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The Influence of Anthropomorphism on Mental Models of Agents and Avatars in Social Virtual Environments

By

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ABSTRACT

The Influence of the Anthropomorphism on Mental Models of Agents and Avatars in Social Virtual Environments

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This project examined the influence of anthropomorphism on mental models of agents and avatars in social virtual environments. This study used a between subjects experimental design with two factors. The first factor, level of anthropomorphism of virtual image had three levels, high, low and no virtual image. The second factor, anthropomorphism of the intelligent other, had two levels, whether the participants were told they were interacting with a human (avatar), or a bot (agent). Participants consisted of 134 (94 males and 40 females) undergraduates at a large midwestern university. The results showed that a virtual confederate (agent or avatar) represented by a high-anthropomorphic image or no image was perceived to be more credible, likeable and copresent in the interaction as compared to virtual confederate (agent or avatar) represented by a low-anthropomorphic virtual body. There were no discernable differences between the perception of virtual confederates when participants were told they were interacting with an avatar as compared to those told they were interacting with an agent.

I dedicate this work to my family and friends. They made it possible for me to achieve so many of my goals. I couldn't have made it without their patience and support during the struggles and trials of life and especially those related to graduate school. First to my family whose support has meant everything - especially my Mother, brother and grandmother. Also to Dave Logie, my better half and partner in life. He made me believe I could do anything and his commitment and dedication has allowed us to survive the years in different states and helped me keep perspective on life. To my friends who have always been there and who I am so fortunate to have in my life especially Fatima Kascht and Erin Hamilton. And to those that came into my life during my time in Lansing- Brian Winn, Zena Biocca, Scott Connell, Kurt Besecker, Andy Kurtz, Trina Anderson, Jenn Gregg, James Ramos, Alice Chan, Lynn Rampoldi-Hnilo, Duncan and Stacy Rowland and so many others-Thank you for introducing me to llamas and for the wonderful memories from the banks of the Red Cedar. All of you encouraged and supported me to accomplish things I may not have attempted on my own.

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CMC= Computer Mediated Communication
SVEs=Social Virtual Environments

INTRODUCTION

Recent technological advances have led to some important changes in interfaces, including the way the human body is connected to, immersed in and represented by the computer, as well as the connection of the user or human to the computer. These changes in the interfaces have led to subsequent influences on both human-computer interaction as well as computer mediated interpersonal communication. The proliferation of technology has led to increasingly social and business related uses of technology with others around the world (Chesebro & Bonsall, 1989; Rice & Love, 1987; Siegel, Dubrovsky, Kiesler, & McGuier, 1986). These social and work related uses of technology have led to the question of how people perceive the "other" in mediated interactions (Lea & Spears, 1992; Palmer, 1995; Rice, 1993; Rice & Tyler, 1995; Short, Williams, & Christie, 1976; Steinfield, 1986; Walther, 1996). This research project explored one such technological advance- the increased anthropomorphism of virtual bodies in cyberspace and artificial intelligences. Specifically, this project tested the influence of anthropomorphism of virtual "others" on both computer mediated interpersonal interaction as well as human computer interaction. Anthropomorphic refers to having human-like qualities (such as intelligence) or physical features (appearing human).

People have automatically responded socially to computers and other intelligent entities and anthropomorphic interfaces, and anthropomorphism has enhanced this tendency, whether the interfaces were anthropomorphic in terms of displaying intelligence or in terms of appearance (Reeves & Nass, 1996). The anthropomorphism of interfaces has increasingly personified interfaces and technology and led to increased social responses to computers (Koda, 1996; Reeves & Nass, 1996; Turkle, 1995). There has been a great deal of concern about how this tendency to respond socially to computers will influence people's ability to distinguish humans from computers and to successfully function in the approaching age of networked computers (Don, 1992; Laurel, 1990; Reeves & Nass, 1996; Turkle, 1995).

In the natural world[1], humans perceive the features of a person or object they encounter in the environment in order to place them in categories that have been meaningful in previous experience in the world (Bruner, 1957; Lakoff, 1987). They also use the characteristics of things to determine whether an object is living or not and, if living, whether human or not. Following assignment to this first category, the process of perceiving the object becomes based on characteristics associated with either inanimate objects, living things or with human living things (Konner, 1991; Sheehan, 1991a; Sheehan, 1991b; Turkle, 1991).

In the process of perceiving humans, the categorization process has relied on indicators provided by the first attributions perceivers can make given their physical and psychological salience and are believed to reflect fundamental

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[1] The natural unmediated world to be contrasted with the virtual, mediated world.

distinctions in social behavior (Fiske & Neuberg, 1990; Hamilton & Sherman, 1994). In the natural world, people have primarily used the features of the body to assign people to membership in categories (Argyle, 1975; Chesebro & Bonsall, 1989; Fiske & Neuberg, 1990; Goffman, 1963; Hinton, 1993; Ichheiser, 1970). Although many of these processes are automatic and unlikely to change in SVEs, the very nature of the mediated information is likely to influence the processing of information and subsequent perception of the other.

The first and most salient influence of the concept of anthropomorphic others in social virtual environments (SVEs) is that it has served to add a level of complexity to the question of perceiving others. First, humans have been represented by virtual bodies (avatars) in SVEs that did not reflect features of their natural[2] physical bodies (Benford, Greenhalg, Bowers, Snowdon, & Fahlén, 1995; Damer, 1997; Suler, 1996). This makes the process of forming mental models of others even more difficult than in the natural world. Second, in virtual worlds, one cannot rely on physical characteristics to distinguish between and among people and objects. Finally, recent advances in artificial intelligence work and increasingly anthropomorphic visual representations, entities in SVEs can speak and move in ways that make it difficult to know if the interaction one is having is with another human or with a bot[3]. In the pages that follow, these

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[2] Natural means real, or the body one was born with. This is contrasted with a virtual body that only exists in cyberspace.
[3] An autonomous computer program, allowed to autonomously interact with other people and bots in the environment.

issues are considered and some of the original predictions and assumptions about anthropomorphic interfaces are questioned.

To begin, the categorization process humans go through when perceiving others will be examined, followed by the way these processes are likely to port[4], or translate, to social virtual environments. The pages that follow explore literature relevant to the topics introduced above, including an exploration of recent trends in the design of virtual bodies as well as the processes of forming mental models of others. It then moves on to develop a theory predicting the likely influence of anthropomorphism[5] on the perception of virtual bodies and intelligent others (whether humans or bots) in social virtual environments (SVEs). The potential influence anthropomorphism is considered in two ways; those traditionally used to consider the influence of virtual environments as well as those traditionally used to measure people's perceptions of others. Those considered in the pages that follow include copresence with their interaction partner and presence in the environment as well as on perceptions of social attraction and partner satisfaction (See figure I).

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[4] In computer science, port means to transfer from one platform to another. For example, one can port a program from a PC to a Mac but the two programs may not run identically.
[5] Anthropomorphic means more like human, or having human-like qualities (such as intelligence) or physical features (such as looking human).

Chapter 1

Types of Social Virtual Environments and Bodies

This chapter defines and explains the influence of mediation and context on people's ability to make mental models of others. It then considers what makes an environment virtual in terms of virtual reality and the defining sense of presence. It defines what makes a virtual environment a social virtual environment and the corresponding sense of copresence with an intelligent other. It briefly explores the phenomenon of interacting in social virtual environments including providing examples of different types of SVEs. The chapter concludes by explaining the difference between agents and avatars and the potential implications of this distinction for perceiving intelligent others in social virtual environments

INFLUENCE OF MEDIATION AND CONTEXT

McLuhan (1964) argued that 'the medium is the message,' and that each new media technology extends our senses further and in new and different directions than the technology before it. He was essentially arguing that the medium chosen for an interaction altered or redefined the message. Similarly, Davis (1995) argued "it is not possible to appreciate the full meaning of a message without knowing the 'language' of the technology and the culture that helped develop that technology" (p. 537). This perception has never been more insightful and potentially powerful than when one considers interface design and communication in virtual environments.

In considering the influence of computer interactions, especially in SVEs, it is important to consider not only the medium and its features but also the context of the interaction as well as the interface. The interface is the connection of the user to the computer world including the way the user has been connected to, immersed in, or represented by the computer. The interface is the part of the medium that influences how our senses are exposed to the message. The different interfaces present information to a variety of senses in different ways. These differences are similar to media differences in that they influence not only the presentation of information, but also how the information is processed and what is remembered (Drew & Grimes, 1987; Graber, 1990; Katz, Adoni, & Parness, 1977; Lang, 1995). This means it is likely that the interface will influence the presentation of information and interactions in the environment as well as how people are perceived and categorized.

VIRTUAL REALITY AND PRESENCE

This section defines what a virtual environment is, as well as the corresponding sense of presence. Many technologies are defined by particular features or physical properties of the medium, or interface. For example, a television has a screen and displays programming. Virtual reality has not been defined in terms of particular features of the medium, the interface, or even in terms of its function. Virtual reality instead has been defined in terms of the experience or perception of the user of the system. A group of input and output devices would be considered virtual reality if they responded appropriately to the input of the user (be interactive) and if they provided a sense of presence in the environment (see Biocca, 1997; Biocca, Nowak, & Lauria, 1997; Steuer, 1994). The term virtual reality would be misleading if one assumed it would accurately reflect the properties of the natural world, or reality. Some of the most interesting uses of virtual reality have been in its ability to provide experiences that would not be possible in the natural world, such as augmented reality or a simulation of possible future events.

Presence has been defined in terms of the sensation of 'being' in the virtual or mediated environment; a feeling that one has left the confines of the natural world and entered or become immersed in the virtual world. Biocca (1997) explained, "Users experiencing presence report having a compelling sense of being in a mediated space other than where their physical body is located" (p. 9). So virtual environment would be an environment that provides a sense of presence. An environment was virtual if an individual feet a sense of presence in the environment (Biocca, 1997; Biocca & Nowak, 1999b; Biocca et al., 1997; Lombard & Ditton, 1997).

Now that virtual reality and the corresponding sense of presence have been defined, the next section explains the characteristics that make a virtual environment social.

SOCIAL VIRTUAL ENVIRONMENTS AND COPRESENCE

As with virtual reality, a social virtual environment has been defined by the sense or perception of the user(s). There is no technological or physical definition of social virtual environments and no technology or group of technologies by themselves could be definitional of social virtual environments. The word social adds a dimension to the definition of a virtual environment in that it must have more than one person interacting in it. An environment is a social virtual environment when two or more individuals are interacting, are not in the same physical space in the natural world, and feel present in the same virtual environment. Technically, this could even include phone conversations but usually this implies communication where individuals feel they are in the same virtual place, resulting in a sense of copresence as defined below. By this definition, a social virtual environment can be a place where people are interacting in real time, but do not require it to be a social interaction (although it can be) It also includes interactions where people are working together in more task-oriented interactions.

Mediated interactions have had the capacity to provide a very strong and distinct sense of other people. Social virtual environments have allowed people to form very supportive and close friendships with others they have encountered (see Fisher, 1997; Parks & Floyd, 1996; Parks & Roberts, 1997; Turkle, 1995). People who have frequently interacted in SVEs have objected to the notion that their interactions in cyberspace are less than real; that their communities are 'pseudo-communities' as Beniger (1987) referred to them. When people began interacting in chat rooms, experiences outside the chat room were referred to as IRL (In Real Life). Now that their experiences in cyberspace are becoming more meaningful to them, the use of "IRL" and the use of the term "real" to refer to experiences and relationships that exist outside (as opposed to those inside) virtual environments has become objectionable[6] (see Fisher, 1997; Turkle, 1995; Watson, 1997).

COPRESENCE

The term copresence originated in he work of Goffman (1963), who explained that copresence existed when people sensed that they were able to perceive others and that others were perceiving them. Further, he explained that in its true meaning, "copresence renders persons uniquely accessible, available, and subject to one another" (Goffman, 1963, p. 22), or when people were able to find the other 'within range (Goffman, 1963).' Ciolec (1982) also considered copresence and emphasized the importance of attention or responsiveness to others. He explained that it is not only necessary for one to be within the observable range of another, but also the observer must be aware of their activity within their sensory zones to achieve copresence (Ciolek, 1982). Copresence as is a combination of a number of concepts and it is likely to be multidimensional. It

[6] This is why the term "natural" world is used instead of instead of real world.

was divided into two different constructs for measurement in this project, as discussed below.

The sense of copresence shares some concepts with interpersonal constructs of intimacy, involvement and immediacy and this section considers how copresence is similar to and distinct from these constructs. Conversational involvement has been defined as "the degree to which participants are enmeshed in the topic, interpersonal relationship, and situation" (Coker & Burgoon, 1987, p. 463).

An important and unique characteristic of immediacy has been that it involves a combination of nonverbal and verbal behaviors working together to increase or decrease the degree of physical, temporal, and psychological closeness between individuals (Burgoon, Buller, & Woodall, 1996). Further, immediacy has been used as a way to measure the intensity and directness of the interaction between entities (Mehrabian, 1967). Immediacy has traditionally relied on a system of visual nonverbal behaviors, with each behavior co-occurring and becoming only a small part of a large system of immediacy behaviors (Burgoon et al., 1996). The behaviors that are perceived to communicate immediacy have carried multiple meanings, and more than one of the nonverbal cues has usually functioned to convey the same sentiment so the different cues have reinforced the message of immediacy in the relationship or interaction (Burgoon, 1991).

Although copresence could be seen to conceptually share some of these issues, there are important distinctions. Mehrabian (1967) argued that when immediacy is adapted to nonverbal communication, it could be considered analogous to the concept of proxemix. First, copresence does not necessarily include this concept of proxemix or nonverbal intimacy. Instead, it solely refers to a psychological connection to and with another person.

Second, copresence requires that interactants feel they were able to perceived their interaction partner, and that their interaction partner actively perceived them. This reciprocal nature of the construct makes it unique and interesting and creates the dual nature of the concept.

Copresence is also distinct from conversational involvement because involvement has been operationally defined in terms of physical behavioral cues that indicate people's involvement in the conversation (see Coker & Burgoon, 1987). Furthermore, involvement focuses more on the relationship and the situation, and not necessarily on whether or not one is attending to their interaction partner. These distinctions make copresence an ideal way to ask about the mental connection between people not in the same geographic location, such as communicators using telecommunication technology. The nature of copresence includes both the extent to which the participant feels involved in the interaction as well as the extent to which they perceive their partner is involved in the interaction.

This section considered the notion of virtual environments and presence, social virtual environments and copresence. The next section considers the types of virtual bodies and environments that can provide this sense of copresence and how the various interfaces, environments and embodiments (especially the current trends toward more anthropomorphic virtual bodies) are likely to influence the processing of information and person perception.

THE VIRTUAL EMBODIMENT: ANTHROPOMORPHIC TRENDS

This section begins with a look at different types of virtual environments and discusses the implications of recent technological advances on people's interactions in these environments.

The first virtual places and environments were based on text only interactions. Users of these early SVEs could "enter" worlds existing only in text-based descriptions of the surroundings and people in the "room". When people signed on, they typed in whatever information they wanted others to know about themselves. This traditionally included a physical description and demographic information, although this represented what the person wanted others know and did not necessarily reflect their appearance or existence in the natural world. Although these text only interactions and virtual environments are still very popular (Schiano, 1999), technological innovation has given rise to new types of worlds with visual images and characters moving through graphical virtual environments which continue to grow in popularity (Cassell & Vilhjalmsson, 1999; Damer, 1997). One factor that is consistent across these environments is that people still choose the description or image others have of them, whether the source of it is text based or resulting from a graphical image (Paulos & Canny, 1997).

Virtual bodies and images[7] have been seen in all visual virtual environments in one form or another. The increased use of virtual bodies may reflect a recognition of the importance of the different communicative functions of the body during an encounter (Cassell & Vilhjalmsson, 1999). The virtual representations have been images created or designed by the user[8] with little or no resemblance to the user's natural physical embodiment (Benford et al., 1995; Damer, 1997; Suler, 1996). Theoretically, these environments could allow people to interact and "exist in a world free from earthly physical constraints" (Paulos & Canny, 1997). Individuals know they may not have an accurate picture of their interaction partner's natural embodiment[9], yet, people have formed impressions of others, as well as relationships and friendships in these environments (Parks & Roberts, 1997).

The morphology, movement, and behavior of the virtual humanoid image are far more subject to design and manipulation than at any point in the past (for a discussion of this, see Badler, Phillips, & Webber, 1993; Benford et al., 1995; Capin, Pandzic, Magnenat-Thalmann, & Thalmann, 1998; Damer, 1997;

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[7] Not all virtual characters have bodies, some are just faces and others represent inanimate objects.

[8] There are 'stock' avatars supplied by most worlds and users can buy an avatar created by someone else.

[9] Natural embodiment is the body one is born with. It is contrasted with virtual embodiment or avatar.

Magnenat-Thalmann, Kalra, & Escher, 1998). The design of effective and interesting virtual bodies has required an examination of how various cues generated by virtual bodies influences the perception of the "other." The types and levels of virtual bodies have been as varied and diverse as the people who were embodied by them. The images vary on a number of levels, from representations of people (highly anthropomorphic) to animals or even inanimate objects (low-anthropomorphic). Their virtual images have also varied from unmoving two-dimensional pictures of a character to fluidly moving 3-D embodiments that walk, fly or float through the environment in a variety of ways. It is likely that choice of image type as well as the interface properties and background environment would influence both the perception of the other and the processing of information.

An issue that may potentially lead to interesting differences in the process of person perception in SVEs is that there are no longer physical differences between a computer or a bot and a human interacting in cyberspace. Both a human and a bot could be represented by a highly anthropomorphic image or by an image that is less anthropomorphic, anything from a human-like character to a rock or a box. A bot could easily be represented by the same virtual image as a human. Although physical differences may not be apparent in virtual environments, terms have evolved to express this difference. A "bot" is an agent and a human is an avatar.

AGENT: EMBODIED "BOTS"

An agent has been defined as a computer program that is designed to interact with, or on behalf of a human. Agents have been capable of autonomous decision-making, and even 'learning' with an algorithm. Those capable of achieving goals autonomously are 'autonomous agents' (Franklin, 1997) or 'intelligent agents' (Hedberg, 1996). An agent could also be defined as a character enacted by the computer who would act on behalf of a human, like an assistant in a virtual environment (Petrie, 1996).

Agents have been used for everything from "managing mundane tasks like scheduling to handling customized information searches that combine both filtering and the production (or retrieval) of alternative representations to providing companionship, advice, and help throughout the spectrum of known and yet-to-be-invented interactive contexts" (Laurel, 1990, p. 356). The term agent means a "bot" which indicates intelligence and autonomous behavior. In this meaning, an agent may have a virtual image, which is not necessary to traditional definitions. But Franklin (1997) argued, an agent with no image can be intelligent, but, with no embodiment they cannot be situated in their environment. The situated body is essential to the concepts explored in the pages that follow. The same is true for avatars, which will be defined in the next section.

AVATAR: HUMANS REPRESENTED BY VIRTUAL BODIES

The word avatar originated in Hinduism. In Hindu, an avatar has been defined as an incarnation or the embodiment of a deity or a spirit in an earthly form. This Hindu notion is part of the belief that when creators of the universe desired to experience earth from the perspective of its inhabitants or to speak with mortals, they were presented as a material body (Vilhjalmsson, 1996). In SVEs, an avatar[10] has been defined as a physical or graphic image that allows the user to be embodied by a graphical representation in a virtual environment.

This chapter explained how the medium has influenced message perception and defined the term social virtual environment (SVE). It outlined the types of virtual worlds and images that have been seen in them. It explained that both agents and avatars are embodied characters and the difference between them was explained as whether the entity behind the character was a human or an autonomous computer program.

The following sections will continue this exploration but expand the issues to consider the influence of these differences on people's perception of virtual others in SVEs. It examines cognitive processes in depth to ask if the influence of the virtual image and the message is strong enough to compensate for the difference in perceiving an agent and an avatar.

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[10] Neil Stephenson is credited with originally using the term in this way in his science fiction book, SnowCrash.

Chapter 2

Forming Mental Models of Others

This section briefly introduces the process of categorization in the natural world and how humans assign other people and objects to categories. It is important to understand that people process each object that enters their range of senses to varying degrees while navigating a complex and ever changing world (Fiske & Neuberg, 1990; Lakoff, 1987; Moore & Cavanagh, 1998). Familiar objects and objects similar to things encountered previously would be classified as "similar to" other things that already have already been processed. In this way, categorizing familiar objects would require fewer processing resources than categorize new or unique objects. New or unique objects must be processed individually, but humans have become very good at using the physical characteristics of an object to perceive not only what a new object is similar to, but also what it is different from.

