in which the virtuality of experience is unnoticed" (Lee, 2004; Lee & Nass, 2004), or simply as "perceptual illusion of non-mediation" (Lombard & Ditton, 1997; see Steuer, 1992, Biocca, 1997, Witmer & Singer, 1998, and Zahorik & Jenison, 1998, for other definitions). Due to the intense interest in this concept, a great amount of knowledge on what causes presence has been amassed. In fact, there are so many individual studies on the causal factors of presence that scholars began to even debate about a categorization system by which those individual studies can be sorted out. For example, Witmer and Singer categorize the factors that contribute to presence into four types—control (degree, mode, and immediacy of control; anticipation of events; physical and environmental modifiability), sensory modality (environmental richness; multimodal presentation; consistency of multimodal information; degree of movement perception; active search), distraction (isolation; selective attention; interface awareness), and realism (sense realism; information consistency with objective world; meaningfulness of experience; disorientation). Lombard and associates suggest three types of factors (Lombard & Ditton, 1997; Lombard, Reich, Grabe, Bracken, & Ditton, 2000)—media form (image size and quality; audio fidelity; camera techniques), content (social and physical realism; use of media convention), and media user (willingness to suspend disbelief; prior experience with the medium; age; gender). Sheridan (1992) also suggests three factors affecting presence—extent of sensory information, control of sensors in relation to the environment, and the ability to modify the environment. More simplistically, Slater and Usoh (1993) list two main factors—exogenous (technology-dependent factors) and endogenous (participant-dependent) factors. Most recently, Lee and Nass (2001) offer three types of factors affecting presence—technology (objective quality of technology), user (individual differences), and social (social characteristics of technology) factors.

A casual review of individual studies on the causes of

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presence based on the last categorization system by Lee and Nass (2001) provides the following findings. First, with regard to the technology factor, it has been either empirically identified or theoretically argued that feelings of presence are closely associated with the following variables:

- Consistency of multimodal sensory information (Held & Durlach, 1992)
- Equipment comfort and ease of navigation (Barfield & Weghorst, 1993)
- Fast response rates to user input (Held & Durlach, 1992)
- Image resolution, color quality, clarity of image (Held & Durlach, 1992; Barfield & Weghorst, 1993; Bocker & Muhlbach, 1993)
- Image size or field of view (Reeves, Detenber, & Steuer, 1993; Prothero & Hoffman, 1995; Kim & Biocca, 1997; Lombard et al., 2000)
- Inclusion of sound in virtual environment (Steuer, 1992; Gilkey & Weisenberger, 1995)
- Isolation of real environment (Witmer & Singer, 1998)
- Meaningful media content (Hoffman, Prothero, Wells, & Groen, 1998)
- Modifiability of environment in virtual environment (Sheridan, 1992)
- Number of sensory dimensions and channels presented and engaged (Steuer, 1992; Kim & Biocca, 1997; Lombard & Ditton, 1997)
- Scene update rates (Barfield & Hendrix, 1995)

Despite the conceptual attention to users' psychological processing, the user factor has either been neglected or simply regarded as a source of random error. As a result, there have been fewer empirical studies reporting the effect of user variables on the feeling of presence. Below are some of the user variables that have been suggested to influence feelings of presence:

- Adaptation and learning of system features, which is usually operationalized as time spent in virtual environments (Held & Durlach, 1992; Loomis, 1992)
- Experience and familiarity with technology (Held & Durlach, 1992; Loomis, 1992; Lombard & Ditton, 1997)
- Focused attention on (or involvement in) virtual environment (VE) (McGreevy, 1992; Slater & Usoh, 1993; Witmer & Singer, 1998)
- Gender (Lombard, 1995; Kim, 1996; Lombard et al., 2000)
- Mood, especially sensation-seeking mood (Apter, 1992)
- Perception of self-movement in VE (Witmer & Singer, 1998)
- Perceived risk to the virtual self (Slater & Usoh, 1993)

In addition to the technology and the user factors, Lee and Nass (2001) demonstrate that a social factor, such as the interaction between users and technologies, also influences feelings of presence, especially social presence. In their experiment, users felt higher social presence when the personality of a synthetic voice matched the user personality.