Classifying and perceiving people requires the same process as perceiving objects, but activates different categories (Asch, 1958; Hastorf, Schneider, & Polefka, 1970; Heider, 1958; Sheehan, 1991b). People categorize others into familiar groups and conserve processing resources that free them to navigate the environment (Fiske & Neuberg, 1990). After a brief consideration of these issues, this section turns to some of the features included in and potentially unique to a mental model of another human. Finally, the implications of these processes and perceptions for human's ability to function effectively with humans and objects in SVEs are considered, including a discussion of salient categories and indicators in these environments as well as the likely influence of anthropomorphism.

UNCERTAINTY REDUCTION THEORY

People go through a number of processes when perceiving people and objects in the world. The purpose of this section is to introduce a metatheory to explain why people engage in the processes of categorization and social judgment of others. This process has been explained by uncertainty reduction theory. This theory was based on the belief that when strangers meet, their primary goal is to create causal structures to explain their behavior and the behavior of others (Berger & Calabrese, 1975). In essence, people's primary goal would be to reduce uncertainty about people, to allow them to better predict future behavior as well as better understand motives and context for current or past behavior (Berger & Calabrese, 1975; Infante, Rancer, & Womack, 1997).

Uncertainty reduction theory was originally conceived of by Berger and Calabrese (1975) and began with a series of axioms and theorems about how people experience strangers during initial interactions. The level of uncertainty about a stranger is largely influenced by the context of the interaction and people like others more when uncertainty is reduced (Berger & Calabrese, 1975). The reduction of uncertainty is axiomatically defined to lead to interpersonal attraction

(Berger & Calabrese, 1975; Clatterbuck, 1979). Uncertainty can only be reduced when people feel they have enough information to make desired judgments within an interaction, In other words, it is not a sum total of information but only the perceived quality of the information that influence uncertainty of judgment (Berger & Calabrese, 1975; Clatterbuck, 1979). Thus, it is likely that interactions in social virtual environments will be a highly unfamiliar and uncertain context which will lead to reduced certainty and lower liking of strangers in SVEs, especially for people with little or no experience in these environments.

Berger and Calabrese (1975) argued that there were three phases involved in these initial interactions. The entry phase, which included the exchange of demographic information. In the next phase, people began to make judgments of values. Finally, during the exit phase, people decided whether or not to pursue future meetings and signal the end of the interaction with certain behaviors, as necessary (Berger & Calabrese, 1975).

THE CATEGORIZATION PROCESS IN THE NATURAL WORLD

> "People categorize other people, social roles, social events, and even themselves to simplify the complex task of interpersonal understanding. Categorization is the process of identifying a stimulus as a member of its class, similar to other members and dissimilar from nonmembers. Categories, then, are cognitive structures that contain instances of the class. Categorizing an instance allows the perceiver to apply to the instance general knowledge and expectations about that category without having to ascertain that those features indeed apply to that instance" (Fiske & Pavelchak, 1986, p. 170).

An understanding of how humans categorize people and objects is central to any understanding of how they think and function (Lakoff, 1987, p. 6). The process of categorization begins when an object enters a person's range of senses. The first step would be to perceive the characteristics of an object and place it into categories that fit with a person's knowledge based on the traits and characteristics that past experiences have shown them to be meaningful and useful (Hamilton & Sherman, 1994; Lakoff, 1987; Wyer & Carlston, 1994). In this way, the memories of past experience with people and objects have enabled humans to interpret new people and objects they encountered in terms of previously acquired concepts and knowledge (Fiske & Neuberg, 1990; Moore & Cavanagh, 1998; Rock, Schreiber, & Ro, 1994; Ullman, 1998; Wyer & Carlston, 1994). Categorization has allowed people to apply expectations about the category without ascertaining that these features apply to the instance, thus allowing the perceiver to make inferences that go beyond the information available (Bruner, 1957; Fiske & Pavelchak, 1986).

There is little difference between the nature and process of the categorical inferences based on defining attributes used in object recognition and the process of forming mental models of living objects, especially another human (Bruner, 1957; Fiske & Neuberg, 1990; Srull, Lichtenstein, & Rothbart, 1985). The difference in perception does not exist in the process, but in the range of categories that become accessible when a living thing is encountered in the environment as compared to encountering an inanimate object.

Further, there is a distinction between categories that becomes accessible for inanimate objects and all other living things and humans. When perceiving other humans, people must consider intentionality and emotion as well as behavior and features (Asch, 1958; Heider, 1958; Ritvo, 1991; Sheehan, 1991b;

Turkle, 1991; Williams, 1991). There are distinctive properties of living things that do not apply to non-living things. For example, living things reproduce, move autonomously through the environment and have physical properties with specific uses to serve them (Keil, 1994). In other words, there would be more to the experience of perceiving other people than to the experience of perceiving objects (Hastorf et al., 1970). Consider the scenario explained by Heider (1958)

> Let us assume that we enter an unfamiliar room for the first time and in it we find a few people we have never met before. A glance around the room will suffice to get an approximately correct idea of the shape of the room and of the objects in it. We shall be much more insecure about our judgments of people (p. 23).

DEFINING HUMANITY: LIVING BUT NOT ANIMAL

Humans have long desired to distinguish themselves from both objects and animals, defining humanity as distinct from, if not superior to, all other things whether living or not (Sheehan, 1991a; Sheehan, 1991b). The human experience in the natural world has led to the perception that if it displays intelligence, it is human. This notion, that intelligence and social interaction are reserved for humans, has been considered diagnostic of humanity.

However, the rise of artificial intelligence and experience with intelligent agents may lead to a reconceptualization of this definition of humananity. Each technological advance has led to a reconsideration of what is diagnostic of humanity, with people struggling to define humanity in terms of behaviors that computers cannot do, trying to stay ahead of the latest computers that can perform these diagnostic behaviors (Bolter, 1984; Turkle, 1991).

Recent technological advances have begun to push the next reconsideration and yet another paradigm shift including new diagnostic behaviors. It may be time to reconsider the notion that behaviors can be diagnostic of humanity and perhaps turn to emotions and feeling for diagnostic indicators, but there we risk an inability to distinguish humanity from animals (Ritvo, 1991; Sheehan, 1991a; Turkle, 1991). Some continue to define humanity as distinct from either animal or computer by discussing the "spark" of people along with the notion that to be human is to be unprogrammable (Turkle, 1991). With "romantic machines" able to "organize themselves to produce intelligent behavior" and reveal a complexity of behavior, computers may not be far from expressing something very similar to or indistinguishable from human emotion (Turkle, 1991, p. 226). Even Hampshier's (1991) claim that the distinction between humans and computers is that humans have bodies and computers do not is becoming less true as computers can have virtual bodies, although his argument that they do not understand drives such as hunger and thirst may still be distinguishing characteristics.

Regardless of what one considers diagnostic of humanity, there are a number of categories that are relevant and accessible when perceiving an intelligent other, many of which will also be relevant when interacting with an agent. On the other hand, there may be categories that are salient only when perceiving a non-human other. Future experience with intelligent others who are not human may give rise to categories brought about only when interacting with an intelligent other that is not human.

A main distinction between humans and all other things, whether living or not, has been intelligence and autonomy, but current advances in artificial intelligence are making that distinction increasingly difficult. The defining distinctions for humanity vary with the thing we are distinguishing humans from. Emotion may distinguish humans from computers, but it has been the ability to self-consciously reflect and rationality that has distinguished humans from animals (Konner, 1991).

The next section considers the question of how humans acquire such information about other people and the implications of these problems peculiar to interpersonal cognition when nonhuman entities look and act as humans and may be perceived to have intent and motives in their behavior.

PHYSICAL CHARACTERISTICS USED FOR CATEGORIZING OTHERS

In the natural world, it has been the physically manifested and 'relatively unchanging' features that were of primary importance in the process of categorizing other people (Argyle, 1975; Chesebro & Bonsall, 1989; Fiske & Neuberg, 1990; Goffman, 1963; Hinton, 1993; Ichheiser, 1970). The primary indicators have included attractiveness, facial expressions, posture, gestures, and body movement among others (Argyle, 1975; Argyle, 1988b; Benford et al., 1995; Berscheid & Walster, 1969; Bull & Rumsey, 1988; Ekman & Friesen, 1969; Ferrari & Swinkles, 1996; Knapp, 1975; Mehrabian, 1972; Otta, Abrosio, &

Hoshino, 1996). The process of categorizing others based on physical appearance characteristics has appeared to be universal and automatic, requiring little or no cognitive effort (Patterson, 1995). As Tagiuri (1958) argued, "this evaluation of other persons, important as it is in our existence, is largely automatic, one of the things we do without knowing very much about the 'principles' in terms of which we operate" (p. ix) Also, these automatic judgments based on physical appearance and nonverbal behavior have been very accurate (Ambady, Hallahan, & Rosenthal, 1995; Patterson & Stockbridge, 1998).

Bruner (1957) termed this process of categorization "model building." In this process, people have made an automatic assessment of how much information they need about the person or object to fulfill their goals of the interaction, compare it to the information they have, and then made every effort to fill the gap between information they need and information they had. The process of creating and evolving this model of others has been largely based, at least initially, on categorization and stereotyping (Bruner, 1957; Fiske & Neuberg, 1990; Hamilton & Sherman, 1994; Lakoff, 1987). People evaluated the context of a meeting, which included information about location and the goals of the interaction as well as the perceiver's available cognitive resources (Patterson, 1994).

People required limited information for this process of model building (Hamilton & Sherman, 1994; Ichheiser, 1970; Reeves & Nass, 1996). They have been able to distinguish what is the same and what is different about objects and at the same time, understand which categories provided meaningful information and which did not (Hamilton and Sherman, 1994). For example, sex category[11] has been perceived to provide meaningful information about another, while eye color has generally not been considered useful information. In this way, categorizing has allowed people to successfully navigate and cope with a complex environment with a limited cognitive processing system in that it has prevented them from having to process every object in our environment in detail (Bruner, 1957; Hamilton & Sherman, 1994).

Once a particular categorization has been made, it was then associated with stereotypes, or judgments associated with a particular categorization that subsequently influenced the mental model of others (Bodenhausen & Macrae, 1998). These predictions have been seen as expectancies and interpretations for the behavior of others (Bodenhausen & Macrae, 1998; Hinton, 1993). In this way, previous interactions with others lead perceivers to make predictions of what people they encounter in the future will "be like" (Fiske & Neuberg, 1990; Wyer & Carlston, 1994).

SOCIAL JUDGMENT FROM MENTAL MODELS

Now that the process of categorization and forming mental models of others in the physical world have been introduced, this section examines some of the evaluations people have made of their interaction partners when forming

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[11] Sex category is achieved through the application of the sex criteria, which is categorized through socially required displays that identify one's membership in one of the two categories.

mental models of them. The section will specifically explore a few categories and judgments people are believed to make automatically during interactions with intelligent others in the natural world and then turns to consider the implications of these processes for SVEs.

SOCIAL ATTRACTION

> For at least the past two decades, theorists and researchers in interpersonal communication have centered much of their attention on interpersonal attraction. Not only has interpersonal attraction been found to be a facilitator of interpersonal communication across a wide range of cultures, but also much interpersonal communication exists for the primary purpose of enhancing interpersonal attraction (McCroskey & McCain, 1974, p. 261).

Social attraction has been shown to have a number of levels and to be very important and salient to perceivers as they form mental models of others. In the past, some have called this notion interpersonal attraction. However, given the focus of this project, the notion of attraction to social entities more clearly addressed the questions. This section considers two of the three dimensions of social attraction recommended by McCroskey and McCain (1974) and Tardy (1988). These are social attraction or liking and task attraction. These are separated because they have been shown to be multidimensional (McCroskey & McCain, 1974). Also, the third dimension of attractiveness, task attraction, was not used in this section, but was instead included in the measurement of partner satisfaction because it has been shown to be a composite of a distinctive theme from other measures of attractiveness (Burgoon & Hale, 1987).

However, "sex" is a determination of socially agreed upon biological criteria. West and Zimmerman (1991)

Social attraction, or liking, has been considered an important part of understanding social judgments of others. This judgment is a determinant of whether or not people avoid or seek out the company of others (Horwitz, 1958). Within this notion is the general concept of interpersonal attraction, which also contains evaluative sentiments that are central components of relationships with others (Tardy, 1988).

PARTNER SATISFACTION

Partner satisfaction includes interpersonal evaluations of credibility (McCroskey, 1971; McCroskey, Hamilton, & Weiner, 1974) and trust (McCroskey & McCain, 1974; Tardy, 1988). Receivers have been shown to be more open to communication from sources they perceive to be credible and/or homophilous than to others (McCroskey et al., 1974). Credibility refers to the judgments made by the perceiver about the believability of the communicator (O'Keefe, 1990). It was arguably the central variable in all communication and, without it, the communication would not be as effective (McCroskey, 1971). The two major components of credibility have been expertise (competence) and trustworthiness (McCroskey, 1966).

It has generally been assumed that as a communicator's credibility increases their effectiveness would as well. McCroskey (1971) argued that the research in the area of credibility has been the clearest of any in the field of communication. If a source has credibility they would influence the audience and, if not, their impact would be minimal. Partner satisfaction and credibility have been used as indicators of one person's perception of another person or persons (McCroskey et al., 1974)

CONFIDENCE OF JUDGMENT

As discussed above, people engage in interactions with others to reduce their uncertainty about how others are likely to behave in the future and to help them understand current behavior in interactions (Berger & Calabrese, 1975). People utilize categories and social judgments that experience has shown them to be meaningful for perceiving others in interactions (Hamilton & Sherman, 1994; Lakoff, 1987; Wyer & Carlston, 1994). Although people are constantly in the process of placing others into categories, they people do not like to think they have judged another without sufficient information or that they have stereotyped a person. Most would prefer to believe that their impressions of others are based on individuating information[12], even when the individuating information is related to their category membership.

In fact, the mere presence of categorical information alone has been shown to produce stereotypical answers (Bargh & Pietromonaco, 1982; Yzerbyt, Schadron, Leyens, & Rocher, 1994). Even when people receive meta-information about a person that was not diagnostic or related to the trait variable being considered, people have been shown to be more confident about their perception (Gill, Swann, & Silvera, 1998; Swann & Gill, 1997). Even information technically irrelevant to the interaction, or not necessary for the judgment, would increase

[12] It is possible that this is unique to Americans or other individualistic cultures.

information about the other person that a perceiver has, which has been shown to increase the person's confidence in their perception (Gill et al., 1998).

THE UTOPIAN PROMISE AND REALITY OF INTERACTIONS IN SVES

The original predictions about interactions in cyberspace represented a type of utopia. Researchers predicted a democratization of computer mediated interactions; that status, gender, race, and other categories accessed during the process of perceiving human "others" discussed above would not be obvious and thus not relevant (Hert, 1997; Lea & Spears, 1992; Rice & Love, 1987; Siegel et al., 1986). The hope was that computer mediated communication would remove these issues from the mental models of others, meaning that each voice would truly be heard and equal, achieving true Jeffersonian democracy. In other words, researchers were hopeful that more people would participate in the decision making process than in traditional face to face interactions and that all voices would carry equal weight.

With few small exceptions (Adrianson & Hjelmquist, 1991), the first reports from cyberspace were not consistent with these utopian predictions, and evidence of the entrenchment of traditional categorization suggested by embodiment has surfaced in even the newest of media (Clark, 1995; Yates, 1997). Uncertainty can be very high in a virtual environment, so it is likely that humans have based attributions of others on categories that have been familiar and useful in traditional interactions in their attempt to "ground or stabilize that which is new" (Clark, 1995, p. 114). This means that people would want to perceive virtual others using the same indicators and categories that they have used in the natural world in order to bring the familiar into an unfamiliar environment.

The human experience in the natural world has led to a reliance on physical cues for information about categorization. In virtual environments, the physical cues have been less distinct and certainly less permanent if they existed at all. This suggests that a reliance on physical distinctions for categorization may lead to confusion in assigning others to category membership. In turn, this may influence people's ability to interact and navigate the environment, as well as their ability to process or use other information. The impact of this on people's ability to interact with others and with the environment is as yet undefined and may result in distortions in people's perceptions of virtual others and their ability to interact in the highly entropic worlds technology makes available.

Research in social cognition implied that categorization of others in unfamiliar environments would be based on whatever features were salient within the stimulus context (Hamilton & Sherman, 1994). Salience in these terms means both a property of the stimulus (i.e. cues that are obvious and easy to discern) and a property of our mental processes; what was accessible[13] and frequently or recently accessed (Bargh & Pietromonaco, 1982; Bodenhausen & Macrae, 1998; Gilbert & Hixon, 1991). The next section considers what features are likely to be salient in social virtual environments.

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[13] Accessible categories are more likely to be used to process relevant information. In this way, accessibility partly determines how social information is interpreted.

CATEGORIZATION PROCESS IN SVES

This section discusses the way the categorization process of the natural world introduced above is likely to port into the worlds of social virtual environments. Early research in cyberspace has indicated that many of the processes involved in social cognition are robust and unchanging, even when mediated by technology. Thus, it is likely that many of these processes would remain unchanged, regardless of context, and that people would continue to categorize others in an attempt to efficiently navigate the world with limited cognitive resources (Bruner, 1957; Hamilton & Sherman, 1994). The human ability to utilize whatever information is at their disposal (Hamilton & Sherman, 1994), and the human tendency to be cognitive misers[14] may mean that humans will continue the process of categorizing others in any environment, whether virtual or not.

When traditional cues or indicators are not available to place another in a category, people would be likely to use whatever cues are present in the environment to make category assignment of others. Regardless of where they get information about people and how to categorize them, people will likely continue to rely on categories of individuals that have proven important in face to face interactions. Further, when natural cues are available, people will use them to categorize others in the traditional manner. Natural embodiment cues are the most salient and perceived to be the most useful for the categorization process.

When traditional embodiment cues are not available, people will need to turn to other indicators for information required to place others in categories. These may include the virtual image or behavior such as language use or ability to navigate the virtual environment and other potential category membership indicators.

Although many of the processes involved in categorization are likely to remain stable, some changes are likely to occur given that mediating the connections between people changes the perception of the source of that information, as well as how the information is processed, remembered and used (as predicted by McLuhan, 1964; Salomon, 1990). For example, it may mean that people will evolve new categories that would be meaningful in virtual environments as well as new indicators of membership in old categories.

These changes in the process of categorizing others during mediated interactions may influence human-human interactions in the natural world. Salomon (1990) explained that technology can alter our cognitive functions and this altered function will influence interactions even in the absence of technology. He described this notion as "cognitive residue" or changing the cognitive function so that it is observed outside the context in which it was internalized. Given this notion, it is likely that interactions through and with media will alter interactions outside the medium and will influence the way people perceive and interact with others.

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[14] Gilbert and Hixon (1991) argued that the tendency of humans to reserve cognitive capacity by making the best decision with the least cognitive resources is automatic.

Consider how people's experience in the natural world influenced this process. Human categories have been encoded almost instinctively upon an individual entering a person's range of senses and for all of our experience in the natural world this has been meaningful. Further, these cues were automatically encoded and usually easy to ascertain. This knowledge proved helpful in categorizing and predicting others in the natural world, so people would be likely to continue to encode it. As discussed above, people have utilized categories to address the human need for "coherence, simplicity, and predictability in the face of an inherently complex social environment" (Bodenhausen & Wyer, 1985, p. 267). People automatically categorize others based on any information provided. This has included context cues as well as nonverbal information. All information around a person would be incorporated into the mental model of them to varying degrees whether that information is diagnostic or not (Gill et al., 1998; Swann & Gill, 1997).

This section predicted that people will continue to try to make sense of the world and categorize in SVEs, and that they will continue to use many of the familiar and salient indicators as they interact in the unfamiliar and new virtual environments. It is possible that in the future, they may begin to rely on new features not currently considered. If this ports (or translates) directly into SVEs, then people with more information, even meta-information, will feel more confident about their attributions of others in the virtual world. In this case, it means that people who can perceive a virtual image representing the other are both more likely to feel more confident about their attributions of others and to let the virtual image influence those attributions. The next section presents a brief description of the types of the categories that are likely to be meaningful in both traditional interactions and in cyberspace and those that will be unique to each.

THE VIRTUAL IMAGE INFLUENCES PERCEPTION

Researchers observing interactions in cyberspace have provided support for the prediction that the categories reserved for physically embodied humans maintain salience and meaning in cyberspace. Major support comes from participant observation research, which has revealed the first questions in social interactions in cyberspace were related to gender and status (Spender, 1996; Turkle, 1995; Waskul & Douglass, 1997). This section addresses the question of what indicators people are likely to use to assign others to category membership.

The first reports from cyberspace have indicated that people continue to rely on any available information pertaining to physical characteristics and that an image has continued to be part of the mental model, even when no visual image is provided to the perceiver. This has included whatever was available, from interactions providing no image at all to the text-based description to the physical characteristics of the virtual image. Further, perceivers have continued to apply the same social judgments of virtual bodies that they would to natural bodies (Reeves & Nass, 1996; Suler, 1997; Takeuchi & Naito, 1995). As Lipton (1996) argued, "When participants represent their virtual body, the means of oneself changes from an unconscious process to a conscious action. In reality, my body is represented by its physical characteristics, and all people will unconsciously read my body as a human body" (p. 340-341).

The expressive body has been considered to be the basis of human action and identity in the world (Waskul & Douglass, 1997). It has been said that people exist only because of their bodies (Hampshier, 1991). A human's physical appearance is the basis of how others would identify them during interactions (Eisenberg, 1990; Ichheiser, 1970; Mehrabian, 1972). In other words, to some extent the natural, unmediated embodiment (the human body) has appeared to do more than represent a person, it has been perceived to "be: the person. As human bodies increasingly enter cyberspace, it is likely that individuality will increasingly be recognized by "the multimedia, full-body electronic surrogates that we may soon control" (Oravec, 1996, p. 48). If the body is the basis of identity in the natural world, then this process is likely to port directly into SVEs, meaning that the virtual body will become the basis of identity in the virtual world. Further the use of embodiment has allowed for a form of personalized expression that has made individuals distinguishable and more attractive as communication partners (Henne, Mark, & Voss, 1998).

This reliance on the body for indications of category membership may bring about distortions in people's mental models of intelligent others in SVEs. In the virtual world, it is possible for a person to swiftly inhabit one virtual body and just as swiftly switch to inhabit a completely different virtual body (Oravec, 1996). Advanced embodied virtual environments present the user with a continuum of bodies. Users may alter the shape at any time during the interaction and others may choose the same shape as those already in the environment (Oravec, 1996). In this way, body morphology becomes fluid in virtual environments and not at all as consistent as would be expected from people's experience with the natural world. This may influence the ability to form meaningful relationships given the inability to easily recognize and locate others with whom people have previously interacted.

This section explained how the human practice of categorizing another person based on what have been considered permanent features would cause problems with perceiving others in SVEs. People have continued their reliance on physical cues, but in virtual environments people have used the visual cues provided by the virtual image as their primary indicator of whether one is human or not and to assign others to membership in other categories accessed when perceiving intelligent others. Given that the same image may be one entity today and another tomorrow, people may need to re-define how they understand and recognize others in these environments. The next section discusses the potential influence of the features of the environment on perception of others and on the nature of the interaction.

THE VIRTUAL ENVIRONMENT AND CONTEXT FOR INTERACTION

The setting and context of the environment influence the outcome and nature of any interaction. This has also applied to interactions in social virtual environments. As discussed above, people have continued to categorize others in social virtual environments. This section considers the potential influence of the features of the medium and environment on people's ability to form mental models of others. This section explores the features available in a variety of environments, from text only to fluidly moving 3-D environments and predicts what information people are likely to use in the process of categorizing and creating a mental model of others and how they will use it. Refer to table I for a summary of this exploration.

People have formed mental models of others based on whatever information is salient, perceivable and accessible within the context (Bargh & Pietromonaco, 1982; Bodenhausen & Macrae, 1998; Bruner, 1957; Hamilton & Sherman, 1994). The indicators used to assign others to their membership in categories have varied based on a number of things including context and available stimulus materials as well as individual preferences and experience.

When the environment provided a fluidly moving 3-D virtual image, many of the features people have used in the natural world for this categorization process are available, though presented in a different manner which may influence processing and memory for these features. It is likely that they would be used in similar ways to categorize people in the relevant and perceivable "human" categories. People could use proxemics, body type (which will include quality of the image and other skill indicators), and the sex of the image, gait information including latency, and/or the ability to navigate and interact in the environment. Race and traditional status indicators may be more difficult to obtain; although race could be assumed from use of language or from any information provided by the virtual image. Status is likely to be associated with everything from size of the virtual image to gait information as well as quality of the virtual image and ability to navigate, and familiarity with, the environment and culture.

When the environment provides only a 2-D virtual image, people could still use proxemics, body type, and gender of the image and knowledge of the environment as described above. When there is no visible image in the environment, it may become more challenging to categorize the other on these primary features, but people have continued make these categorizations (see Schiano, 1999). People have created a mental model of the other and this model has included an image of the other based on the categories to which they were assigned. In other words, just because no visible image was provided in the interaction did not mean people's mental model did not include an image.

In some text-based environments the user may provide a physical description of themselves. This description could include sex, perhaps race, interests and even profession. Although this is not necessarily an accurate description, people have used these indicators in the process of assessing the person and assigning them to categories.

When there is no visible image and no description of the other, uncertainty would be the highest of any other context. This means that creating a mental model of another would require the most effort. Given no physical indicators, the individual must treat every word typed and typing speed and style as indicators of "human" categories.

Categorization would occur whether an image is visible or not and much of this categorization has likely been based on cues that were salient and meaningful in nonmediated interactions (Clark, 1995; Oravec, 1996). However, it is likely that over time, what is meaningful and salient will continue to evolve. The question of which cues will be meaningful in virtual environments is as yet unanswered, perhaps even undefined. In Cyberspace, not only have people continued to utilize the same cues and categories they have used in traditional interactions, but also new categories are evolving and the meaning of these cues are beginning to take on different meanings.

This indicates that the quality of the virtual image and familiarity with the environment and culture could be the defining characteristics, while language and the content of the interaction also play a large role in the perception process as well. "So, although natural physical appearance, dress, and other status cues recede, educational competencies and linguistic skills increase in importance. Computer-communication media are not neutral with regard to culture, education, and socio-economic class. And electronic persons are not more 'equal' than proximate individuals, we just use different criteria to rate them" (Schmitz & Fulk, 1991, p. 85).

But when there is no image to be identified, or when a virtual image is easily manipulated and transformed at will, the codes that structure the meanings people make of bodies may take on new functions. The characteristics of humans that have defined peoples' positions in society have evolved in different contexts with different environments and social values and this is likely to continue in SVEs.

As more people enter cyberspace, the differences of access to and experience with technology promises to increase in significance. As hinted at in Stephen's science fiction novel, *Snow Crash,* beautifully designed virtual bodies with fluid movement and no discernible lags will contrast with the store bought virtual bodies represented by people dialing in from public terminals, and the "wrong side of the tracks" will take on a new meaning (Clark, 1995; Stephenson, 1993).

RESPONDING TO ANTHROPOMORPHIC OTHERS

People have responded to anything that looks human as human. Evolutionary psychology argued that it is simply automatic and efficient to interpret stimuli that appear human as animated or driven by a human intelligence (Reeves & Nass, 1996). This would be consistent with people's experience in the natural world. As discussed in Chapter 1, when people meet others, their primary goal would be to be able to better predict and or control their behavior and to reduce uncertainty (Berger & Calabrese, 1975). As people begin the process of uncertainty reduction, they assess the goals of the interaction and decide what they need to know to fulfill these goals. People then use whatever information is available or salient in the environment to fill in the blanks (Bruner, 1957).

People have spent their lives interacting with others. During these interactions, people form mental models of people and predict their motives during interactions. People have less experience interacting with and considering motives of agents and other non-human intelligent beings. Thus, it is likely that people will feel more confident in making predictions about humans than agents and that a more anthropomorphic other will be more likely to be classified as human, which will influence the mental model of the other.

In interactions with no visible natural bodies a number of issues arise that complicate the perceptual processes. First, the lack of embodiment would detract from the ability to recognize one another and the ability to take turns during an interaction (Benford et al., 1995). This would also make it difficult to identify the speaker, which is important for credibility and trustworthiness issues (Short et al., 1976). Interface designers have responded to this concern and there are currently a number of different systems that allow varying degrees and types of interactant recognition (Benford et al., 1995). The remainder of this section explores the influence of the virtual image, especially when anthropomorphic, on the process of forming mental models of others.

As indicated above, people have made rapid initial categorizations of others based on some attribute (usually physical characteristics) that allowed them to form impressions and mental models of the people they encountered

(Bruner, 1957; Fiske & Neuberg, 1990; Fiske & Pavelchak, 1986; Hamilton & Sherman, 1994; Lakoff, 1987). But how does the presence of the virtual image influence this process? How does it influence the categorization? Which features most influence a person's judgment (i.e., the color, shape, size or attractiveness)?

Before answering these questions, this section considers the processes likely to influence mental models. People automatically make judgments of others based on their bodily appearance (Argyle, 1975; Chesebro & Bonsall, 1989; Fiske & Neuberg, 1990; Goffman, 1963; Hinton, 1993; Ichheiser, 1970). The automaticity of these processes (Patterson, 1995) makes it unlikely to be questioned or altered when individuals are in social virtual environments. Although in SVEs the virtual image would not necessarily have a relationship to the natural image, it is predicted that perception of the other will be largely based on any available cues, such as the visible characteristics of the virtual image. The judgments of the person are thus more likely to be influenced by stereotypical cues associated with the virtual image than to information presented in other forms during the interaction.

The categories reserved for humans are likely to be most salient in perceiving anthropomorphic others, or those that look and act like humans. Further, virtual others will be categorized in a manner consistent with stereotypical notions related to the image presented. In other words, people will use the features of the moving body, whether virtual or natural, to categorize their interaction partner. People treat computers as social actors (Reeves & Nass, 1996), it is likely that the categorization process will be more complete and the social response will be more exaggerated when the interface appears anthropomorphic.

In considering the influence of anthropomorphism, it is important also to consider the implications of this for designing and using interfaces. One important and controversial area of discussion with regard to virtual humans is the push to create a type of embodiment for humans that is clearly discernable not only from agents or other objects, but also, that allows for easy differentiation between and among individuals (Benford et al., 1995). On the other hand, a group of human computer interaction researchers are attempting to blur the line between human-human interaction and human-computer interaction by making the interface so intuitive and intelligent that the difference is not easy to discern (for a discussion see Brent & Thompson, 1999). Further, designers are intentionally creating agents with personalities to further encourage people to respond socially to computers (Dryer, 1999). Before the question of which direction is most advisable can be addressed, one must first address how these differences influence perception of intelligent others and it is to these issues this section considers.

As discussed above, perceiving others in SVEs has required the consideration of new types of images as well as different issues and a new range of intelligent others. These others have not necessarily been physically discernable from human others, as both have virtual images, which has complicated the perception process. People should not assume that anthropomorphic bodies represent humans because this may not be the case, but this does not mean people will no longer make these assumptions. Also, objects that are inanimate in the natural world can be animated and anthropomorphized in a variety of ways in virtual environments and people may choose to be embodied by them.

Researchers at Stanford University undertook a program of study in this area that asked how people responded to computers in a variety of settings. They concluded that people responded socially to computers, or in the same way as they responded to other humans (Reeves & Nass, 1996). For example, they found that people were polite to computers and seemed to worry about hurting the computers feelings. They gave more positive evaluations of a computer-based tutorial when they evaluated the tutorial on the same computer as compared to the evaluation of the same tutorial when evaluated on a different computer. Also, participants were more likely to feel affiliation with a computer that had been assigned as a teammate. Participants also were shown to apply gender stereotypes to synthesized voices on computer tutorials even though participants reported that it would be unreasonable to do so.

Others have looked at the influence of computerized anthropomorphism in two ways; language use (Wexelblat, 1997), and embodiment (Dryer, 1999; Koda, 1996). Wexelblat (1997) and Koda (1996) found no change in perceived intelligence, as long as the virtual image was more complex than a simple line drawing. This work indicated that, "even when dealing with an extremely realistic human interface representation, people are not fooled into thinking the system is more intelligent or more capable" (Wexelblat, 1997). However, Koda (1996) found other differences between impressions based on the appearance of characters and impressions in a playing poker manipulation. This included the finding that a realistic face was more likely to be rated as more likable and engaging than either a caricature face or smiley face. Further, she found that the existence of a human face (as opposed to no face or a dog's face) increased ratings of likeability, engagement and comfort. People like to talk to attractive or interesting looking people (Berscheid & Walster, 1969). This has continued to be true in cyberspace, where attractive avatars are more popular and liked more (Suler, 1996).

Similarly, Wexelblat (1997) reported that participants found the interaction more enjoyable when the agents were more anthropomorphic. Essentially, this means that people respond to computers and other objects as social actors (or as human) whether these objects are anthropomorphized or not (Reeves & Nass, 1996). However, Dryer (1999) found that the artistic style of the representation as well as the kind of thing (human or not) that was represented determined how the agents were classified in terms of personality attribution.

Virtual bodies, especially more anthropomorphic bodies, have been shown to be more engaging, interesting and attractive (Koda, 1996; Wexelblat, 1997).

More anthropomorphic virtual images have been shown to be more influential than less anthropomorphic virtual images. Thus, a more anthropomorphic virtual image is likely to have more extreme social reactions, to be treated as "more human." A less anthropomorphic image will be treated as more human than an entity with no image, but not as human as a more anthropomorphic image. For example, participants seemed to feel more confident of their prediction of the other's behavior when the other looked more like a person because people feel more confident making attributions of human motives (as found by Parise, Kiesler, Sproull, & Waters, 1999).

Although an interface that was more engaging and interesting has provided more satisfactory interactions, the engagement with the image takes processing resources that were then unavailable for processing other features of the interaction. First, consider the influence of the natural body on perception in an interaction. In any interpersonal interaction, people have been very sensitive to communication cues provided by body morphology and movement (Argyle, 1988b; Burgoon et al., 1996; Ekman & Friesen, 1969; Mehrabian, 1972). These have included attractiveness, facial expression, posture, gestures and body movement among others (Argyle, 1988a; Berscheid & Walster, 1969; Bull, 1983; Bull & Rumsey, 1988; Dion, Berscheid, & Walster, 1972; Ichheiser, 1970). These cues have been so powerful and influential that when these cues provided by the body or nonverbal "signals" have contradicted information communicated verbally, people have had more faith in the veracity of the cues provided by the body (Burgoon et al., 1996). Psychologically, the body, virtual or otherwise, has been seen as the more authentic expression of the other's consciousness. It is important to note that the sensitivity to bodily cues have been automatically applied by individuals to draw inferences about the "intentions" and "mental states" of computers when facial or body displays (even simplified simulations of these cues) were provided (Reeves & Nass, 1996; Sproull, Subramani, Kiesler, Walker, & Waters, 1996; Takeuchi & Naito, 1995).

This means that when a virtual image moved and acted in a computer-generated environment it had a powerful psychological effect on the interaction and on people's perceptions of one another. The embodied humanoid form triggered mental models of human intelligence in observers and influenced the observers' interaction even when the observer is fully conscious that the "other intelligence" is not human (Reeves & Nass, 1996; Sproull et al., 1996; Takeuchi & Naito, 1995). For example, people have tried to interpret facial expressions of even simulated or iconic human faces at the expense of their task, or other information in the environment (Koda, 1996; Nowak & Anderson, 1999; Takeuchi & Naito, 1995). Sprouli, Subramani, Kiesler, Walker and Waters (1996) found that providing a synthetic talking face on a computer monitor caused people to perceive the interaction with the computer as more social and caused them to modify their behavior as if they were interacting with another human. Nowak and Anderson (1999) found that people tended to be more focused on the existence of smiley faces in the corner of a computer than on important information presented via text.

Although people were more involved with the interface when it was an expressive face, this involvement was at the expense of attending to and processing other information in the environment (Koda, 1996; Takeuchi & Naito, 1995). Users have tended to interpret all computer-based intelligence in anthropomorphic terms. Giving computer interfaces humanoid embodiments has enhanced this tendency of users to interact with agents and non-human entities as if they were controlled by human intelligence or by humans.

So the decision of whether or not to use virtual images should depend on the purpose of the interaction. If the goal is to transmit complex information, it may be best to do so without images or facial expressions that may distract the people involved. This is especially in persuasive communication, given that systematic persuasion is more robust than heuristic based persuasion (Chaiken, 1980; Pallak, 1983).

The remainder of section examines how the various cues generated by the virtual image influence the mental model of intelligent others. Advanced embodied virtual environments can present the user with a continuum of bodies. They can allow various shapes to be controlled by human and/or artificial intelligences. If it is true that users have a tendency to anthropomorphize all intelligent others (Reeves & Nass, 1996), especially if they take humanoid form, then it is quite possible that we will see the rise of various types of new and unique mediated relationships. All of these may not be interpersonal, because the level of copresence may vary tremendously from system to system and the relationship might be with a non-human mind, or some form of artificial intelligence rather than a human intelligence. But, from the users viewpoint, they may ***all*** possess some "interpersonal" quality of copresence with another, a sense of access to another mind, whether that "mind" is humanoid or computer generated and human-like. It is also entirely feasible for the nature of the intelligence, or the entity behind the embodiment, to change during the course of an interaction (Oravec, 1996).

It follows that in human-computer interaction, interaction cues from humanoid virtual bodies would be a powerful means to enhance the meaning and apparent co-presence of a human-artificial intelligence interaction. This would be especially true in any mediated interaction involving highly interactive virtual environments and expressive virtual bodies. Research has found that "a number of social conventions are carried over from our interaction in the physical world, were conveyed through the embodiment and positioning, and play a strong role in virtual interaction" (Henne, Mark and Voss, 1998, p. 1).

Contrary to experience in the natural world, there would not necessarily be any physical distinctions between and among humans and computers in SVEs. This further complicates the processes involved in perceiving anthropomorphic intelligent others. This in itself is likely to result in distortions in people's ability to form mental models of intelligent others in these environments. Recent advances in the design and anthropomorphic motion and embodiment of virtual humans (Badler et al., 1993; Capin et al., 1998; Magnenat-Thalmann et al., 1998) have given salience to the potential influence of anthropomorphism in social virtual environments. Objects vary in their level of anthropomorphism[15]. A thing could be more anthropomorphic in a variety of ways. The three most likely to influence the mental model of the other are whether or not the other is perceived to be human, the degree to which one appears human and the degree to which one can mimic human behaviors.

The first level of anthropomorphism is really an ontological question. The "other" is either human or it is not human. Although whether the other is perceived to be human is actually more important when considering how this will influence the development of a mental model of the other. Tagiuri (1958) discussed the importance of the perceiver feeling the object had the potential of representation and intentionality or they would not be perceived as human. It is predicted that there are varying degrees of certainty of the perception of humanity and that this perception would influence the mental model of the other. The importance of this distinction will vary with the goals of the interaction.

The other two levels of anthropomorphism, appearance and behavior were considered to have varying degrees. One either looked more or less like a human (a more or less anthropomorphic image) or acted more or less like a human (displaying behavior like those humans display, such as intelligence).

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[15] In this meaning, something that is more human is more anthropomorphic

The basic processes of categorization were not predicted to change in SVEs. If this were true, then people would have different mental models for humans than for objects. Further, people would have required different types of information about bots than about humans. For example, people may not consider intentionality of a bot in the same way they would a human. The differences may be subtle, but the accessible categories will influence the processing of information.

Whether in the natural world or the virtual world the initial categorization of another was predicted to be the living non-living distinction. If living, then people would ascertain whether or not the object is human. Once people established category memberships in the above distinctions, they would continue the process of creating a mental model of that person or object. This process of creating a mental model of another was predicted to include their perception of the other and their membership in each of the primitive categories such as gender, race, age and social class (Fiske & Neuberg, 1990; Hamilton & Sherman, 1994).

The next section considers the theoretical predictions to which the above literature leads and proposes a way to test them. It explores the potential implications of the fact that there are no physical distinctions between and among humans and computer intelligences in SVEs as well as the influence of anthropomorphism on perceptions of intelligent others in SVEs.

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Chapter 3

Model of Anthropomorphism of Mediated Intelligent Others on Mental Models of Social Interactants

As discussed previously, the anthropomorphism of virtual entities in cyberspace has occurred to varying degrees and on several levels. The theoretical model proposed in this section was based on the premises of uncertainty reduction theory including that people interact with others to reduce uncertainty about both the future behavior of others as well as to explain past and present behavior (Berger & Calabrese, 1975).

The theory was the basis for the theoretical model that assumed that people interacting in SVEs would continue to strive to reduce uncertainty during interactions. The model began with a consideration of the degree to which the perceived intelligent other was anthropomorphized and perceived to be human. The model presented this as a very important consideration in a person's concept of an intelligent other in social virtual environments. The model predicted that the two most prevalent levels of anthropomorphism influencing perception would be physical and behavioral (whether verbal or nonverbal). As discussed below, the model predicted the influence of these two levels of anthropomorphism on copresence and presence in the environment, as well as perceptions of social attraction and partner satisfaction.

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Please refer to the graphic outline of the theoretical model in Figure 1.

MENTAL MODELS OF OTHERS

As people navigate ever-changing environments, they process each object they encounter to varying degrees. People have been able to perceive the characteristics of a new or unfamiliar object and place it into categories, noting how the new object is similar to and distinct from other objects that have been previously encountered and processed (Fiske & Pavelchak, 1986; Hamilton & Sherman, 1994; Lakoff, 1987; Wyer & Carlston, 1994). This process of categorizing the features of new objects in terms of its similarity to and distinction from familiar objects has allowed humans to navigate a complex environment with limited cognitive resources (Bruner, 1957; Fiske & Neuberg, 1990; Hamilton & Sherman, 1994). The categories used in this process vary based on a number of factors, including what was salient in the environment (Hamilton & Sherman, 1994), what was mentally accessible and what has been shown to be meaningful or frequently utilized in previous encounters with similar objects (Bargh & Pietromonaco, 1982; Bodenhausen & Macrae, 1998; Gilbert & Hixon, 1991). In this way, the processes involved in perceiving living things and inanimate objects are the same or very similar (Bruner, 1957; Fiske & Neuberg, 1990; Srull et al., 1985).