In addition to the findings on the causes of presence, decades of research on presence also reveal a great deal about psychological and physiological *effects* of presence. Previous studies provide six types of presence effects:

- Arousal: It is an intensity of experience that determines the energy with which people react to media (Reeves & Nass, 1996). The more presence one feels while using media, the higher the level of arousal (Heeter, 1992, 1995). A larger image invokes greater arousal (see Reeves & Nass, 1996, chapter 17).
- Mood: Perhaps the most prominent psychological impact of presence would be enjoyment and delight (Lombard & Ditton, 1997; Heeter, 1995). For example, Barfield and Weghorst (1993) report that presence is related to enjoyment.
- Memory: Presence (or characteristics of media that are assumed to increase the feeling of presence, such as screen size) improves memory for mediated content (see Reeves & Nass, 1996, chapter 17; Biocca, 1997; Kim & Biocca, 1997)

- Persuasion: It can be argued that under some circumstances, presence can enhance the persuasiveness of media content. Previous attempts to test this hypothesis, however, have failed (Kim & Biocca, 1997; Lombard & Ditton, 1997). A recent study by Klein (1999), however, indicates that presence positively influences message credibility and persuasion.
- Physiological side effects: Too much immersion in a virtual environment can yield many negative side effects (Azar, 1996). These comprise motion sickness (Biocca, 1993), simulation sickness (Lampton, et al., 1994), sensory disorientation (Biocca & Rolland, 1998), and other negative side effects such as dizziness, malaise, stomachache, headaches, eyestrain, and nausea (Regan & Price, 1994).
- Improved task performance and skill training (Held & Durlach, 1992; Pausch, Shackelford, & Proffitt, 1993).
- Psychological desensitization to exposed stimulus (Rothbaum et al., 1995).

Presence scholars, however, may find it surprising and even disturbing that there have been limited attempts to explain the fundamental reason *why* human beings can feel presence when they use media and/or simulation technologies. To some degree, our focus on empirical research has caused this problem. We have focused more on individual operationalizations of the concept rather than a general theorization of it. As a result, we know a great deal about the *how* part of presence-related phenomena (e.g., how various factors affect presence, how presence causes various effects), but we lack comprehension of the *why* part of the equation. This is a perplexing situation, as studies on how something happens can be significantly enhanced by the understanding of the intrinsic reasons why it can happen.

In this paper, we try to address this missing link. Based on recent developments in evolutionary psychology, we provide a possible mechanism for explaining the fundamental reason why human beings can feel presence. More specifically, we reexamine various media-equation phenomena (see Reeves & Nass, 1996)—in which people equate media with real life and thus feel strong physical or social presence (see p. 14 for the definitions of physical and social presence)—according to the "modularity of the human mind" argument (see Chomsky, 1980; Sherry & Schacter, 1987; Cosmides & Tooby, 1992, 1994).

2 Why Presence Occurs: Willing Suspension or Natural Tendency?

The possibility that both experienced and novice users of technology feel various types of presence—even with low-tech media—calls for a fundamental question: "What makes human minds *not* notice the virtuality of incoming stimuli?" (See Lee, 2004, for a detailed explication of virtuality.)

One popular answer to this question is the "willing suspension of disbelief" argument (Reeves and Nass, 1996, and Holland 2003, contend that this argument has its origin in Coleridge, 1847), which has played an important role in explaining the construction of reality in traditional media (Wiley, 2000) as well as in new computer interfaces (Laurel, 1993). The willing-suspension argument proposes that the fundamental reason why feelings of presence occur is that people purposefully and consciously follow the intention of authors-producers and forget about the artificiality of mediated-staged communications (e.g., books, TV, movies, theatre, software agents) in order to fully enjoy themselves (see Hayes-Roth, Johnson, van Gent, & Wescourt, 1999). By applying this argument, Slater and Usoh (1993) even define presence as "suspension of disbelief that they [users of virtual reality systems] are in a world other than where their real bodies are located" (p. 222). According to this argument, active and conscious mental efforts to suspend one's disbelief are the major prerequisites for the feelings of presence to occur. The validity of this argument has been seriously questioned by a series of empirical studies (see Reeves & Nass, 1996; Nass & Moon, 2000). In their studies, Nass and his colleagues consistently show that people *automatically* and *naturally* accept incoming virtual (mediated or simulated) stimuli as if they were real, rather than *willingly* and *consciously* suspending their disbelief in the validity of the stimuli. In the current paper, therefore, we will not focus on the "willing-suspension" argument.