Now that the processes of forming mental models of others have been introduced, the next section discusses the theoretical model and explains the model's predicted influence of whether or not one has been perceived to be human, whether or not the other is represented by a virtual body and the influence of an anthropomorphic virtual body on these processes and the resulting social judgments of others.

EFFECT OF HUMANITY ON SOCIAL JUDGMENT OF INTERACTANT

This section explores the potential implications of the perception of whether the other is human or not for social judgment. People create mental models of both people and objects. The processes have been shown to be the same, but different categories would become relevant and accessible when the perceived object was believed to be human as compared to any other entity or object encountered in the environment (Heider, 1958; Konner, 1991; Ritvo, 1991; Sheehan, 1991a; Sheehan, 1991b; Tagiuri, 1958). People have almost instinctively made this distinction from an early age (Keil, 1994). In this way, the categories that would be accessed and utilized would be different when perceiving a living or human as compared to not human or inanimate objects.

Therefore, the model predicted that the perception of whether or not the other is human would influence the types of judgments included in the mental model of the other. It further predicted that the information contained in the mental model of the perceived other would be different when the other was introduced as an agent compared to an avatar because the category models for humans are different from that of objects (Heider, 1958; Keil, 1994). This would only be true if an agent is classified as more similar to an object than a human.

In the natural world, all living things contain certain common properties that distinguish them from inanimate objects (Asch, 1958; Hastorf et al., 1970; Heider, 1958). So, the model predicted that on the first level of anthropomorphism, there was the ontological question of whether or not the other is human. Then, especially in the virtual world, the model predicted there would be varying levels of "humanness" or qualities that brought up the categories and perceptions used for humans.

Most living things have had more physical characteristics in common with other living things than with inanimate objects (Keil, 1994). For example, in the natural world, only living things have been able to autonomously move and interact in the environment and only living things have been able to breathe and eat. In the natural world, things that are not living have not moved or spoken. However, in virtual environments a computer (an object) has been able to display features and characteristics that are traditionally reserved for living things or specifically humans, such as intelligence. The model predicted that this would result in distortions in people's perceptions of others.

It predicted that these distortions would eventually result in the evolution of new categories that merge parts of the categorization accessed for humans and part of that accessed for objects. For example, motivations, and the decision to form an ongoing relationship with another are usually only relevant during interactions with another human. Intelligent others interacting in SVEs may well be a new category for intelligent others in the social world of virtual environments. The model predicted that an anthropomorphic character and/or anthropomorphic behavioral characteristics would make more of the categories traditionally reserved for humans salient and accessible, whether the other was simply an anthropomorphic agent or truly a human (avatar). The mental distinction between them was predicted to be important because the distinction defines or frames the categories that previous experiences have shown to be important or useful (Hamilton & Sherman, 1994; Lakoff, 1987).

The theoretical model predicted how the mental model and corresponding social judgment of an interaction partner that was perceived to be an avatar would differ from the mental model of another perceived to be an agent. Specifically, it predicted that the process would be similar and the perception of the same virtual image would consistently result in similar categorization whether the intelligent other is an agent or an avatar. This would mean that although the mental model of an agent was different from that of an avatar, the salient categories for any intelligent other would be similar, as is the case for salient categories of any animate object.

The model predicted that in some ways perceiving an agent would not be so different from perceiving an avatar because it would appear animate and could have many of the characteristics normally reserved for living things and even characteristics traditionally reserved for human others. If this were true, then many of the same categories would become salient. For example, anthropomorphic non-living things could raise categories traditionally reserved for humans such as attractiveness, gender, social status and race. The model predicted that people would interact with anything displaying intelligence or anthropomorphic cues in similar ways (Reeves & Nass, 1996). Although some have argued that this will result in the same mental models for agents as for avatars the theoretical model predicted that there would still be discernable differences because of fundamental information from basic categories (human/non-human, living/non-living).

Hypothesis I: People will feel more social attraction for avatars than for agents.

Hypothesis II: People will feel more partner satisfaction with an avatar for an interaction partner than with an agent.

Given the human tendency to prefer things that are familiar and similar to them, the model predicted that people would prefer interactions with other entities that were human and, if not human, they would prefer those that either looked and/or acted human. If the model were correct, then people would feel more attracted to and satisfaction with their choice of partners when they interacted with an avatar as compared to an agent because they would feel more confident in their ability to perceive intentions and motives (Dryer, 1999).

Credibility and intelligence have been generally considered part of the notion of partner satisfaction. The model predicted that there would be some individual differences in perceptions of the credibility of an agent as compared to an avatar. If the model was correct, there would be differences between social responses to a human other when compared with social responses to non-human "others".

Hypothesis III: People will feel more copresent with an avatar than with an agent.

People have experienced copresence with other humans in both the physical and the psychological sense. Two humans with physical bodies could be copresent and physically present in the same location with other humans in the natural world. However, the idea that one can be copresent with a virtual other, that one can be in the same physical location as an entity with no true existence outside the computer may be difficult to perceive. Therefore, the model predicted that feeling copresent with another human would seem more real than the feeling of copresence or involvement and intimacy with a computerized agent. If the model was correct, this would influence people's perception of their level of connectedness with an intelligent other as well as the perception that their interaction partner was copresent in the interaction.

Hypothesis IV: People will feel less uncertainty in social judgments of avatars than of agents.

When people encounter an intelligent other, they have been shown to automatically respond to that entity in social ways (Reeves & Nass, 1996). This has represented part of the script humans have for intelligent others. However, the model predicted that people would not feel as certain in using this script for agents. If the model was correct, people would have felt more uncertainty in their interactions with agents because they did not have a script to perceive or evaluate computers or bots (Dryer, 1999). Therefore, the model predicted that they would substitute the only script they have for intelligent others-that which is used to evaluate humans but that they would feel less certain in using this script.

Hypothesis V: Judgments of avatars will be more extreme than judgments of

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The model predicted that the intensity of the social responses and complexity of the model formed about the other would be more extreme when the perception was of another human as compared to the perception of a computer. If the model was correct, people would attend more to cues and other indicators during interactions with other humans as compared to interactions with agents. In this way, the model used extremity as an indication of involvement in the interaction in the process of making social judgments. The model predicted that the closer the other was perceived to be human the more people would attend to the creation of a mental model of the other, and the stronger the sense of the other will be; when positive it would be more positive and when negative it would be more negative. Categories that were not predicted to be relevant when perceiving a bot that were predicted to be relevant when perceiving a human include social attraction, partner satisfaction and copresence. If the model is correct, people's ratings of agents on these measures would have been less extreme or less applicable as compared to the ratings of avatars on copresence, partner satisfaction and social attraction.

THE RELATIONSHIP OF PRESENCE AND COPRESENCE

Hypothesis VI: People that feel more physical presence in the environment will feel more copresence with their interaction partner.

The model predicted that people who felt more copresent with their interaction partner, would report feeling more physical presence and more engaged in the environment. If the model was correct, then the feeling of c

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copresence with another would make the environment more "real" and it would make the surroundings more interesting, engaging and compelling. The feeling that one has connected with another in the environment would therefore influence the perception of the environment itself, or the perception of the environment may be influencing the feeling of connection with the other. If the model is correct, people that felt more copresent with their interaction partner would feel more physical presence in the environment.

EFFECT OF EMBODIMENT ON SOCIAL JUDGMENT OF INTERACTANT

This section focuses on the question how the virtual image is likely to influence the social judgment of agents and avatars in SVEs. The theoretical model predicted that when people enter an environment, whether virtual or natural, they would make mental models of the things and people they encountered. As discussed above, if the model was correct, people would continue to place objects and people into categories that related to people and objects they have encountered in previous environments. People would work to reduce uncertainty in the environment and to function in a complex world with limited cognitive resources (Bruner, 1957; Hamilton & Sherman, 1994). People have used visual information to assign things and people to categories (Argyle, 1975; Chesebro & Bonsall, 1989; Fiske & Neuberg, 1990; Goffman, 1963; Hinton, 1993; Ichheiser, 1970). In the natural world, people have relied on the relatively stable and permanent physical features of the face and body to categorize other humans (Argyle, 1975; Argyle, 1988a; Hinton, 1993; Ichheiser, 1970). The natural, physical body has provided information that people have used to categorize others in meaningful ways.

People have continued to categorize other people in social virtual environments and the same categories have remained salient (Lipton, 1996; Reeves & Nass, 1996; Spender, 1996; Suler, 1996; Takeuchi & Naito, 1995; Waskul & Douglass, 1997). The theoretical model predicted that people's experience in the natural world would lead them to rely in similar ways upon the features of the virtual image to provide information for categorization in virtual environments. If the model is correct about this, then just the presence of an embodied other, whether truly human or not, would trigger mental models of human intelligence in observers and would subsequently influence the observers interaction even when the observer was fully conscious that the "other intelligence" was not human (Reeves & Nass, 1996; Sproull et al., 1996; Takeuchi & Naito, 1995).

Hypothesis VII: When a virtual image is visible, people will feel copresence with their partner than when no virtual image is visible.

The image that represents a person communicates not only information about the person, but also information about another person's physical presence (Benford et al., 1995; Biocca, 1997; Biocca & Nowak, 1999a). The theoretical model predicted that when there was a visible image, virtual or otherwise, people would feel they have shared an experience or connected with their interaction partner. If the model was correct, participants would feel more copresence when the other was represented by a virtual image.

Hypothesis VIII: When a virtual image is visible, people will feel more social attraction for their partner than when no virtual image is visible.

Hypothesis IX: When a virtual image is visible, people will feel partner satisfaction than when no virtual image is visible

The model predicted that people would feel that their interaction partner was closer to human when their partner was represented by a virtual image. This was predicted to make more of the categories traditionally reserved for human others salient. If this were true, even an agent represented by an image would be perceived to be more human than one not represented by a human. Further, it would make humans represented by virtual images seem more real and more attractive than those not represented by virtual images. If the model was correct, people would have felt more social attraction and partner satisfaction for others represented by a virtual image than for those not represented by a virtual image.

Hypothesis X: When a virtual image is visible, people will feel less uncertainty in judgments of others than when no virtual image is visible.

The theoretical model predicted that even when information was not technically diagnostic of the judgment being rendered (such as the appearance of a highly anthropomorphic virtual image on attributions of partner satisfaction and social attraction), more information about another would increase confidence of attribution and would increase the perception that the other was familiar (Gill et al., 1998; Swann & Gill, 1997). If the model was correct, the presence of a virtual image would make people feel more connected to and able to identify with the intelligent other and they would feel as if they have more information about the other. This would specifically result in less uncertainty regarding their interaction partner. Although the model predicted that people would continue to create mental models of others who were not represented by bodies, it also predicted that the appearance of an image, whether natural or virtual, would lead to more confident social judgment of the other.

Hypothesis XI: Judgments of others will be more extreme when a virtual image is perceivable.

The theoretical model predicted that the appearance of an image, whether virtual or natural, would cause categories that had been traditionally reserved for human others to be salient. Thus, social judgments traditionally reserved for human others, such as likeability and credibility as discussed above would be more salient and meaningful. If the model was correct, then people would feel more strongly about the social judgments of others when they were represented by a virtual image than when they were not represented by a virtual image. If people felt more strongly about their social judgments of others, then their judgments would be more extreme and less neutral than when people did not feel strongly about the social judgment.

MORE ANTHROPOMORPHIC VIRTUAL BODIES GENERATE MORE POSITIVE SOCIAL JUDGMENTS OF HUMAN AND NON-HUMAN INTERACTANTS

This section considers the influence of anthropomorphism on people's sense of presence in the physical environment and their sense of copresence with virtual entities as well as the influence on social judgment. Anthropomorphic bodies have been shown to engage the user more and provide a more interesting interaction for participants (Koda, 1996; Takeuchi & Naito, 1995). The theoretical model predicted that the influence of a virtual image will be most extreme when the virtual image was a more anthropomorphic image. Thus, the appearance of the image was predicted to influence the degree to which the intelligent other was perceived to be human. This in turn was predicted to influence the people's sense of copresence, physical presence, partner satisfaction and social attraction. The influence of a more anthropomorphic image was predicted to be very influential in the type of mental model people formed of another entity (Koda, 1996; Takeuchi & Naito, 1995).

Hypothesis XII: People will perceive intelligent others with highly anthropomorphic images as more socially attractive than those with low-anthropomorphic images.

Hypothesis XIII: People will be more satisfied with partners represented by highly anthropomorphic virtual images than those with low-anthropomorphic images.

The theoretical model predicted that people would feel that the more anthropomorphic character was more human and thus were more likely to rate the highly anthropomorphic avatar or agent as higher in attractiveness and satisfaction with partner than the low anthropomorphic or no image person. The model predicted that people who were able to interact with a partner who was represented by a highly anthropomorphic virtual image would be more satisfied with their potential interaction partner. If the model were correct, then in virtual environments, individuals represented by highly anthropomorphic avatars would be rated as more socially attractive than people represented by less anthropomorphic avatars or people with no visual representation at all.

Hypothesis XIV: People will feel more copresent with a partner represented by a highly anthropomorphic image than those with low-anthropomorphic images.

The theoretical model predicted that people would treat any intelligent others as social actors, especially when they were highly anthropomorphic, but that there would be differences in the type of information processed and how thoroughly it is processed. The model also predicted that because people have experience feeling copresent with other humans, a more anthropomorphic image would remind a person of other humans they have felt copresence with and increase the feeling that they were connected with their interaction partner.

Insert Table II Here

Chapter 4

Method

DESIGN

This study used a between subjects experimental design with two factors. The first factor, degree of anthropomorphism of virtual image had three levels, high, low and no virtual image. The second factor, anthropomorphism of the intelligent other, had two levels; whether participants were told they were interacting with a human (avatar) or a bot (agent).

Insert Table III about here.

The dependent variables included copresence, physical presence, social attraction, partner satisfaction and attractiveness evaluations. Also, this included a measure of the degree of certainty of the attribution of personality variables and sex category of the perceived person and an exploratory measure[16].

PARTICIPANTS

134 undergraduates at a large midwestern university took part in this experiment for class credit. Participants were stratified by sex and randomly

[16] social presence

assigned to condition. There were a total of 94 males and 40 females. The average age of participants was 21, and ages ranged from 19 to 33.

STIMULUS MATERIALS

Virtual Environment. This interaction took place in a 3-dimensional environment created in the MIND Lab using *Director, V-Realm* and *3D Studio Max,* all are computer software programs used to provide the illusion that participants were interacting in a real time virtual environment. This environment appeared on a computer screen and resembled a meeting room. In all conditions, there was a sign indicating that participants were in the scavenger hunt meeting place. In the no image condition, only the environment was perceivable (See Figure 2). In the other conditions, participants first went to the character selection screen (See Figure 3), where they selected the character they wanted to represent them during the interaction. When participants "entered" the virtual environment, the virtual face representing the virtual confederate (agent or avatar) was already in the room, ready to begin the interaction. The difference was in whether the virtual face is highly anthropomorphic (See Figure 4) or less anthropomorphic (See Figure 5). This environment allowed participants to speak into a microphone and hear their interaction partner via headphones. It resembled an interaction between individuals across networked computers.

Avatars/Agents. The avatars and agents appeared the same and were represented by one of two images; a female virtual face (high-anthropomorphic condition, see Figure 4) or a very abstract face with only a mouth and eyes (low-anthropomorphic condition, see Figure 5). All participants in each condition saw the same virtual face, which was associated with the same female voice that read the same script. The two images contained the same number of cues including faces with eyes, mouths and noses. The only difference was that one is more iconic (low anthropomorphism) and one appeared more human (high anthropomorphism). In the control condition, there was no virtual image, only the virtual room and the voice reading the script.

Audio Scripts. A female read the script. All participants in all conditions heard the same voice reading the same script (See Appendix A. The content of the script contained a short biography, listing their skills relevant to a web scavenger hunt task. The script began with the virtual confederate (agent or avatar) introducing themselves and then waited for the participant to do the same. Following the introduction, the participant pressed a button indicating they had introduced themselves and then the virtual confederate (agent or avatar) discussed their Internet skills. The script included information about the virtual confederate's (agent or avatar) self-proclaimed web experience. Following participant's "turn" to indicate their skills, the virtual confederate said goodbye and indicated a wish to continue working with the participant. Participants were then given a chance to say goodbye before pressing the button to end the interaction.

MEASUREMENT INSTRUMENTS

The pre-test questionnaire was done on paper and pencil (See Appendix B). The post-test questionnaire (see Appendix C) was presented to the participants using *Surveysaid*, a computerized questionnaire software (Masters, 2000). This Software presents each question one at a time on the computer screen. Participants select their response by clicking the appropriate box with a mouse and then click a button marked "next question" to continue through the questionnaire.[17]

Presence. Presence is a measure of the feeling a person has that they are "inside" a virtual environment, a sense of "being there." This measure comes from a development of a measure for presence with the subheading of presence as immersion (Lombard & Ditton, 1999). Eight likert-type items with a 7-point metric were used to form a scale (see Appendix C, items 28-35). This scale included indicators such as how intense the experience in the environment was and the extent to which the experience was involving and immersive.

Copresence. Copresence as discussed above is related to the feeling of connection between two people. Given its dual nature, this was measured by two separate scales, one asked about the participant's perception of their partner's involvement in the interaction and the other asked the participant about their own involvement in the interaction.

The scale measuring the perceived copresence of the virtual confederate (agent or avatar) included 15 indicators taken from three of the dimensions of immediacy (see Appendix C, items 2-16). This included immediacy/affection, similarity/depth and receptivity/trust. This scale was derived from a combination of the indicators for intimacy, involvement and immediacy from Burgoon and Hale (1987). This included whether the other was perceived to be involved, interested or emotional about the conversation. It also included whether or not the interaction partner made the conversation seem superficial or created a sense of distance between the interaction partners. These were likert-type items with a five-point metric.

The second scale included 11 indicators similar to those above, but they were revised to ask how involved the participant was in the interaction (see Appendix C, items 17-27). These items measured the extent to which the participant self-reported being copresent in the interaction and included questions about whether they were interested in a deeper relationship or more intimate conversation with their interaction partner. These were also likert-type items with a five-point metric.

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[17] Thus, the instructions appear above every question instead of just above a cluster of questions in the printed version of the text.

Social Attraction. A 9-item likert-type scale with a 7-point metric measuring social attraction was modified for the purposes of this project (see Appendix C, items 36-44). This scale came from McCroskey and McCain (1974) and included questions about the extent to which they feel the other person could be a friend, was pleasant or offensive and whether or not the participant desired a future interaction.

Partner Satisfaction. Partner Satisfaction included two separate scales. One was a likert-type scale consisting of ten indicators of partner satisfaction from McCroskey and Wright (1971), including whether the confederate was professional, cooperative and knowledgeable (see Appendix C, items 59-68). The second scale was a semantic differential scale consisting of 6 items including whether the participant considered their partner reliable, informed or intelligent (see Appendix C, items 69-74).

Certainty. Confidence was based on Clatterbuck's (1979) 7-item Attributional Confidence Scale (see Appendix C, items 45-51). This included items asking whether people were completely confident or unable to answer how their partner would behave in the future and whether they felt able to predict their attitudes, values and feelings.

Demographics. Demographic questions included previous experience with computers, chat rooms and computer games, as well as their sex, ethnicity, age and year in school (see Appendix B).

PROCEDURE

After signing a consent form indicating their voluntary participation in this experiment, participants filled out their pretest using paper and pencil in a conference room. The pretest asked for demographic information, including biological sex, age, year in school and computer use and chat room experience. Participants then read a piece of paper containing their assignment and the scenario. They were told that their goal was to get to know their partner who may work with them in the future on a scavenger hunt on the World Wide Web. There were two versions of the instruction sheet with only one difference. In the avatar condition, participants were told they were to interact with a student from another university (See Appendix D). In the agent condition, participants were told they were interacting with a "bot" or computer programmed to be interactive (see Appendix E). The instruction sheet also told participants that if their team were selected they would be asked to participate in an online scavenger hunt where they would search for a variety of computer software and technologies. Further, they were led to believe that the team that finished the scavenger hunt and found the best prices in the least amount of time would win $100. The participant was then taken to a computer in a computer laboratory and the instructions were explained again in more detail. The participant was verbally reminded that their partner was either an agent or an avatar and any questions participant had were answered at this time.

In the no image condition, participants entered their participant identification numbers and began the interaction. In either of the other conditions, participants entered their participant id numbers, selected a virtual face to represent them and then began the interaction. Although the participants were told they were interacting with their interaction partner in real time, they were exposed to pre-recorded scripts[18]. All of them heard the same script associated with the same virtual face. Their interaction partners are virtual confederates whether in the agent condition or in the avatar condition. In the embodied conditions the virtual confederates were represented by a character, either highly anthropomorphic or less anthropomorphic. In the no image control condition, the virtual confederates were not represented by a virtual image at all.

After the interaction, participants completed the post-test questionnaire. This included measures of presence, copresence, social attraction, partner satisfaction, and certainty. Finally, participants responded to the exploratory measures of social presence and filled out open-ended questionnaires aimed at exploring participants' perceptions of the virtual images and the interaction as well as exposing participant suspicion or difficulty with the manipulation or the experience. After participants completed the questionnaires, they were debriefed.

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[18] During open-ended questions at the end of the interaction, 28 participants expressed suspicion that their interaction partner was pre-recorded. The implications of this for the agent/avatar manipulation are discussed below.

Chapter 5

Results

Hypotheses

An alpha level of .05 was used for all statistical tests.

SCALE CONSTRUCTION

Standardized item alpha is included for all scales. The dimensionality of each scale was determined in two ways. First, confirmatory factor analysis tests of internal consistency were applied to each instrument. All retained items met the criteria for internal consistency: (a) face validity and (b) a primary factor loading of at least .5. Further, items were removed when they had greater errors with other items than what would be expected by sampling error. Items were dropped from their respective scales when item correlations failed tests of internal consistency. Second, all scales were evaluated together and all items loaded highest on their primary factor. Any item that did not meet all tests was removed from the scale. The final number of items in each scale is detailed when the scale is first used in analysis.

A one-way ANOVA for Agency was conducted for all analyses in this section.

(Insert Figure 6 Here)

Hypothesis I: People will feel more social attraction for avatars than for agents.

This hypothesis was not supported.

Of the 9 likert-type items originally included in the scale of social attraction (Standard alpha = .83), six items remained after the tests of internal consistency and reliability (See Appendix C, items 41, 42 and 43 were removed), and responses on this scale ranged from 6 to 42 (See Table IV for items remaining in this scale).

The effect of agency on social attraction is not statistically significant, $F(1, 132) = .07$, $p = .80$. Means (with standard deviations in parentheses) for those in the agent condition and avatar condition were 22.39 (6.36) and 22.10 (6.86), respectively.

In an open-ended questionnaire, 28 participants (10 in the agent condition and 18 in the avatar condition) expressed doubt that they were interacting with another entity in real time, or doubt that they were interacting with another human (in the avatar condition). As a control, in the analysis below, those participants were removed from the analysis. Eliminating those participants did not influence this result. The effect of agency on social attraction is still not significant, $F(1,$

104) = .10, p = .75. Means (with standard deviations in parentheses) for those in the agent condition and avatar condition were 22.27 (6.33) and 21.86 (6.90), respectively

Hypothesis II: People will feel more partner satisfaction with a human interaction partner than with a bot.

This hypothesis was not supported on either scale.

All ten likert-type indicators of partner satisfaction remained after the tests of internal consistency and reliability (Standard alpha = .89) and responses on this scale ranged from 10 to 41 (See Table V). Also, all six of the semantic differential partner satisfaction items remained after tests of internal consistency and reliability (Standard alpha = .91) and responses on this scale ranged from 6 to 28 (See the bottom of Table V).

The effect of agency on partner satisfaction is not significant, $F(1, 132) = .79$, $p = .38$. Means (with standard deviations in parentheses) for those in the agent condition and avatar condition were 18.37 (6.75) and 17.42 (5.65), respectively. Eliminating those participants who expressed doubt about whether they were interacting with another in real time did not influence this result. The effect of agency on partner satisfaction is still not significant, $F(1, 104) = 1.43$, $p = .23$). Means (with standard deviations in parentheses) for those in the agent condition and avatar condition were 18.16 (6.26) and 16.83 (4.99), respectively.

The effect of agency on partner satisfaction as measured with the semantic differential scale is also not significant, $F(1, 132) = .27$, $p = .61$. Means (with standard deviations in parentheses) for those in the agent condition and avatar condition 13.58 (4.49) and 13.18 (4.42), respectively. Eliminating those participants who expressed doubt about whether they were interacting with another in real time does not influence this result. The effect of agency on partner satisfaction is still not significant, $F(1, 104) = .18$, $p = .68$. Means (with standard deviations in parentheses) for those in the agent condition and avatar condition were 13.40 (4.13) and 13.06 (4.19), respectively.

Hypothesis III: People will feel more copresent with a human interaction partner than with a bot.

This hypothesis was not supported on either dimension.

The scale measuring the perceived copresence of the virtual confederate (agent or avatar) maintained 13 of the original 15 indicators after the tests of internal consistency and reliability (standard alpha = .9) and responses on this scale ranged from 15 to 60 (See Appendix C, items 4 and 5 were removed, see Table VI for retained items). Of eleven items originally included in the scale of self-reported copresence, five items remained after the tests of internal consistency and reliability (Standardized alpha= .78) and responses on this scale ranged from 6 to 30 (See Appendix C, items 17, 18, 19, 21, 25 and 26 were removed, see Table VII for retained items). The items that were dropped appeared to be bad items in this manipulation[19].

[19] All of these included a measure of how involved, detached or intimate this particular conversation was. They were not related directly to their perception of their interaction partner. Another manipulation may be a better test of this dimension of the construct.

The effect of agency on the perception that the virtual confederate (agent or avatar) was copresent is not significant, $F(1, 132) = .27$, $p = .60$. Means (with standard deviations in parentheses) for those in the agent condition and avatar condition 36.48 (9.76) and 37.37 (9.96), respectively. Eliminating those participants who expressed doubt about whether they were interacting with another in real time did not influence this result. The effect of agency on perceived copresence of the virtual confederate (agent or avatar) is still not significant, $F(1, 104) = .13$, $p = .72$. Means (with standard deviations in parentheses) for those in the agent condition and avatar condition were 36.46 (9.99) and 35.77 (9.80), respectively.

The effect of agency on the participant's self-reported copresence in the interaction is not significant, $F(1,132) = .37$, $p = .54$. Means (with standard deviations in parentheses) for those in the agent condition and avatar condition were 17.39 (4.13) and 16.92 (4.77), respectively. Eliminating those participants who expressed doubt about whether they were interacting with another in real time does not influence this result. The effect of agency on the participant's self-reported copresence in the interaction is still not significant, $F(1, 104) = .96$, $p = .33$. Means (with standard deviations in parentheses) for those in the agent condition and avatar condition were 17.44 (4.38) and 16.54 (5.10), respectively.

Hypothesis IV: People will feel less uncertainty in judgments of avatars than agents

This hypothesis was not supported.

All seven indicators from the Attributional Confidence Scale remained after tests of internal consistency and reliability (Standard alpha = .84) and responses on this scale ranged from 7 to 32 (See Table VIII).

The effect of agency on uncertainty is not significant, $F(1, 132) = 2.90$, $p = .09$. Means (with standard deviations in parentheses) for those in the agent condition and avatar condition were 15.88 (6.51) and 14.17 (5.00), respectively. Eliminating those participants who expressed doubt about whether they were interacting with another in real time does not influence this result. The effect of agency on uncertainty is still not significant, $F(1, 104) = .96$, $p = .33$). Means (with standard deviations in parentheses) for those in the agent condition and avatar condition were 15.79 (6.46) and 14.28 (5.00), respectively.

Hypothesis V: Judgments of avatars will be more extreme than judgments of agents

A folded scale technique was used to test this hypothesis. The scales are measured from 1 (not at all) to 7 (very much) with 4 resulting in a neutral judgment of the other or from 1 to 5 with 3 resulting in a neutral judgment. The folded scale technique recoded the variables to uncover the absolute values from neutral of the attribution of the other. In this way, a 4 (or 3) rating is neutral and a 1 or a 7 (or 5) are on the absolute extremes.

This hypothesis was not supported on any measure.

On both of the measures of copresence, a main effect for Agency is not significant.

The effect of agency on the extremity of perceived copresence of the virtual confederate (agent or avatar) is not significant, $F(1, 132) = 1.21$, $p = .27$. Means (with standard deviations in parentheses) for those in the agent condition and avatar condition were 24.74 (5.25) and 25.71 (4.92), respectively.

The effect of agency on the degree of copresence self-reported by participants is not significant, $F(1, 132) = .21$, $p = .65$. Means (with standard deviations in parentheses) for those in the agent condition and avatar condition were 11.34 (2.37) and 11.54 (2.60), respectively.

The effect of agency on social attraction is not significant, $F(1, 132) = .08$, $p = .78$. Means (with standard deviations in parentheses) for those in the agent condition and avatar condition were 13.03 (3.32) and 13.21 (4.22), respectively.

On both measures of partner satisfaction a main effect for agency is not significant. The effect of agency on partner satisfaction is not significant, $F(1,132) = .22$, $p = .64$. Means (with standard deviations in parentheses) for those in the agent condition and avatar condition were 23.44 (4.68) and 23.81 (4.57), respectively.

The effect of agency on the semantic differential scale of partner satisfaction is not significant, $F(1,132) = .04$, $p = .84$. Means (with standard deviations in parentheses) for those in the agent condition and avatar condition were 16.84 (3.76) and 16.98 (4.11), respectively.

Hypothesis VI: People that feel more physical presence in the environment will feel more copresence with their interaction partner.

This hypothesis was supported.

For the scale of presence (standard alpha= .88), six of the 8 original items were retained after tests of internal consistency and reliability (See Appendix C, items 33, 34 and 35 were removed, see Table IX for retained items)

There is a significant positive correlation between copresence and physical presence. There is a positive correlation between presence and the degree to which participants felt their partners were copresent ($r = .46$, $p = .00$), as well as a significant positive relationship between the degree to which people felt themselves to be copresent in the interaction and the degree to which they felt present in the environment ($r = .54$, $p = .00$). The correlation between the degree to which people felt copresent and the perceived copresence of the virtual confederate (agent or avatar) was also significant, but smaller, ($r = .33$, $p = .00$). People that felt more copresence with their interaction partner on either dimension also felt more physical presence in the environment.

INFLUENCE OF A VIRTUAL IMAGE

A one-way ANOVA with a priori contrasts (-2 no image, +1 high-anthropomorphic image, +1 low-anthropomorphic image) for the effect of Agency was conducted for all analyses in this section.

Hypothesis VII: When a virtual image is visible, people will feel copresence with their partner than when no virtual image is visible.

This hypothesis was not supported.

This hypothesis was tested for both the perceived copresence of the virtual confederate (agent or avatar) and the self-reported copresence of the participant.

The effect of a visual virtual image on people's perception that the virtual confederate (agent or avatar) is copresent is not significant, $T(2, 131) = -1.25$, $p = .22$. Means (with standard deviations in parentheses) for those in the no image condition, low-anthropomorphic condition and high-anthropomorphic condition and were 38.36 (9.52), 38.83 (9.46), and 33.47 (9.83), respectively and responses on this scale ranged from 15 to 60.

The effect of the existence of a visual virtual image on people's self-reported copresence is not significant, $T(2, 131) = -.57$, $p = .57$). Means (with standard deviations in parentheses) for those in the no image condition, high-anthropomorphic condition and low-anthropomorphic condition were 17.45 (4.17), 17.96 (4.69), and 16.01 (4.29), respectively.

Hypothesis VIII: When a virtual image is visible, people will feel more social attraction for their partner than when no virtual image is visible.

This hypothesis was not supported.

The effect of a visual virtual image on social attraction is not significant, $T(2, 131) = -.58$, $p = .56$. The means are not in the predicted direction. Means (with standard deviations in parentheses) for those in the no image condition, high-anthropomorphic condition and low-anthropomorphic condition were 22.67 (6.05), 24.00 (6.47), and 19.95 (6.70), respectively.

Hypothesis IX: When a virtual image is visible, people will feel partner satisfaction than when no virtual image is visible.

This hypothesis was not supported.

The effect of a visual virtual image on partner satisfaction is not significant T(2, 131) = .47, p = .64). Means (with standard deviations in parentheses) for those in the no image condition, high-anthropomorphic condition and low-anthropomorphic condition were 17.51 (5.84), 19.35 (7.07) and 16.75 (5.42), respectively.

The effect a visual virtual image on partner satisfaction with the semantic differential scale is not significant, T(2, 131) = .77, p = .44. Means (with standard deviations in parentheses) for those in the no image condition, high-anthropomorphic condition and low-anthropomorphic condition were 12.93 (4.03), 14.51 (5.00) and 12.61 (4.02) respectively and responses on this scale ranged from 6 to 28.

Hypothesis X: When a virtual image is visible, people will feel less uncertainty in judgments of others than when no virtual image is visible.

This hypothesis was not supported.

The effect of a visual virtual image on uncertainty is not significant, T(2, 131) = .58, p = .56. Means (with standard deviations in parentheses) for those in the no image condition, high-anthropomorphic condition and low-anthropomorphic condition were 14.63 (5.42), 14.49 (5.88) and 16.02 (6.23), respectively and responses on this scale ranged from 7 to 32.

Hypothesis XI: When a virtual image is visible, people will make more extreme judgments of others than when no virtual image is visible.

This hypothesis was not supported.

Tests of this hypothesis used the folded scale technique discussed above and a one-way ANOVA with a priori contrasts (-2 no image, +1 high-anthropomorphic image, +1 low-anthropomorphic image) on all dependent variables.

The effect of a visual virtual image on extremity of perceived copresence of the virtual confederate (agent or avatar) is not significant, $\underline{T}(2, 131) = .31$, $\underline{p} = .76$). Means (with standard deviations in parentheses) for those in the no image condition, high-anthropomorphic condition and low-anthropomorphic condition were 25.03 (4.81), 24.97 (4.94) and 25.67 (5.58), respectively.

The effect of a visual virtual image on extremity of self-reported copresence is not significant, $\underline{T}(2, 131) = 1.09$, $\underline{p} = .28$. Means (with standard deviations in parentheses) for those in the no image condition, high-anthropomorphic condition and low-anthropomorphic condition were 11.10 (2.23), 11.70 (2.61) and 11.49 (2.56), respectively.

The effect of a visual virtual image on extremity of social attraction is not significant, $\underline{T}(2, 131) = .71$, $\underline{p} = .48$. Means (with standard deviations in parentheses) for those in the no image condition, high-anthropomorphic condition and low-anthropomorphic condition were 12.80 (3.71), 12.82 (3.86) and 13.76, (3.75), respectively.

The effect of a visual virtual image on extremity of partner satisfaction is not significant, $T(2, 131) = -.62$, $p = .54$. Means (with standard deviations in parentheses) for those in the no image condition, high-anthropomorphic condition and low-anthropomorphic condition were 24.00 (4.33), 22.72 (4.87), and 24.22 (4.56), respectively.

The effect of a visual virtual image on extremity of uncertainty is not significant, $T(2, 131) = -.29$, $p = .77$). Means (with standard deviations in parentheses) for those in the no image condition, high-anthropomorphic condition and low-anthropomorphic condition were 16.53 (2.66), 16.75 (2.90) and 16.02 (2.86), respectively.

INFLUENCE OF AN ANTHROPOMORPHIC VIRTUAL IMAGE

(Insert Figure 7 Here)

Hypothesis XIII: People will perceive intelligent others with highly anthropomorphic images as more socially attractive than those with low-anthropomorphic images.

This hypothesis was supported.

This was tested with a one-way ANOVA with a priori contrasts (0 no image, +1 high-anthropomorphic image, -1 low-anthropomorphic image). The effect of a highly anthropomorphic virtual body on social attraction is significant, $T(2, 131) = 3.01$, $p = .00$). This was confirmed by a one-way ANOVA. The effect of a highly anthropomorphic body on social attraction is significant, $F(2, 131) = 4.66$, $p = .01$). Means (with standard deviations in parentheses) for those in the no image condition, high-anthropomorphic condition and low-anthropomorphic condition were 22.67 (6.05), 24.00 (6.47), and 19.95 (6.70), respectively. Participants who interacted with high-anthropomorphic virtual images felt significantly more social attraction than those that interacted with low-anthropomorphic virtual images. Those interacting with high-anthropomorphic virtual images felt the highest social attraction and those interacting with low-anthropomorphic virtual images felt the lowest social attraction.

This was also tested using a one-way ANOVA with contrasts (1 no image, 1 high-anthropomorphic image, -2 low-anthropomorphic image). The effect of a high-anthropomorphic virtual body on social attraction is significant, $T(2, 131) = 2.86$, $p = .01$. People who interacted with a low-anthropomorphic image felt less social attraction than either those interacting with no image or with a high-anthropomorphic image.

Hypothesis XIV: People will be more satisfied with partners represented by highly anthropomorphic virtual image than those with low-anthropomorphic image.

This hypothesis was supported with both scales.

The contrast test (0 no image, +1 high-anthropomorphic image, -1 low-anthropomorphic image) showed that the effect on partner satisfaction of a low-anthropomorphic image compared to a high-anthropomorphic image is significant, $T(2, 131) = 2.0$, $p < .05$. Participants who interacted with a high-anthropomorphic image felt more partner satisfaction than those that interacted with low-anthropomorphic virtual images. Means (with standard deviations in parentheses) for those in the no image condition, high-anthropomorphic condition and low-anthropomorphic condition were17.51 (5.84), 19.35 (7.07) and 16.75 (5.42), respectively.

This was also tested using a one-way ANOVA with contrasts (-1 no image, +2 high-anthropomorphic image, -1 low-anthropomorphic image). The effect of a high-anthropomorphic virtual body on partner satisfaction is significant, $T(2, 131) = -1.98$, $p < .05$. People who interacted with a low-anthropomorphic image felt less partner satisfaction than either those interacting with no image or with a high-anthropomorphic image.

The same tests were used with the semantic differential scale measuring partner satisfaction. The contrast test (0 no image, +1 high-anthropomorphic image, -1 low-anthropomorphic image) showed that the effect on partner satisfaction of a low-anthropomorphic image compared to a high-anthropomorphic image is significant, $T(2, 131) = 2.07$, $p = .04$. Means (with standard deviations in parentheses) for those in the no image condition, high-anthropomorphic condition and low-anthropomorphic condition were 12.93 (4.03), 14.51 (5.00) and 12.61 (4.02), respectively. Participants interacting with a high-anthropomorphic image felt more partner satisfaction than either those interacting with no image or the low-anthropomorphic image.

This was also tested using a one-way ANOVA with contrasts (0 no image, +1 high-anthropomorphic image, -1 low-anthropomorphic image). The effect of a high-anthropomorphic virtual body on partner satisfaction is significant, $\underline{T}(131) = -2.19$, $\underline{p} = .03$. People who interacted with a less anthropomorphic avatar felt less partner satisfaction than either those interacting with no image or with a high-anthropomorphic image. People that interacted with high-anthropomorphic virtual images felt more partner satisfaction than those in the no image condition or than those who interacted with less anthropomorphic images.

Hypothesis XV: People will feel more copresent with a partner represented by a highly anthropomorphic image than those with low-anthropomorphic images.

This hypothesis was supported on both dimensions.

The contrast test (0 no image, +1 high-anthropomorphic image, -1 low-anthropomorphic image) showed that the effect of an anthropomorphic image on the perceived copresence of the virtual confederate (agent or avatar) is significant, $\underline{T}(2, 131) = 2.66$, $\underline{p} = .01$. Means (with standard deviations in parentheses) for those in the no image condition, high-anthropomorphic condition and low-anthropomorphic condition were 38.36 (9.52), 38.83 (9.46) and 33.47 (9.83), respectively. This was confirmed by a one-way ANOVA. The effect of an anthropomorphic body on perceived copresence of the virtual confederate (agent or avatar) is significant, $\underline{F}(2, 131) = 4.26$, $\underline{p} = .02$. Participants interacting with a high-anthropomorphic image felt more partner satisfaction than either those interacting with no image or the low-anthropomorphic image.

This was also tested using a one-way ANOVA with contrasts (+1 no image, +1 high-anthropomorphic image, -2 low-anthropomorphic image). The effect of an anthropomorphic virtual body on perceived copresence of the virtual confederate (agent or avatar) is significant, $\underline{T}(2, 131) = 2.90$, $\underline{p} = .00$. People interacting with the less anthropomorphic virtual image reported their partners to be less copresent than those who interacted with either a high-anthropomorphic virtual image OR with no image.

The same trend in the results was found with regard the participants' self-reported copresence in the interaction. People that interact with highly anthropomorphic virtual images felt more copresent than those that interact with low-anthropomorphic virtual images.

This was tested with a one-way ANOVA with a priori contrasts (0 no image, +1 high-anthropomorphic image, -1 low-anthropomorphic image). The effect of an anthropomorphic virtual body on self-reported copresence is significant, $\underline{T}(2, 131) = 2.11$, $\underline{p} = .04$. Means (with standard deviations in parentheses) for those in the no image condition, high-anthropomorphic condition and low-anthropomorphic condition were 17.45 (4.17), 17.96 (4.69) and 16.01 (4.29), respectively. People that interacted with highly anthropomorphic virtual images felt more copresent than those that interacted with low-anthropomorphic virtual images.