As we briefly saw from Nass and his colleagues' argument (Reeves & Nass, 1996; Nass & Moon, 2000), a recent answer to the issue of the fundamental presence-enabling mechanism has been that humans have a strong tendency to accept any incoming information as true, unless there is a strong counterevidence (see Gerrig, 1993; also Gilbert, 1991). "Unacceptance is a more difficult operation than acceptance" and therefore, "acceptance occurs prior to or more easily than rejection" (Gilbert, 1991, p. 111). This natural preference for acceptance over rejection is a manifestation of the fundamental psychological tendency shaped through the course of human evolution. For example, Mantovani (1995) attributes this priority of acceptance to the survival value of prompt reactions to incoming stimuli:

> We act in a world in which it is important to respond promptly to situations, while accuracy usually is not the top priority. The result is that human cognitive systems have developed adaptively the tendency to treat all representations as if they were true, except when there is proof to the contrary (p. 680).

Even though the existing literature briefly reviewed above (Gilbert, 1991; Gerrig, 1993; Mantovani, 1995; Reeves & Nass, 1996; Nass & Moon, 2000) provides a rough answer to the fundamental question of why humans usually do not notice the virtuality of incoming stimuli and feel presence with little mental effort, it fails to fully elaborate the mental mechanism that lies beneath the feelings of presence. In the current paper, we attempt to provide a more elaborate—and probably controversial—account of the fundamental presence-enabling mechanism. More specifically, we will explain the modularity of human minds, and propose that human beings can feel presence mainly because of the automatic application of two types of causal reasoning modules—folk-physics modules for knowing about physical causation, and folk-psychology modules for knowing about social causation (see below for detailed explanation of each causal reasoning module)—to mediated and/or simulated stimuli. To clarify our points, we will reexamine the media-equation phenomena (see below for the explication of this term) (Nass & Moon, 2000; Reeves & Nass, 1996) according to the modularity argument (to be explained later).

Media-equation phenomena were chosen for the following reasons. First, there have been limited attempts to link the media-equation literature to presence research, even though studies of media equation are in fact studies of presence. With the exception of Lombard and Ditton (1997), research on media equation has never been seriously discussed in the presence literature. Therefore, the current reexamination will establish an important link between two separate research traditions. Second, while Reeves and Nass (1996) ultimately resort to the nature of human evolution as a fundamental reason why media equation happens, they—like other presence researchers—fail to provide a detailed mechanism of how those phenomena occur. We will overcome this limitation by reexamining the results of major media-equation studies according to the modularity argument.

3 Modularity of Human Minds

The modern human mind is designed to solve the statistically recurrent adaptive problems that our ancestors actually encountered over evolutionary time (Cosmides & Tooby, 1994). Since it would be almost impossible for a single general computational system to solve the enormously broad array of adaptive problems, including—but not limited to—hunting for food, navigating terrains, selecting a mate, and engaging in social exchange, the human mind is expected to include a number of functionally distinct domain-specific computational systems called modules (Chomsky, 1980; Sherry & Schacter, 1987; Cosmides & Tooby, 1992, 1994).