This was also tested with a one-way ANOVA with contrasts (+1 no image, +1 high-anthropomorphic image, -2 low-anthropomorphic image). The effect of a low-anthropomorphic image on people's self-reported copresence is significant,

$T(2, 131) = 2.09$, $p = .04$). People interacting with a less anthropomorphic virtual image felt less copresence with their partner than those interacting with either no image or with a highly anthropomorphic virtual image.

Chapter 6

Discussion

The results of this project have shed light on how people perceive and respond to mediated others in social virtual environments. They specifically have provided further insight into the influence of an anthropomorphic virtual image on the social judgment of a mediated other. This chapter explores the findings in relationship to the theoretical model (Figure 1), with specific attention to the implications of the results on the distinction between the perception of agents and avatars, and of the existence of anthropomorphic virtual images on the feelings of social attraction, partner satisfaction, uncertainty, presence and copresence and suggests a revised theoretical model in light of the results. The final section of this chapter explores the potential limitations of the manipulation and findings.

ON THE DIFFERENCE BETWEEN HUMAN AND NON-HUMAN INTERACTANTS

The model predicted that people would be less involved in interactions with agents and that they would be seen as less human and less deserving of social responses than would avatars. This led to the theoretical prediction seen in Figure 1 that is represented by the *Agent/Avatar* circle just to the left of the *Mental Model of Interactant & Environment* square. This circle represents the classification of whether one is perceived to be an agent or an avatar.

The model predicted that the mere suggestion that one was not interacting with a human would influence social judgment. This was specifically tested by hypotheses I through V (See Table II). Tests of these hypotheses examined the influence of the perception of avatars as compared to the perception of agents on judgments of social attraction, uncertainty, partner satisfaction and copresence as well as the extremity of social judgment. The results did not support this prediction on any measure and no evidence of a distinction was found between the perception of avatars and the perception of agents. This led to the removal of the agent/avatar distinction from the far left side of the model in the revised model (See Figure 8), but one cannot conclude that there is no influence on social judgment and mental models of others of the distinction between agents and avatars, only that this manipulation and these measurements did not reveal any distinctions.

The fact that participants did not respond in discernibly different ways to agents as compared to avatars strengthened the conclusion that people respond socially to all intelligent others, whether human or not. It supported the findings of other researchers showing that people respond to intelligent non-human others in the *same ways* they respond to human others (Reeves & Nass, 1996) and the script read by the virtual confederate (agent or avatar) was sufficient to qualify the partner as an intelligent other. There are other possible explanations for these results and interpreting null results is always questionable, but the fact that it was consistent with previous research makes this conclusion easier to support. As can be seen from the revised model (figure 8), the agent/avatar distinction may have influenced the mental model in some way, but directionality and the judgments it influences are as yet undetermined.

ON THE EXISTENCE OF A VIRTUAL IMAGE

The theoretical model predicted that any visible virtual image would lead to increased social judgment and involvement in the interaction. This led to the theoretical prediction seen in Figure 1 that is represented by the *Embodiment Visible/Not* and *Body Morphology Looks Human/Not* circles on the far left side of the model. These circles represented the classifications of whether or not there is a visible image present and whether or not that image was anthropomorphic.

In essence, this prediction was based on the notion that when an interaction partner was represented by any virtual image, they would be more likely to be classified as human or more human-like than when there was no virtual image. This notion was tested by hypotheses VII through XI (See Table II). Tests of these hypotheses specifically examined whether or not participants felt more copresence, social attraction, partner satisfaction, uncertainty or extremity of social judgment when participants interacted with a partner represented by a virtual image as compared to those who interacted with a partner not represented by a virtual image. Contrary to what was predicted above, the simple existence of a virtual image did not lead to either the perception that one was human or to increased social judgment or response.

NOT ALL VIRTUAL IMAGES ARE EQUAL

People's experience in the natural world has led them to rely on the physical, relatively unchanging features, especially those related to the physical body for social judgment and to place others into meaningful social categories (Argyle, 1975; Chesebro & Bonsall, 1989; Fiske & Neuberg, 1990; Goffman, 1963; Hinton, 1993; Ichheiser, 1970). The process of categorizing others based on physical appearance has been shown to be universal and automatic, not even requiring conscious attention (Patterson, 1995; Tagiuri, 1958). The theoretical model predicted that even in a highly structured task-oriented interaction people would continue to rely on the characteristics of the virtual image for category assignment, whether they perceived their partner to be an agent or an avatar. This was specifically tested in hypotheses XII, XIII and XIV (See Table II), which examined the influence of an anthropomorphic virtual image on perceptions of copresence, uncertainty, partner satisfaction and social attraction.

In examining the implications of the results of these hypotheses on the theoretical model (Figure 1), note that the arrows indicated the prediction that the existence and/or shape of the virtual image would influence the perception of another as avatar or agent. The mere existence of the virtual image did not influence perception in the direction that was predicted by the model. In other words, the existence of a virtual image did not result in an increased perception of humanness as predicted. This does not imply that the presence of a virtual image did not influence perception; it only means that the influence of a virtual image was not always in the direction of a more social, or human judgment. The model did not predict that the influence of the virtual body would be this much stronger than the influence of the perception of whether the interaction partner was an agent or avatar. The perception of agents did not differ from the perception of avatars when the virtual image was the same on any of the dependent variables represented in Figure 1. Essentially, the results indicated that when the image of an interaction partner was more anthropomorphic the judgments were more social than when the image was less anthropomorphic.

Across the measures, the most positive perception was of the virtual confederate (agent or avatar) represented by a highly anthropomorphic image as the model predicted. Participants in the high-anthropomorphic image condition perceived that the virtual confederate (agent or avatar) was more copresent in the interaction than the virtual confederate represented by a low anthropomorphic virtual image. Further, participants in the high anthropomorphic condition reported feeling more copresence with the confederate, were more socially attracted to their partner, and they reported more partner satisfaction.

THE FEELINGS OF COPRESENCE AND PRESENCE ARE INTERCONNECTED

As predicted by the model, both dimensions of copresence were highly and significantly correlated with the concept of presence. This was predicted in hypothesis VI (See Table II) and tested with a correlation that showed a significant relationship between the variables. This significant association indicated one of two things: either the connection between people influenced presence in the interface, *or* the presence in the interface influenced attention to their interaction partner, the virtual confederate. It is difficult to ascertain the direction of this influence and whether presence increases copresence or whether copresence increases presence. Future research should explore the directionality of this relationship.

Even without making claims regarding causality, the relationship between these variables represented an important consideration for both designers and users of telecommunication technology. When people did not feel present in the environment, they felt less satisfied with, and less of a connection with, their interaction partner. Interestingly, presence was also negatively correlated with uncertainty ($r = -.45$, $p = .00$). This indicated that the less uncertainty one feels about their ability to predict their interaction partner's behavior the more presence they felt in the environment, or the more presence one felt in the environment the less uncertainty they felt about their interaction partner.

As researchers continue their exploration of the influence of presence on people's mental processes they should also consider the importance of this sensation on the perception of copresence with other people and objects in the environment. Designers and users of interfaces for interpersonal interactions ought to take careful note of this information. This could allow them to design or choose media that best facilitates the needs of their interaction goals, promoting the necessary levels of both presence and copresence.

ON REVISING THE MODEL AND UNDERSTANDING THE INFLUENCE OF THE VIRTUAL IMAGE

The results supported the notion that people have continued to use the visible features of the body, whether virtual or natural, to make social judgments of others. The body influenced participants even when the interaction, experience and body were mediated or virtual. Even a virtual image and mediated interaction influenced participants' social judgment of their interaction partner. This was consistent with the notion that people in virtual environments have used the characteristics of the body or image that were salient and familiar based on their experience in the natural world for social judgment. More research is needed to clarify the strength of the virtual body as compared to other indicators and information in the interaction and environment.

It is important to look at the implications for the findings from hypotheses I-V and VII-XI together (See Table II). This provided unique insight into the influence of a visible virtual image on the perception of an intelligent other. It was these groups of hypotheses together that contribute the most to understanding the implications of the results on changes to the theoretical model. The theoretical model (Figure 1) predicted first that people would respond more socially to others represented by a virtual image - any virtual image. Further, the model predicted that people would use the features of the image to form their mental model of them. This part of the prediction indicated that a less anthropomorphic virtual image would invoke less social response and less social judgment as compared to those interacting with another represented by a more anthropomorphic image. The model was incorrect in predicting that any virtual image would increase the tendency of people to respond socially. However, the model was correct to predict that the appearance of the virtual image would be influential and that people represented by more anthropomorphic virtual images would be responded to more socially.

The fact that the responses of participants that interacted with a virtual body and those who did not were not significantly different should not be interpreted to mean that the virtual body is not influential. Having a non-anthropomorphic virtual image provided less social response than either the high anthropomorphic virtual image or no image. In other words, people responded more socially to those represented by more anthropomorphic images or by no image at all than to those represented by a low anthropomorphic image. The model does not accurately reflect the direction or extremity of the influence of a low-anthropomorphic virtual image.

It is likely that the default mental model of an intelligent other included an anthropomorphic image and, when the image was more anthropomorphic, the image created by the mental model was not distinguishably different. On the other hand, when the virtual image was less anthropomorphic, the difference between the mental model and the image were very different, which caused a negative, less social perception of the virtual confederate. Specifically, when the virtual face did not appear human, the virtual confederate (agent or avatar) was perceived to be a less intelligent other than when there was either no image or when the virtual face was more anthropomorphic.

The model should have two different circles on the far left side (Figure 1). These are a highly anthropomorphic virtual body and a low anthropomorphic body. The results here did not show a difference between the existence of a virtual body and the lack of one, there was no distinguishable difference between those in the high anthropomorphic virtual image condition and those in the no image condition. Having only two circles would more clearly show the difference between a high anthropomorphic virtual image and a low anthropomorphic virtual image (See revised model on Figure 8).

When virtual image was less anthropomorphic, the virtual confederate represented by it was responded to in less social ways or as less human. This supported the prediction that if it does not look human, it was not perceived to be human, as long as it demonstrated some form of intelligence. In other words, just because there was a virtual image did not mean the other was more likely to be perceived as human, but the characteristics of the virtual image were the keys to this distinction. It further supported the notion that people relied on their experience in the natural world, where all living things have had certain common properties that distinguished them from inanimate objects (Asch, 1958; Hastorf et al., 1970; Heider, 1958). This means that, when both intelligence and the physical properties traditionally ascribed to humans were seen in agents, participants still perceived them to be human, or at least human-like enough to form the same or an indistinguishable mental model of them.

In the theoretical model, having no image was predicted to lead to less copresence and partner satisfaction than having any image. This was not supported. The results supported the conclusion that having no image for a task-oriented interaction was better for attributions of credibility and copresence and partner satisfaction than having a less-anthropomorphic image.

This supported previous research showing that virtual images, especially more anthropomorphic images, were more engaging, interesting and attractive (Koda, 1996; Wexelblat, 1997) and that they influenced people's perception of their interaction partner. It appeared that when visual cues were presented people used them, even if the indicators provided by the virtual image contradicted other information provided during or before the interaction (Koda, 1996; Nowak & Anderson, 1999; Takeuchi & Naito, 1995). Further, the judgments of the virtual confederate (agent or avatar) were related to judgments that could logically be associated with the virtual image. The script spoken by the virtual confederate (agent or avatar) was written to represent an individual very qualified to be a good partner during the Internet Scavenger Hunt. People who saw no image thought their partner was credible and likeable as did those who saw the more human-like face.

The difference between the influence of the more anthropomorphic virtual image and the low-anthropomorphic virtual image was hypothesized, but the original theoretical model did not accurately reflect the definitive significance of this influence. In this case, the appearance of the virtual image significantly influenced all measures except for uncertainty.

POTENTIAL LIMITATIONS OF THIS MANIPULATION

In this section, specific issues are discussed that may limit or influence the interpretation of the results. These include issues related to the interaction and manipulation as well as unique properties of the virtual confederate (agent or avatar) and the interface. First, whenever research is done in a laboratory there are concerns regarding external validity. This project took place in a computer laboratory where participants knew their behavior was being monitored, so they may have behaved differently than they would have in a more natural setting.

FEATURES OF THE INTERFACE

The virtual environment used was a new interface and many participants expressed discomfort interacting with another through a microphone attached to a computer. Not all participants had interacted in SVEs before and was possible that experienced users would have perceived this differently. If more time were allowed to get used to the system, there may have been an influence on uncertainty, but all participants were highly uncertain across conditions. It is possible that it was the uncertainty in the interaction that was driving participant's responses and especially the lack of distinction between the perception of agents and avatars. It is important to note that participants were from computer science and telecommunication and were thus likely to react differently to this interface than would less technologically oriented students.

ISSUES RELATED TO THE INTERACTION

This was a very limited interaction. A number of participants expressed frustration at getting only 3 "turns" in the interaction. The interaction was highly controlled and scripted. In the future, researchers should consider having people interact in natural interactions but tell some they are interacting with an agent. This would remove the control over script and content but may allow more variation in the sense of copresence.

It was possible that the results would have been different if the interaction had been more social or less controlled. Specifically, it is likely that this, in combination with participant's uncertainty, influenced the results with regard to measuring the copresence in this interaction. It is likely that the stiff nature of the interaction kept people from feeling copresent in the interaction and this measure should be tested in a more natural interaction to see how the items hold together in different contexts. In other words, people did not feel compelled or immersed in this interaction. It was short and controlled and participants repeatedly mentioned that this did not allow them to get engaged in the interaction.

FEATURES OF THE VIRTUAL CONFEDERATE (AGENT OR AVATAR)

THE UNIQUENESS OF THE VIRTUAL IMAGES

The low-anthropomorphic virtual face was very iconic and odd. Participants were unlikely to have experienced anything like it in the past. This image was selected because it was very clearly not human, although it had a face, it still did not resemble anything human, living or even a familiar object. It is possible that an image could be less anthropomorphic like an animal, every day object or other image that would not cause the negative perception to be as extreme and unsocial as that seen by participants in this project. However, it is the extremity and level of uniqueness of the low-anthropomorphic character that made it less anthropomorphic. People anthropomorphize all familiar objects, so the less familiar an object is the less anthropomorphic it would seem. It seems that this iconic image was far from the default mental image people created when no image was provided. These results may be tapping into some type of expectancy violation or social cost related to the unexpected low-anthropomorphic virtual face. Future research should further explore this possibility.

The more anthropomorphic virtual image was also unique. The image represented a woman with brown hair and eyes. The face was not very lifelike and movements were halted and the contours of the face were not as smooth as a natural human face would be. It may be that a face that is closer to a natural human face would have made the results more extreme, but it is unlikely that this altered the direction of the results. If there is a sufficiency threshold for anthropomorphism, it appeared that this face reached it.

The images selected for this project were on the extremes; one highly anthropomorphic and one very iconic and less anthropomorphic. This left open a few questions including what would have happened if the virtual image was less anthropomorphic and non-iconic or what would happen if the more anthropomorphic image was slightly less anthropomorphic, more masculine or less attractive. Future research should explore the influence of these factors.

THE VOICE AND SCRIPT

The script was written to represent an intelligent and highly qualified partner. Also, the woman who read the script was chosen specifically because of her ability to articulate well and sound credible. In the open-ended questions, some participants wondered about the veracity of one person having all these skills. It is possible, but unlikely, that the voice or the script influenced the direction of the results. In other words, it was the script that made the partner seem credible and likeable and by itself made participants perceive the virtual confederate as credible and likeable. This may have partially influenced the results but would not explain the difference between those in the high anthropomorphic and those in the low anthropomorphic condition.

ISSUES RELATED TO THE MANIPULATION AND LAB SETUP

The manipulation was very task-oriented and restricted. One of the things that distinguish the perception of humans from the perception of other living things is the consideration of intentionality and emotion (Asch, 1958; Heider, 1958; Ritvo, 1991; Sheehan, 1991b; Turkle, 1991; Williams, 1991). It was possible that the task-oriented nature of this interaction gave people the perception of intentionality in both conditions and removed this consideration from the perception of the other. In other words, the manipulation provided and set up the intention of the perceived other, which neutralized this consideration regardless of whether the virtual confederate was agent or avatar.

As considered in Chapter 6, there were a number of possible reasons for the lack of influence of agency on people's perception of their virtual partner. Chapter 2 considered the degree to which the perceived intelligent other was perceived to be human. It may be that no differences were detected in this project because the virtual confederate (agent or avatar) was considered human enough for the task at hand across the board. Bruner (1957) argued that people assess how much information about another person they need to fulfill their goals and use the resources and information available to fill the gap between what they need to know and what they already know. It was possible that the task-oriented nature of this interaction reduced the amount of information participants needed to make these social judgments, given the context. Perhaps there was a sufficiency threshold where an intelligent other begins to be perceived intelligent or human enough for the purposes of the interaction. Finding this sufficiency threshold, if it exists, may be an important area of future research. The results from this project indicate that the sufficiency threshold included some indication of intelligence, such as the script. The presence of the low anthropomorphic virtual image seemed to have influenced this perception in negative ways, but it was difficult to conclude why this happened without further research.

If there was indeed a sufficiency threshold for 'humanness' or a point at which the other was human enough for the purposes of the interaction, then it seems that the standard for social interactions would be higher than the standard for task-based interactions. It may be that in this type of interaction the level of humanness did not matter. It is possible that a more personal interaction would uncover a distinction between human others and non-human others. Even if the interaction was less controlled, it is unlikely that this would alter the fact that agency did not influence perception or social judgment because it confirmed similar findings in previous research using love tutorials (Reeves & Nass, 1996) and other more personal situations which have also revealed a lack of distinction between agents and avatars. Future research may manipulate intention as well as amount of information required to fulfill interaction goals as variables to examine the extent to which this influences perception.

THE AGENT/AVATAR MANIPULATION

There was the possibility that the manipulation did not work and that people did not perceive they were interacting with a human in the avatar condition, interacting with a bot in the agent condition, or even interacting with a person or thing in real time in either condition, even though they were told in their instruction sheet and verbally by the experimenter. At the end of the questionnaire were open-ended questions designed to serve as a manipulation check. At this point, 28 people expressed suspicion that they were interacting with a human (in the avatar condition) or that they were interacting in real time with a bot (in the agent condition).

Although eliminating the 28 people who expressed doubt that they were interacting in real time did not change the direction of results, it was possible that none of the participants believed they were interacting with a person in real time. However unlikely, this could explain the lack of variance between conditions. Researchers should carefully consider this possibility as they consider to ask questions about the influence of agency on social judgment.

However, past research is consistent with the finding that people respond to machines as they do humans (Reeves & Nass, 1996). Also, an open-ended question at the end of the experiment directly asked participants what they thought was really going on. If anything, this pointed question would lead to more people expressing suspicion than actually felt it during the interaction. Future research should explore these possibilities.

ENVIRONMENTAL ISSUES: LAB SETUP

Finally, participants were in a lab with eight computers and at times more than one participant was in the lab at one time. Some participants were speaking to their interaction partner while others were on other computers filling out post-tests. A few participants mentioned that they felt self-conscious speaking into a microphone to their partner when the rest of the room was relatively quiet. This may have had an influence on perceived presence and copresence in the interaction.

INTERACTING WITH INTELLIGENT OTHERS IN SVES; IMPLICATIONS OF FINDINGS FOR INTERFACE DESIGNERS AND USERS

The features of the virtual image influenced social judgment in the virtual world. A human looking other triggered more social judgments of human intelligence in participants, even when they were aware that their interaction partner was not human. This may have been related to people's experience in the natural world where things that look similar are similar. Further, a lack of experience with intelligent others who are not human and a lack of experience with human others who do not look human (as discussed by Reeves and Nass, 1996) may explain why no distinction was made between an intelligent agent and an avatar. Reeves and Nass (1996) predicted that this is due to a hard-wired tendency to in human's categorization process that make the perception of anthropomorphic images and intelligence to automatically register humanness. While this is one possible explanation, there are other possible explanations as well.

It may well be that the human experience in the natural world has only provided interaction with human intelligent others and no intelligent others who were not human. It is possible that the human brain has not adapted to dealing with entities that look human but are not or entities that are human but do not look it. Because of this, people may not make a meaningful distinction between human and non-human intelligences. If this explanation is true, then this will change over time as experience in social virtual environments becomes more common. Perhaps further experience with non-human intelligent others will promote the evolution of a more meaningful categorical distinction between agents and avatars with new meanings and interpretations.

As predicted, on the level of visual anthropomorphism influenced social judgment, which may have reflected experience in the natural world. The only entities in the natural world that look human actually are humans, so using anthropomorphism as a way to identify other humans has been useful and meaningful. The results indicate that people interacting in SVEs continued to use categories that have been useful in the natural world. Participants used a combination of visual anthropomorphism and the script of an intelligent other; future research should examine the extent to which other categories continue to be salient and useful.