Cosmides and Tooby (1994) outline three reasons why the perspective that the human mind is a general-purpose computational system (rather than comprising domain-specific modules) is implausible. First, the definition of an adaptive error (or a success) differs from domain to domain. For example, avoiding interaction with kin is an error in the helping domain, while it is a success in the sexual domain. Therefore, a domain-general system cannot effectively guide adaptive behaviors in a timely manner. Second, the developmental process of each individual cannot supply all necessary perceptual information needed for a general-purpose system to acquire all the classes of necessary domain-specific knowledge. As Chomsky (1975) argues, infants cannot acquire all of the necessary constraints on the hypothetical space of potential language grammars from perceptual stimuli alone. Third, a domain-general system could not solve an adaptive problem within a time limit, because it needs to compute all alternatives before providing a solution. Thus, it would be evolutionarily selected out.

The evidence for the claim that the brain is an evolved organ with diverse domain-specific systems or modules (see Segal, 1996, for a general review of the modularity view of human minds) comes mainly from the literature on language acquisition (Chomsky, 1975) and knowledge acquisition of causal relations in the physical (see Spelke, 1988) and social (see Carruthers & Smith, 1996) worlds. Just as the literature on language acquisition has a profound impact on the field of linguistics, the literature on the acquisition of causal knowledge has great importance to the study of presence. Below we explain the reason.

3.1 Causal Reasoning Modules for the Physical and Social Worlds

Humans are psychologically compelled to believe in relatively stable cause-effect structures in the world, even though they are not a perfect reflection of reality. The main reason is that understanding cause-effect relations is a matter of life and death. That is, to survive in a continuously threatened environment, humans need to understand both physical and social worlds in a causal relation framework (Plotkin, 1998).

More importantly, the knowledge of the causal texture of both the physical and social worlds should be innate, or at least developed very rapidly after birth (probably within the first three or four years). The lack of innate or very rapidly acquired knowledge of the causal structure of both the physical and social worlds poses an enormous survival threat to humans. For example, without the innate knowledge that the lack of support from a surface would cause falling (a physical causal relationship) infants would consistently walk off cliffs and probably die (Plotkin, 1998). An experimental finding where three-month-old babies look significantly longer at an object that is still stable in the *air* after being pushed to an edge than at exactly the same object that is stable on the *surface* after being pushed with the same power indicates that even infants have an innate knowledge of the rule of gravity (Baillargeon, Kotovsky, & Needham, 1995). This type of innate, or rapidly developed, knowledge about how the physical world works is called "folk physics" (McCloskey, 1983).

An innate causal reasoning ability about the social world is also very important for survival because, for a human, other humans can be either the most desirable mating partners or the most dangerous foes. As a result, even very young infants (3–4 years old), except those with autism, have a device—or a set of devices—for understanding the minds of other people. Without this so-called folk psychology or theory of mind mechanism (Baron-Cohen, 1995; Leslie, 1987), infants cannot fully understand why other people do the things they do. For example, autistic children in a version of the Sally-Anne test of false belief (see Wimmer & Perner, 1983 for the original version of the test) could not fully understand why Sally kept looking for a marble in a place where she originally had hidden it even after Anne had secretly placed it somewhere else. They simply could not think of themselves as a person who did not know the fact that the marble had been moved by someone. They simply could not put themselves in Sally's shoes. As a result, they failed to correctly predict Sally's behavior, whereas normal 4-year-old children and even children with Down syndrome made the correct prediction based on the false belief that the marble was in the original place (Baron-Cohen, Leslie, & Frith, 1985, 1986).

3.2 Causal Reasoning Modules and Modern Media

Modern media, computers, and simulation technologies defy the adaptive value of rapid application of the causal reasoning modules to all incoming stimuli. Unlike real objects, para-authentic or artificial objects do not require the rapid application of the causal reasoning modules; it is illogical and has no survival value to rapidly apply physical and/or social reasoning modules to virtual (mediated or simulated) objects, because virtual objects possess no survival threats. Nevertheless, people keep using their old brains—i.e., causal reasoning modules—when they respond to mediated or simulated objects. As a result, people respond to mediated or simulated objects as if they were real. Reeves and Nass (1996) call these phenomena "The Media Equation" (TME). Even though never explicitly discussed in TME research paradigms, feelings of presence lie at the heart of TME phenomena. In other words, media (or other simulation technologies) equal real life as long as people feel presence when they interact with the media (or other simulation technologies).

We categorize TME phenomena into two types: (1) automatic application of folk-physics modules to virtual objects on the screen, and (2) automatic application of folk-psychology modules to virtual social actors simulating humans. Byron Reeves has usually worked on the former issue, which is more closely related to feelings of physical presence: a "psychological state in which technology users do not notice either the para-authentic nature of mediated objects (or environments) and/or the artificial nature of simulated objects (or environments)" (as cited in Lee, 2004). In contrast, Clifford Nass has focused on the latter issue, which is about feelings of social presence: "a psychological state in which technology users do not notice the para-authenticity of mediated humans and/or the artificiality of simulated nonhuman social actors" (as cited in Lee, 2004), or simply "the mental simulation of other intelligences" (see Biocca, Burgoon, Harms, & Stoner, 2001). Put together, their works successfully demonstrate how human beings keep using their Stone Age causal reasoning modules, which had evolved since the time when Homo Sapiens were first seen in Southern Africa and the Near East (see Mithen, 1996, p. 22), when they interact with Space Age media and simulation technologies.

3.3 Physical Presence as a Result of the Automatic Application of Folk-Physics Modules to Virtual Objects on the Screen

As discussed earlier, humans have an innate or rapidly developed knowledge of causal relations in the physical world—folk physics. As a result, even very young infants (3–4 months old) do understand the physical impossibility of objects being in the air without a support, and the causal implausibility of a struck ball moving toward a direction from which it was hit. Works by Reeves and his colleagues indicate that people continue to apply various types of folk-physics modules when they respond to virtual objects on the screen. Their research results on image size (Reeves et al. 1993; Detenber & Reeves, 1996), fidelity (Reeves, Detenber, & Steuer, 1993), and motion (Reeves et al., 1985) provide good evidence that our minds constantly apply various types of domain-specific folk-physics modules and feel physical presence when we interact with media and simulation technologies. We briefly reexamine the result of each study according to the theoretical claim that physical presence occurs as a result of the automatic application of folk-physics modules to virtual objects (for a similar claim, see Pylyshyn, 1999, for the notion of cognitive impenetrability).

3.3.1. Image size. Since size is one of the most primitive cues humans have about what is happening in the environment, humans are likely to evolve to judge objects and/or other humans based on their size (Reeves & Nass, 1996). Big objects are more likely to become challenges to, or opportunities for, survival. So, humans have evolved to pay more attention to big objects. As a result of the attention, big objects come to be more psychologically present to perceivers and easily recalled. Studies by Reeves and colleagues show that people continue to use the same mind module of judging something based on size, even when they see images on the screen. As a result, images on a large screen yield more arousal, better memory, and more excitement than images on a small screen, even when the content is identical. Most importantly, people perceive images on a large screen as more realistic and feel that they are more part of the action depicted in the screen (see Reeves & Nass, 1996, chapter 17, for review). A recent study by Reeves' former student Lombard and his colleagues (Lombard et al., 2000) also shows that participants in a big-screen condition felt more physical presence, manifested by speed of movement, sense of physical movement, and perceived danger of videotaped activity. Since all adults know that the size of an image on the screen has nothing to do with the actual size of the mediated object in the real world, these results provide strong evidence that people automatically apply the size-judgment module when they see virtual objects on the screen.

3.3.2 Fidelity. As opposed to the sensitivity to image size, human minds have large tolerance for variance in image fidelity. The reason is simple. Humans usually see the world through a peripheral vision field that cannot render images as sharply as the foveal vision field. As a result, humans usually do not care about image fidelity, because low fidelity of the world is in fact natural to them. High fidelity becomes important only when human eyes are really focusing on something using the foveal vision field (Hochberg, 1986). Reeves and colleagues (1993) show that there is no difference between a low-fidelity version of a scene and a high-fidelity version of the scene in terms of arousal, memory, and attitudes. These results imply that some technology factors have less impact on feelings of presence than other technology factors, depending on the existence of a domain-specific mind module for a given technology.