Participants who saw the less natural and iconic face rated their partner as less capable than those who saw either the high-anthropomorphic image or no image. It could be said that the low-anthropomorphic image led individuals to make a less accurate judgment of their interaction partner because it led them to believe the other was not human and therefore less intelligent, credible and likeable. Future researchers should examine whether or not the reverse is true or whether a script written to be less credible would be perceived as more credible when read by a more anthropomorphic virtual image as compared to a less anthropomorphic virtual image. If this is true, then the script was influential to participants in that it made the virtual confederate seem intelligent and credible. If it was the script that made the virtual confederate seem intelligent, then the negative perception of participants in the low-anthropomorphic condition may well be explained by an expectancy violation. In other words, an intelligent other represented by a low anthropomorphic image sent mixed signals to perceivers who then rated them as less social.

Although the results answered some questions about the influence of the virtual image on the perception of the other, there are a number of unanswered questions remaining. Future researchers should examine the influence of changing the virtual image during the interaction. For example, what is the influence of beginning with a highly anthropomorphic image and switching at the end to a low-anthropomorphic virtual image at the end of the interaction? What if the order were reverse and the interaction began with the low-anthropomorphic virtual image? Which of the images would most influence the mental model of the other?

Chapter 7

Conclusion

The results of this project support what may, on the surface, appear to be a contradiction. People have responded socially to all mediated others displaying any level of intelligence, whether they are agents or avatars, unless they are represented by low-anthropomorphic images. Whether one is responded to as human is *not* based on whether one is or is not perceived to be human, but instead on whether one does or does not ***appear*** human-like. Even a rough computer animation resembling a female face was anthropomorphic enough to cause people to respond to their partner socially.

In fact, the perception of humans (avatars) and computers (agents) was indistinguishable when they were represented by the same virtual image. This means that cyberspace has not become a utopia where all voices are equal, nor are all entities responded to equally. The results indicated that the appearance of the virtual image is used in SVEs as the natural body is used in the natural world. Hence, the visual representation was very influential on the mental model of the other. However, the influence of the highly credible script may have also played a role in this perception in that it may have influenced the perception that the virtual confederate (agent or avatar) was intelligent, whether human or not.

Understanding when an agent can replace an avatar without negative response or when the absence of an image is preferable will be increasingly important as more and more of our business and personal interactions move online. It is possible that the influence of the non-anthropomorphic image would not be as significant or as influential in a more personal or less task-oriented interaction. Further, it is possible that the distinction between agents and avatars would be more influential in a more personal or social interaction. It is important that researchers consider the context of their interaction. For example, many researchers in social situations report that knowing the gender of your interaction partner is the first question asked (Spender, 1996; Turkle, 1995; Waskul & Douglass, 1997). This might not matter to the same extent in a task-oriented or business interaction. As designers and users of SVEs, it is important to understand the implications of selecting a low-anthropomorphic image during a task-based interaction. When credibility is an issue, a person will be better served by a high-anthropomorphic representation in cyberspace than a low-anthropomorphic image.

Providing no virtual image does not imply that people do not have an image in their mental model of the other. The default image people create is likely to be anthropomorphic. If this is true, this would explain why the results showed that the perception of the virtual confederate (agent or avatar) with no virtual image was similar to the virtual confederate with a more anthropomorphic image and not at all like that of the virtual confederate represented by a low-anthropomorphic image.

The virtual image influenced the perception of the virtual confederate more than any other variable examined in this project. This is an important finding and corresponds to previous research that visual cues will be processed at the expense of other information in task-oriented interactions (Koda, 1996; Nowak & Anderson, 1999; Takeuchi & Naito, 1995). This has served to reinforce the conclusion that cue lean media are best for task-oriented interactions or for interactions requiring the transmission of complex or linear information. In other words, more cues are not always better and in some cases can distract people from important information presented elsewhere in the interface.

People in SVEs continued to use the visible image to perceive intelligent others and the image influenced social judgment. Further, participants responded socially in mediated interactions, but this does not mean that other factors were not influencing their social judgment. The results extended the understanding of this phenomenon. The results of tests of the hypotheses added one qualification to the conclusion that people respond socially to all mediated others; people did not respond to intelligent others as social actors when they had a face that is not anthropomorphic. The results support the drive to create a type of embodiment that is clearly discernable from agents and other objects (as discussed by Benford et al., 1995). Designers are working to create agents that blur the line between humans and computers to encourage people to respond socially to computers (Brent & Thompson, 1999; Dryer, 1999). An anthropomorphic face in the interface would greatly support this effort.

TABLES

Table I

Types of Virtual Images and Indicators Available

No Visible Image		Visible Image		
Text with No Description of Image	Text with Description of Image	2D Virtual Image	3D Virtual Image	Natural Image
Text structure/use of language, spelling, typing speed, literacy	Text structure/ use of language, spelling, typing speed, literacy	Text structure/use of language, spelling, typing speed, literacy	Text structure/use of language, spelling, typing speed, literacy	Structure/use of language or accents
Context of interaction	Context of interaction	Context of interaction	Context of interaction	Context of interaction
Content of Interaction	Content of Interaction	Content of Interaction	Content of Interaction	Content of Interaction
		Body Type- Avatar quality/selection/ appropriateness	Body Type- Avatar quality/selection/ appropriateness	Body type/height
		Gender of Image	Gender of Image	Gender /Biological sex
		Proxemics	Proxemics	Proxemics
		Knowledge of/ Familiarity with Environment	Knowledge of /Familiarity with Environment	Clothing Choice
			Gait information/ latency/ ability to navigate environment	Gait information

Table II

Summary table of Hypotheses

Effect of Agency on Social Judgment of Interactant		
Hypothesis I:	People will feel more social attraction for avatars than for agents.	**Not Supported**
Hypothesis II:	People will feel more partner satisfaction with an avatar for an interaction partner than with an agent.	**Not Supported**
Hypothesis III:	People will feel more copresent with an avatar than with an agent.	**Not Supported**
Hypothesis IV	People will feel less uncertainty in judgments of avatars than agents	**Not Supported**
Hypothesis V	Judgments of avatars will be more extreme than judgments of agents	**Not Supported**
Relationship of Presence and Co-presence		
Hypothesis VI:	People that feel more physical presence in the environment will feel more copresence with their interaction partner.	**Supported**
Effect of Embodiment on Social Judgment of Interactant		
Hypothesis VII:	When a virtual image is visible, people will feel more copresence with their partner than when no virtual image is visible	**Not Supported**
Hypothesis VIII:	When a virtual image is visible, people will feel more social attraction for their partner than when no virtual image is visible.	**Not Supported**
Hypothesis IX:	When a virtual image is visible, people will feel partner satisfaction than when no virtual image is visible	**Not Supported**
Hypothesis X:	When a virtual image is visible, people will feel less uncertainty in judgments of others than when no virtual image is visible.	**Not Supported**
Hypothesis XI:	When a virtual image is visible, people will make more extreme judgments of others than when no virtual image is visible.	**Not Supported**
Effect of More Anthropomorphic Embodiment on Social Judgment of Interactant		
Hypothesis XII:	People will perceive intelligent others with highly anthropomorphic images as more socially attractive than those with low-anthropomorphic images.	**Supported**
Hypothesis XIII:	People will be more satisfied with partners represented by highly anthropomorphic virtual images than those with low-anthropomorphic images.	**Supported**
Hypothesis XIV	People will feel more copresent with a partner represented by a highly anthropomorphic image than those with low-anthropomorphic images.	**Supported**

Table III

Design of Experiment and Number of Participants in Each Condition

	Agent	Avatar
Anthropomorphic (avatar 1)	23	24
Not Anthropomorphic (Avatar 2)	22	22
NO avatar	23	20
TOTAL	68	66

Table IV

Six Items retained in Social Attraction Scale. These indicators were measured on a 7-point metric. 1 strongly agree to 7 strongly disagree.

I think he (she) could be a friend of mine
I would like to have a friendly chat with him (her)
We could never establish a personal friendship with each other
She (he) just wouldn't fit into my circle of friends
She (he) would be pleasant to be with
I don't care if I ever get to interact with him (her) again

Table V

Ten Items retained in partner satisfaction scale. These indicators were measured on a 5-point metric. 1 strongly agree to 5 strongly disagree.

My interaction partner is NOT of very high intelligence,
My interaction partner is a reliable source of information on the topic
My interaction partner lacks information on the subject
I would consider my interaction partner to be an expert on Internet searches
I believe my interaction partner is quite intelligent
This interaction partner is an unreliable source of information on Internet Searches
This speaker has had very little experience with Internet Searches
This speaker has considerable knowledge of the factors involved in Internet searches
This speaker has very little knowledge of the factors involved in Internet searches
My partner has had substantial experience with Internet Searches

Six items retained in the semantic differential partner satisfaction scale. These indicators were measured on a 7-point metric, participants were asked whether they considered their partner to the far left (1), or the far right (7) on each of the following pairs of words.

Reliable/Unreliable
Informed/Uninformed
Qualified/Unqualified
Intelligent/Unintelligent
Valuable/Worthless
Expert/Inexpert

Table VI

Thirteen Items retained in perceived copresence of the virtual confederate scale. These indicators were measured on a 5-point metric. 1 strongly agree to 5 strongly disagree.

My interaction partner was willing to listen to me
My interaction partner was intensely involved in our interaction
My interaction partner seemed to find our interaction stimulating
My interaction partner communicated coldness rather than warmth
My interaction partner created a sense of distance between us
My interaction partner seemed detached during our interaction
My interaction partner was unwilling to share personal information/feelings with me
My interaction partner made our conversation seem intimate
My interaction partner created a sense of distance between us
My interaction partner created a sense of closeness between us
My interaction partner acted bored by our conversation
My interaction partner was interested in talking to me
My interaction partner showed enthusiasm while talking to me

Table VII

Five Items retained in self-reported copresence scale. These indicators were measured on a 5-point metric. 1 strongly agree to 5 strongly disagree.

I did not want a deeper relationship with my interaction partner
I wanted to maintain a sense of distance between us
I was unwilling to share personal information/feelings with my interaction partner
I wanted to make the conversation more intimate
I was interested in talking to my interaction partner

Table VIII

Seven Items retained in Uncertainty scale. These indicators were measured on a 5-point metric. 1 unable to answer to 5 Completely Confident.

Following your interaction, how confident are you of your general ability to predict how he/she will behave?
Following your interaction. How certain are you that he/she likes you?
Following your interaction. How accurate are you at predicting the values he/she holds
Following your interaction. How accurate are you at predicting his/her attitudes?
Following your interaction. How well can you predict his/her feelings and emotions?
Following your interaction. How much can you empathize with (share) the way he/she feels about himself/herself?
Following your interaction. How well do you know him/her?

Table IX

Five Items retained in Presence scale. These indicators were measured on a 7-point metric. 1 Not at All to 7 Very Much.

How involving was the experience?
How intense was the experience?
To what extent did you feel like you were inside the environment you saw/heard?
To what extent did you feel immersed in the environment you saw/heard?
To what extent did you feel surrounded by the environment you saw/heard?

FIGURES

FIGURE 1. THIS MODEL REPRESENTS THE THEORIZED INFLUENCE OF LEVELS OF ANTHROPOMORPHISM ON THE MENTAL MODEL OF ANOTHER AND THE RESPONDING SOCIAL JUDGMENT OF A MEDIATED INTERACTANT.

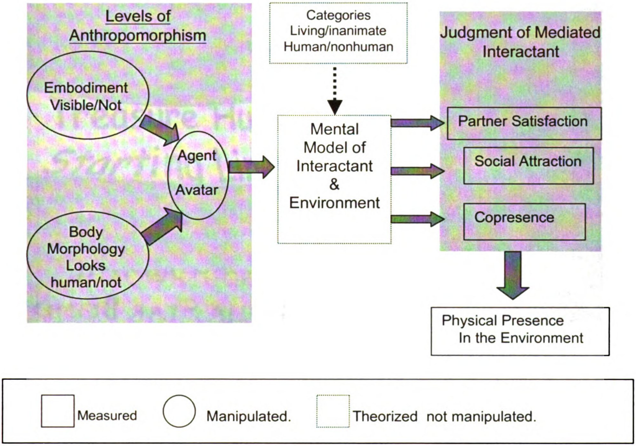


FIGURE 2. IN THE NO IMAGE CONDITION, WHERE THE VIRTUAL CONFEDERATE WAS NOT REPRESENTED BY AN IMAGE, PARTICIPANTS VIEWED THIS SCENE OF THE VIRTUAL ENVIRONMENT.

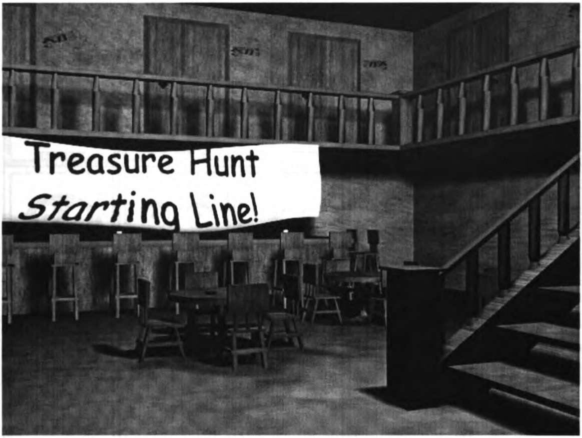
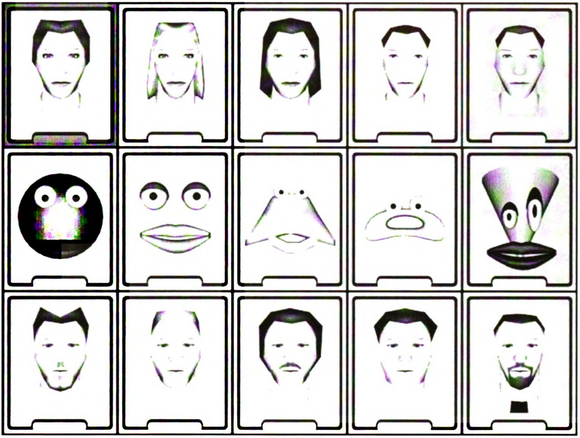


FIGURE 3. IN EITHER THE ANTHROPOMORPHIC OR LOW-ANTHROPOMORPHIC IMAGE CONDITIONS, PARTICIPANTS WERE ALLOWED TO SELECT ONE OF THESE CHARACTERS ON THE VIRTUAL REPRESENTATION SELECTION SCREEN TO REPRESENT THEM.



<u>FIGURE 4</u>. *IN THE HIGH ANTHROPOMORPHIC IMAGE CONDITION, PARTICIPANTS VIEWED THIS SCENE OF THE VIRTUAL ENVIRONMENT AND THIS WAS THE HIGH ANTHROPOMORPHIC IMAGE.*

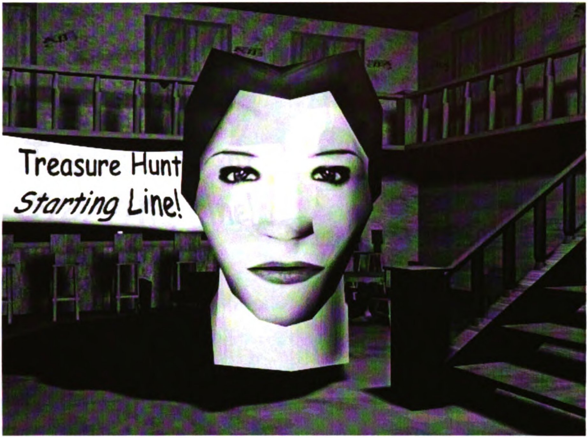


FIGURE 5. *IN THE LOW-ANTHROPOMORPHIC IMAGE CONDITION, PARTICIPANTS VIEWED THIS SCENE OF THE VIRTUAL ENVIRONMENT AND THIS WAS THE LOW-ANTHROPOMORPHIC IMAGE.*

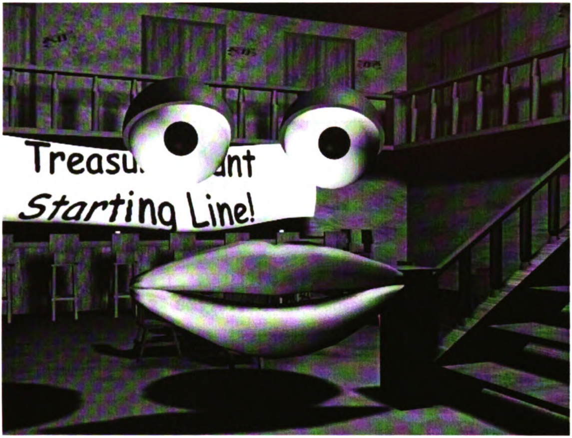
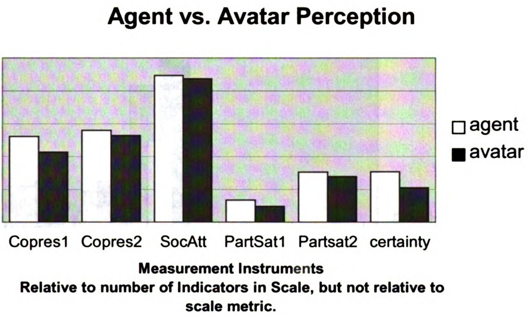
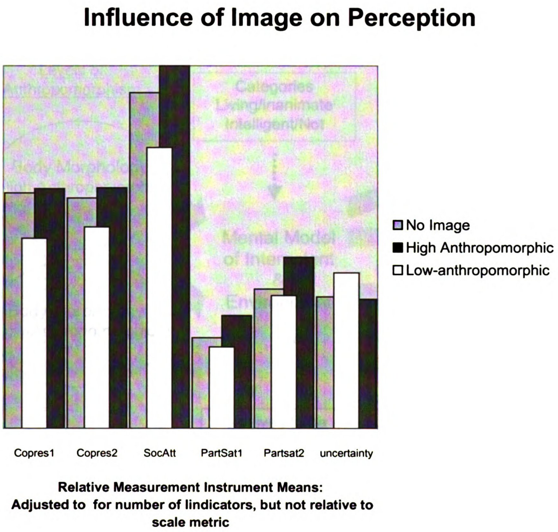


FIGURE 6. MEANS OF PERCEPTION OF VIRTUAL CONFEDERATE ON EACH DEPENDENT VARIABLE: AGENT CONDITION VS. AVATAR CONDITION



Measurement Instruments are measures of the dependent variables.
Copres1= perceived copresence of the virtual confederate (1-5 metric).
Copres2=Self-reported copresence with the virtual Confederate (1-5 metric).
SocAtt= Social Attraction (1-7 metric).
PartSat1=Partner Satisfaction measure (1-5 metric)
PartSat2= Partner Satisfaction Semantic Differential (1-7 metric).
Uncertainty (1-5 metric)

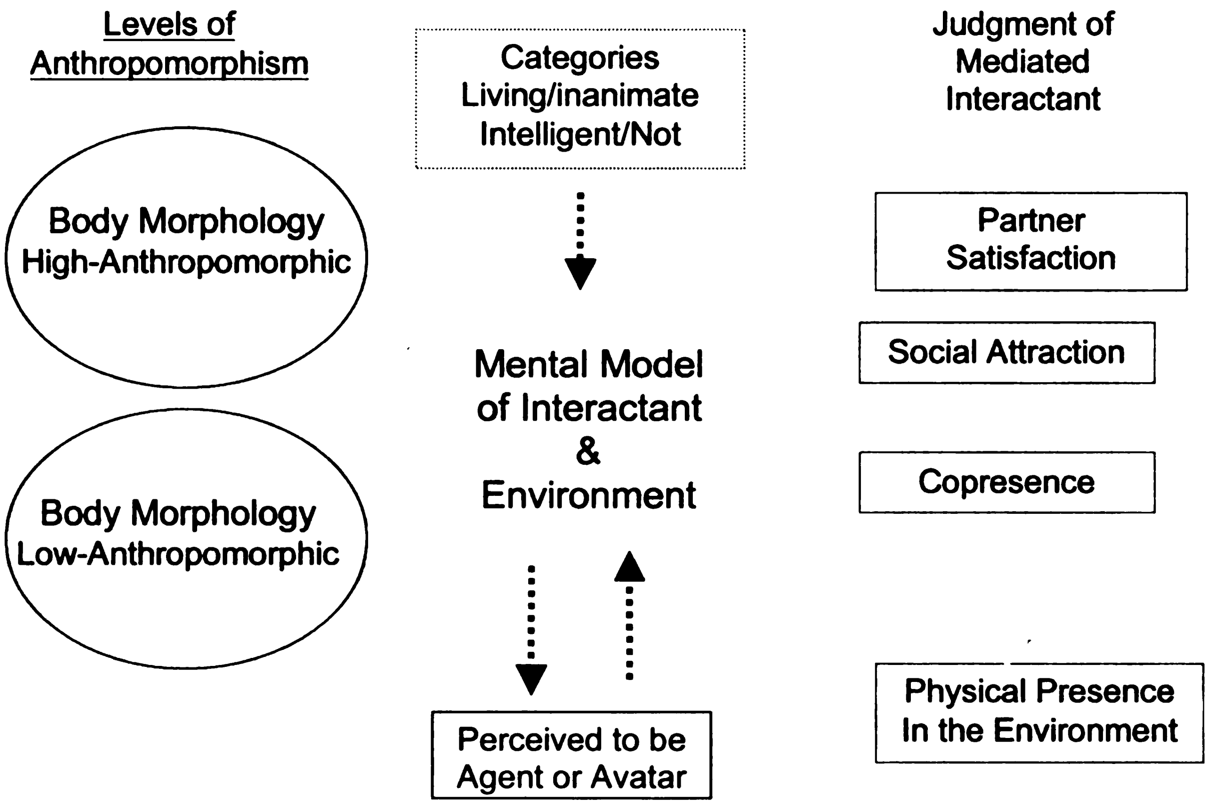
FIGURE 7: MEANS OF PERCEPTION OF VIRTUAL CONFEDERATE ON EACH DEPENDENT VARIABLE: NO IMAGE CONDITION VS. ANTHROPOMORPHIC IMAGE CONDITION VS. LOW-ANTHROPOMORPHIC CONDITION



Measurement Instruments are measures of the dependent variables.
Copres1= perceived copresence of the virtual confederate (1-5 metric).
Copres2=Self-reported copresence with the virtual Confederate (1-5 metric).
SocAtt= Social Attraction (1-7 metric).
PartSat1=Partner Satisfaction measure (1-5 metric)
PartSat2= Partner Satisfaction Semantic Differential (1-7 metric).
Uncertainty (1-5 metric)

FIGURE 8. REVISED MODEL: INFLUENCE OF ANTHROPOMORPHISM ON MENTAL MODELS OF AGENTS AND AVATARS IN SVES

This model represents the influence of levels of anthropomorphism on the mental model of another and the responding social judgment of a mediated interactant as indicated by the data reported in this project.