3.3.3 Motion. Along with size, motion is also one of the most primitive cues that we consider when making a judgment about what is happening in our environment. Since moving objects are more likely to be either threats or opportunities, motion alerts people to pay attention. When something moves, especially when something big moves toward us, we automatically orient ourselves toward the source of motion, probably to decide quickly the next behavior (run or stay) in a way to maximize survival—the visual orienting response (see Reeves et al., 1985 for review). Studies by Reeves et al. (1985) show that people psychologically orient themselves to moving objects on the screen and pay more attention to them (see Reeves & Nass, 1996, chapter 20 for review) than to static objects. Since the moving objects on the screen provide no real, actual threats to their audience and all adults know the fact that they are watching only virtual objects, the results obtained from those studies provide compelling evidence for the automatic application of folk-physics mind modules in controlling our initial responses to moving virtual objects on the screen. A logical cognitive thinking mechanism cannot explain the visual orienting responses that people show to virtual objects on the screen.

3.4 Social Presence as a Result of Automatic Application of Folk-Psychology Modules to Virtual Social Actors Simulating Humans

Just as our ability to make sense of the physical world depends on the body of knowledge about the ways in which physical objects tend to behave, our everyday understanding of complicated social life and human behavior depends on our understanding of mental states of other people (Goldman, 1993). Philosophers usually call this common-sense understanding of psychological processes of other minds "folk psychology," whereas psychologists tend to name it "theory of mind" (ToM) (Gordon, 1999). In this paper, we choose the term "folk psychology" and define it in its broadest sense—innate or rapidly developed knowledge about how the social world (or other minds) works.

In a similar way that Reeves and his colleagues show how people continue to use various types of folk-physics modules when they respond to virtual physical objects on the screen, Nass and colleagues demonstrate that people continue to apply various types of domain-specific folk-psychology modules when they interact with virtual social actors such as computers and software agents. Based on the CASA (Computers Are Social Actors) theory (see Nass & Moon, 2000, for summary), they have conducted a series of studies and found that people apply a wide range of social rules and categories when they interact with computers. Using some of the CASA studies as examples, we will show below that people automatically apply various types of folk-psychology modules when they interact with virtual social actors (e.g., computers, interface agents). As a result, we argue, people can feel social presence even when they interact with nonhuman virtual objects.

3.4.1 Reciprocity. According to social contract theory, the mind contains specialized inference modules for detecting cheaters. Numerous experiments based on the Wason selection task show that humans have a specialized reasoning module for detecting cheaters of social contracts (Cosmides & Tooby, 1992). For example, a problem with exactly the same logic—"if P, then Q"—was solved more easily when it was framed in the context of a social contract such as "if you take the benefit, then you pay the cost, whereas if you pay the cost, then you take the benefit" than when it was framed in other contexts (Cosmides & Tooby, 1992). This result suggests that our minds might evolve to become good cheater detectors that are very sensitive to the reciprocity rule in social life. Fogg and Nass (1997) show that participants who worked with a computer that had helped them before the main test worked significantly more to calibrate the resolution of the computer when it asked them for help than participants who worked with two separate computers for the preliminary and the main test, respectively. Moon (1998) also shows that people disclose more about themselves when a computer discloses information about itself to them than when it does not disclose anything about itself. Put together, these two results provide evidence for the automatic application of the cheater-detection mind module to computers and anthropomorphic technologies. When interacting with human-like virtual social actors, people reciprocate first before thinking about the ontological nature of the virtual actors. In other words, people do not notice the virtuality of reciprocated virtual social actors, and feel social presence unless they carefully examine the ontological nature of the virtual actors.

3.4.2 In-Group. According to the kin selection theory (Hamilton, 1964, as cited in Cosmides & Tooby, 1992), altruistic behaviors of any species can be understood by the following formula:

$$C_i < r_{ij} B_j$$

(Note: C_i = Costs to individual i's reproduction, B_j = Benefits to individual j's reproduction, r_{ij} = the probability that i and j have inherited the same helping system).

As the formula suggests, the degree of another individual's genetic relevance has been a major interest for human minds. Therefore, it seems likely that people have special mind modules for diagnosing genetic in-group members and this sensitivity to genetic in-groupness would expand to other types of in-group characteristics, such as sharing the same community. A direct test of the influence of this in-group sensitivity module in human-computer interaction comes from a teammate study (Nass, Fogg, & Moon, 1996). Similar to a human-to-human interaction situation (Spears, 1989), computer users show strong in-group favoritism even to computers. That is, when a computer is labeled as a teammate, it is deemed more intelligent, friendlier, and more cooperative than when it is not. A study about the ethnicity of a computer agent (Nass, Isbister, & Lee, 2000) also demonstrates the automatic application of in-group favoritism when people interact with virtual agents and other technologies simulating humans. In this study, a seemingly similar ethnic background computer agent was evaluated more positively than a seemingly different ethnic computer agent, even though both agents conveyed exactly the same information. Similar to the previous experiments, this study provides strong evidence that people automatically apply various types (e.g., in-group favoritism) of folk-psychology modules when they interact with computers. In-groupness is judged first before the logic of the ontological impossibility of a computer agent's having ethnicity.

3.4.3 Personality. A brief list of definitions of personality easily reveals that personality is a trait only applicable to humans. For example, personality has been defined as the representation of "those characteristics of the person that account for consistent patterns of feeling, thinking, and behaving" (Pervin & John, 1997, p. 4, or "an individual's characteristic pattern of thought, emotion, and behavior, together with the psychological mechanisms—hidden or not—behind those patterns" (Funder, 1997, p. 1). By using personality terms such as the big five traits—extroversion, agreeableness, dependability, neuroticism, and openness (Digman, 1990; John, 1990)—humans can easily categorize their impression of other humans (Persson, Laaksolathi, & Lönnqvist, 2000). The categorization of other humans according to relatively simple personality traits significantly reduces cognitive load when humans engage in social interaction. In addition, personality traits provide a useful guideline for predicting other humans' behaviors. For example, a dominant person takes initiative in social interaction, whereas a submissive one tends to be passive in social interaction. An impulsive person is more likely to act according to feeling rather than thinking. A sly individual can become a dangerous foe. As a result, humans have evolved to become good trait detectors. Humans can judge personalities of other humans based on simple cues (e.g., appearance, language, voice, and behavioral tendency) with relatively high accuracy. Studies by Nass and his students (Moon & Nass, 1996; Isbister & Nass, 2000; Nass & Moon, 2000) demonstrate that people use their trait-detecting mind module even when they interact with computers. Participants in the studies listed above attributed personality (extroversion, introversion, submissiveness, and dominance) to computers and software agents. More interestingly, participants also unknowingly applied personality-based complicated social rules, such as the similarity attraction and the consistency attraction rules, when they interacted with computers and software agents manifesting personality. These results imply that traits of virtual social actors (computers and software agents) are automatically judged, despite the ontological impossibility of their having personality. The virtuality of social experience is unnoticed—and thus social presence occurs—at the moment when the judgment of social traits is made for virtual social actors.

4 Final Remarks

We do not expect or anticipate that our explanation of the presence-enabling mechanism will be accepted without any criticism of the validity of its argument. We fully understand that an argument based on evolutionary psychology inevitably calls for justifiable criticisms. Controversies about its validity and nontestability aside, however, recent developments in evolutionary psychology have undoubtedly provided dramatically new ways of thinking to the field of computer science and robotics, which sometimes make it possible to overcome some major gridlocks in that field (e.g., Brooks, 2002). We believe that presence research will be equally benefited by seriously considering the implication of evolutionary psychology for the explanation of how people use and interact with media and simulation technologies. For example, a study of how brain-damaged or mentally-disabled people—whose evolutionary hardwired causal reasoning modules are somewhat damaged—use and cognize media and simulation technologies will give us an opportunity to investigate the complicated relationship between the brain and its responses to simulated virtual objects. In doing so, the study will provide many new insights into the question of how normal people use and respond to simulation technologies and media in their everyday lives. We hope our paper will stir debates among presence scholars on the use and misuse of evolutionary psychology in presence research.

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