APPENDICES

APPENDIX A

AUDIO SCRIPT

Hi this is Kim.

Ok, my name is Kim and I use my Internet connection almost constantly. I have some experience with searching for a product and finding the lowest price online. I worked for a company where I made some online purchases of hardware and software as well as electronics. I also know how to find good deals, coupons and rebates for online shops. I like search engines that give me a lot of room to maneuver--- *Alta vista*, *Lycos*. I really like web rings because you can get really specific, you don't have to go around looking at a lot of things you don't need. I don t like *Go network* or *hotbot* or other search engines that are more limited. Anyway, it usually takes me a while to find things at times, but I have to say that I have a pretty decent vocabulary so I can usually find what I am looking for.

Great, thanks. I hope we can do the Scavenger Hunt together.

APPENDIX B

PRE-EXERIMENT QUESTIONNAIRE

Participant ID ____________

MIND Lab

Your opinion about media technologies is ***very important to us***. Please let us know what you think by completing the questionnaire that follows. To help you give thoughtful and sincere answers, we have made this questionnaire ***strictly confidential***.

****

What is your gender?

1. Male 2. Female

What year were you born? ________

What is your class standing? (circle one)

1 Freshman 2. Sophmore

3. Junior 4. Senior

5. Graduate

With what ethnic background do you most strongly identify yourself? (circle one)

1. African American
2. Asian
3. Hispanic
4. Caucasian (white)
5. Native American
6. Other ______________

****

Approximately how many days did you play arcade or video games in the past month?

0 1 2 3 4 5 6 7 8 9 10or more

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Which of the following items are available to you at home? Please check in all boxes (☒) that apply.

☐ TV	☐ Radio	☐ VCR
☐ Camcorder	☐ Satellite Dish	☐ Cable TV
☐ Nintendo	☐ CD Player	☐ Pager
☐ Fax Machine	☐ CD-ROM	☐ Cell Phone
☐ Laser Disk Player	☐ Answering Machine	

On the average, how much time a day do you use computer(s) at home? (Please answer "0" hours and "0" minutes, if you don't have a computer at home.)

______ hour(s) ______ minutes

On the average, how much time a day do you use computer(s) at work/school? (Please answer "0" hours and "0" minutes, if you don't have a computer at work/school.)

______ hour(s) ______ minutes

How frequently or rarely do you use your computer for the following purposes?

	Very Rarely						Very Frequently
Word-processing	☐	☐	☐	☐	☐	☐	☐
Spreadsheets	☐	☐	☐	☐	☐	☐	☐
Games	☐	☐	☐	☐	☐	☐	☐
Information reference	☐	☐	☐	☐	☐	☐	☐
On-line service	☐	☐	☐	☐	☐	☐	☐
Personal communication	☐	☐	☐	☐	☐	☐	☐
Arts (graphics/music)	☐	☐	☐	☐	☐	☐	☐
Statistical analysis	☐	☐	☐	☐	☐	☐	☐
Engineering simulation	☐	☐	☐	☐	☐	☐	☐
Online Searches	☐	☐	☐	☐	☐	☐	☐

How much do you know about how virtual reality technology works?

Not Much A Lot

0 1 2 3 4 5 6 7

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please indicate the degree to which you find computers useful for each of the following goals:

	Not at All Useful						Very useful
Job performance	☐	☐	☐	☐	☐	☐	☐
School work	☐	☐	☐	☐	☐	☐	☐
Personal tasks (e.g., paying bills, letters)	☐	☐	☐	☐	☐	☐	☐
Shopping	☐	☐	☐	☐	☐	☐	☐
Entertainment/Fun	☐	☐	☐	☐	☐	☐	☐
Getting job training	☐	☐	☐	☐	☐	☐	☐
Keeping in touch w/ friends	☐	☐	☐	☐	☐	☐	☐
Keeping in touch w/ family	☐	☐	☐	☐	☐	☐	☐
Keeping in touch w/ community	☐	☐	☐	☐	☐	☐	☐
Getting educated (e.g., taking courses)	☐	☐	☐	☐	☐	☐	☐
Providing information to others	☐	☐	☐	☐	☐	☐	☐
Learning about interests/hobbies	☐	☐	☐	☐	☐	☐	☐
Finding information	☐	☐	☐	☐	☐	☐	☐
Getting ahead in life	☐	☐	☐	☐	☐	☐	☐

Have you ever used online chat rooms?

Never	Seldom	Sometimes	Often	Always
☐	☐	☐	☐	☐

How many times have you used virtual reality equipment?

____ Never
____ 1 time
____ 2-4 times
____ 5-7 times
____ 8 or more times

How long have you been using the Internet (years, months, 0=never) _______

How often, on average, do you use the Internet?

almost never ☐ ☐ ☐ ☐ ☐ ☐ ☐ every day

Where have you used the Internet? Circle all that apply. (Skip if you've never used a computer.)

1. Work 2. Home 3. School 4. Library
5. Community Center 6. Friend's Home
7. Relative's Home 8. Church
9. Other (______________________)

Please indicate your feelings regarding your internet skills and experience.

I am very skilled at using the Internet.	**Strongly Agree**	**1** ☐	**2** ☐	**3** ☐	**4** ☐	**5** ☐	**6** ☐	**7** ☐	**Strongly Disagree**
I use the Internet almost every day.	**Strongly Agree**	**1** ☐	**2** ☐	**3** ☐	**4** ☐	**5** ☐	**6** ☐	**7** ☐	**Strongly Disagree**
Using the Internet is fun	**Strongly Agree**	**1** ☐	**2** ☐	**3** ☐	**4** ☐	**5** ☐	**6** ☐	**7** ☐	**Strongly Disagree**
I don't know much about using the Internet	**Strongly Agree**	**1** ☐	**2** ☐	**3** ☐	**4** ☐	**5** ☐	**6** ☐	**7** ☐	**Strongly Disagree**
I get anxious when I use the Internet.	**Strongly Agree**	**1** ☐	**2** ☐	**3** ☐	**4** ☐	**5** ☐	**6** ☐	**7** ☐	**Strongly Disagree**
Using the Internet is stressful	**Strongly Agree**	**1** ☐	**2** ☐	**3** ☐	**4** ☐	**5** ☐	**6** ☐	**7** ☐	**Strongly Disagree**
How successful were you in doing what you wanted to do the last time you used your computer?	**Very Successful**	**1** ☐	**2** ☐	**3** ☐	**4** ☐	**5** ☐	**6** ☐	**7** ☐	**Not Successful**
How difficult was it to do what you wanted to do the last time you used your computer?	**Not Very Easy**	**1** ☐	**2** ☐	**3** ☐	**4** ☐	**5** ☐	**6** ☐	**7** ☐	**Very Easy**

In general, how often do you have problems using your home computer?

1. Almost never 2. Occasionally, but not often
3. Sometimes 4. Frequently 5. Almost always

When you have problems using your home computer, what do you usually do? Circle ONE ONLY.

1. Turn off the computer and try again right away.
2. Turn off the computer and try again later
3. Ask a family/household member to help me.
   (Male or Female? (circle one), Age? _____)
4. Call/ask a friend to help me.
   (Male or Female? (circle one), Age? _____)
5. Call/ask project staff to help me
   (Male or Female (circle one), Age? _____)
6. Figure out the problem and correct it myself.
7. Other ______________________________

The last time you used the Internet at home, what was the main thing you were doing? Circle ONE ONLY.

1. checking my e-mail
2. sending e-mail
3. searching for information I needed for my job/school
4. searching for information I wanted for myself
5. visiting a chat room
6. surfing the net
7. posting a message to a listserv/mailing list or newgroup
8. reading a message from a listserv/mailing list or newsgroup
9. working on my personal Web page
10. online shopping
11. playing a game
12. Other ________________

What ***ELSE*** did you do the last time you used the Internet at home? Circle ALL THAT APPLY.

1. checking my e-mail
2. sending e-mail
3. searching for information I needed for my job/school
4. searching for information I wanted for myself
5. visiting a chat room
6. surfing the net
7. posting a message to a listserv/mailing list or newgroup
8. reading a message from a listserv/mailing list or newsgroup
9. working on my personal Web page
10. online shopping
11. playing a game

Other ________________

Thanks for your honest answers.

Please inform Experimenter that you are ready.

APPENDIX C

POST EXPERIMENT QUESTIONNAIRE

Instructions:
○ - select ONLY ONE Choice ❑ - select ALL that apply.

1 In the first part of this questionnaire, please think of the interaction you have just experienced. Take time to read the instructions and answer the following questions. Instructions: Using the following scale, for each question please indicate how confident you are in your abilities to answer, or predict, the correct response to the question based on the computer interaction you just had.

2 Please indicate the degree to which you agree with the following statement: My interaction partner was willing to listen to me

Strongly Agree 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ Strongly Disagree

3 Please indicate the degree to which you agree with the following statement: My interaction partner was intensely involved in our interaction

Strongly Agree 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ Strongly Disagree

4 Please indicate the degree to which you agree with the following statement: My interaction partner did not want a deeper relationship

Strongly Agree 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ Strongly Disagree

5 Please indicate the degree to which you agree with the following statement: My interaction partner was not attracted to me

Strongly Agree 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ Strongly Disagree

6 Please indicate the degree to which you agree with the following statement: My interaction partner seemed to find our interaction stimulating

Strongly Agree 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ Strongly Disagree

7 Please indicate the degree to which you agree with the following statement: My interaction partner communicated coldness rather than warmth

Strongly Agree 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ Strongly Disagree

8 Please indicate the degree to which you agree with the following statement: My interaction partner created a sense of distance between us

Strongly Agree 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ Strongly Disagree

9 Please indicate the degree to which you agree with the following statement: My interaction partner seemed detached during our interaction

Strongly Agree 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ Strongly Disagree

10 Please indicate the degree to which you agree with the following statement: My interaction partner was unwilling to share personal information/feelings with me

Strongly Agree 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ Strongly Disagree

11 Please indicate the degree to which you agree with the following statement: My interaction partner made our conversation seem intimate

Strongly Agree 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ Strongly Disagree

12 Please indicate the degree to which you agree with the following statement: My interaction partner created a sense of distance between us

Strongly Agree 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ Strongly Disagree

13 **Please indicate the degree to which you agree with the following statement: My interaction partner created a sense of closeness between us**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

14 **Please indicate the degree to which you agree with the following statement: My interaction partner acted bored by our conversation**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

15 **Please indicate the degree to which you agree with the following statement: My interaction partner was interested in talking to me**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

16 **Please indicate the degree to which you agree with the following statement: My interaction partner showed enthusiasm while talking to me**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

17 **Please indicate the degree to which you agree with the following statement: I was willing to listen to my interaction partner**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

18 **Please indicate the degree to which you agree with the following statement: I was detached during the conversation**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

19 **Please indicate the degree to which you agree with the following statement: I was intensely involved in this interaction**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

20 **Please indicate the degree to which you agree with the following statement: I did not want a deeper relationship with my interaction partner**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

21 **Please indicate the degree to which you agree with the following statement: I found the interaction stimulating**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

22 **Please indicate the degree to which you agree with the following statement: I wanted to maintain a sense of distance between us**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

23 **Please indicate the degree to which you agree with the following statement: I was unwilling to share personal information/feelings with my interaction partner**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

24 **Please indicate the degree to which you agree with the following statement: I wanted to make the conversation more intimate**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

25 **Please indicate the degree to which you agree with the following statement: I wanted to make the interaction seem casual**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

26 **Please indicate the degree to which you agree with the following statement: I tried to create a sense of closeness between us.**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

27 **Please indicate the degree to which you agree with the following statement: I was interested in talking to my interaction partner.**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

28 **How involving was the experience?**

Not At All 1 O 2 O 3 O 4 O 5 O 6 O 7 O Very Much

29 **How intense was the experience?**

Not At All 1 O 2 O 3 O 4 O 5 O 6 O 7 O Very Much

30 **To what extent did you feel like you were inside the environment you saw/heard?**

Not At All 1 O 2 O 3 O 4 O 5 O 6 O 7 O Very Much

31 **To what extent did you feel immersed in the environment you saw/heard?**

Not At All 1 O 2 O 3 O 4 O 5 O 6 O 7 O Very Much

32 **To what extent did you feel surrounded by the environment you saw/heard?**

Not At All 1 O 2 O 3 O 4 O 5 O 6 O 7 O Very Much

33 **How often did you want to touch something you saw/heard?**

Not At All 1 O 2 O 3 O 4 O 5 O 6 O 7 O Very Much

34 **How often did you try to touch something you saw/heard?**

Not At All 1 O 2 O 3 O 4 O 5 O 6 O 7 O Very Much

35 **How often did you want to smell something you saw/heard?**

Not At All 1 O 2 O 3 O 4 O 5 O 6 O 7 O Very Much

36 **Please indicate the degree to which you agree with the following statement: I think he (she) could be a friend of mine**

Strongly Agree **Strongly Disagree**
1 O 2 O 3 O 4 O 5 O 6 O 7 O

37 **Please indicate the degree to which you agree with the following statement: I would like to have a friendly chat with him (her).**

Strongly Agree **Strongly Disagree**
1 O 2 O 3 O 4 O 5 O 6 O 7 O

38 **Please indicate the degree to which you agree with the following statement: We could never establish a personal friendship with each other**

Strongly Agree **Strongly Disagree**
1 O 2 O 3 O 4 O 5 O 6 O 7 O

39 **Please indicate the degree to which you agree with the following statement: She (he) just wouldn't fit into my circle of friends.**

Strongly Agree **Strongly Disagree**
1 O 2 O 3 O 4 O 5 O 6 O 7 O

40 Please indicate the degree to which you agree with the following statement: She (he) would be pleasant to be with

Strongly Agree 1 O 2 O 3 O 4 O 5 O 6 O 7 O Strongly Disagree

41 Please indicate the degree to which you agree with the following statement: I feel I know her (him) personally

Strongly Agree 1 O 2 O 3 O 4 O 5 O 6 O 7 O Strongly Disagree

42 Please indicate the degree to which you agree with the following statement: He (she) is personally offensive to me

Strongly Agree 1 O 2 O 3 O 4 O 5 O 6 O 7 O Strongly Disagree

43 Please indicate the degree to which you agree with the following statement: I don't care if I ever get to interact with him (her) again.

Strongly Agree 1 O 2 O 3 O 4 O 5 O 6 O 7 O Strongly Disagree

44 Please indicate the degree to which you agree with the following statement: I wish I were more like him (her).

Strongly Agree 1 O 2 O 3 O 4 O 5 O 6 O 7 O Strongly Disagree

45 Following your interaction, how confident are you of your general ability to predict how he/she will behave?

Unable to Answer 1 O 2 O 3 O 4 O 5 O Completely Confident

46 Following your interaction, How certain are you that he/she likes you?

Unable to Answer 1 O 2 O 3 O 4 O 5 O Completely Confident

47 Following your interaction, How accurate are you at predicting the values he/she holds?

Unable to Answer 1 O 2 O 3 O 4 O 5 O Completely Confident

48 Following your interaction, How accurate are you at predicting his/her attitudes?

Unable to Answer 1 O 2 O 3 O 4 O 5 O Completely Confident

49 Following your interaction, How well can you predict his/her feelings and emotions?

Unable to Answer 1 O 2 O 3 O 4 O 5 O Completely Confident

50 Following your interaction, How much can you empathize with (share) the way he/she feels about himself/herself?

Unable to Answer 1 O 2 O 3 O 4 O 5 O Completely Confident

51 Following your interaction, How well do you know him/her?

Unable to Answer 1 O 2 O 3 O 4 O 5 O Completely Confident

52 Please indicate the degree to which you agree with the following statement: I think the virtual body was very attractive

Strongly Agree 1 O 2 O 3 O 4 O 5 O 6 O 7 O Strongly Disagree

53 **Please indicate the degree to which you agree with the following statement: I think the virtual body was very sexy looking**

Strongly Agree 1 O 2 O 3 O 4 O 5 O 6 O 7 O **Strongly Disagree**

54 **Please indicate the degree to which you agree with the following statement: I like the look of the virtual body**

Strongly Agree 1 O 2 O 3 O 4 O 5 O 6 O 7 O **Strongly Disagree**

55 **Please indicate the degree to which you agree with the following statement: I think the virtual body is somewhat ugly**

Strongly Agree 1 O 2 O 3 O 4 O 5 O 6 O 7 O **Strongly Disagree**

56 **Please indicate the degree to which you agree with the following statement: I think the virtual body was very becoming**

Strongly Agree 1 O 2 O 3 O 4 O 5 O 6 O 7 O **Strongly Disagree**

57 **Please indicate the degree to which you agree with the following statement: I think the virtual body was not very good looking**

Strongly Agree 1 O 2 O 3 O 4 O 5 O 6 O 7 O **Strongly Disagree**

58 **Please indicate the degree to which you agree with the following statement: The virtual body was repulsive to me**

Strongly Agree 1 O 2 O 3 O 4 O 5 O 6 O 7 O **Strongly Disagree**

59 **Please indicate the degree to which you agree with the following statement: My interaction partner is NOT of very high intelligence**

Strongly Agree 1 O 2 O 3 O 4 O 5 O **Strongly Disagree**

60 **Please indicate the degree to which you agree with the following statement: My interaction partner is a reliable source of information on the topic**

Strongly Agree 1 O 2 O 3 O 4 O 5 O **Strongly Disagree**

61 **Please indicate the degree to which you agree with the following statement: My interaction partner lacks information on the subject.**

Strongly Agree 1 O 2 O 3 O 4 O 5 O **Strongly Disagree**

62 **Please indicate the degree to which you agree with the following statement: I would consider my interaction partner to be an expert on Internet searches**

Strongly Agree 1 O 2 O 3 O 4 O 5 O **Strongly Disagree**

63 **Please indicate the degree to which you agree with the following statement: I believe my interaction partner is quite intelligent**

Strongly Agree 1 O 2 O 3 O 4 O 5 O **Strongly Disagree**

64 **Please indicate the degree to which you agree with the following statement: This interaction partner is an unreliable source of information on Internet Searches**

Strongly Agree 1 O 2 O 3 O 4 O 5 O **Strongly Disagree**

65 **Please indicate the degree to which you agree with the following statement: This speaker has had very little experience with Internet Searches**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

66 **Please indicate the degree to which you agree with the following statement: This speaker has considerable knowledge of the factors involved in Internet searches**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

67 **Please indicate the degree to which you agree with the following statement: This speaker has very little knowledge of the factors involved in Internet searches**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

68 **Please indicate the degree to which you agree with the following statement: My partner has had substantial experience with Internet Searches**

Strongly Agree 1 O 2 O 3 O 4 O 5 O Strongly Disagree

69 **Consider the interaction you just heard. Would you consider your partner**

Reliable 1 O 2 O 3 O 4 O 5 O 6 O 7 O Unreliable

70 **Consider the interaction you just heard. Would you consider your partner**

Informed 1 O 2 O 3 O 4 O 5 O 6 O 7 O Uninformed

71 **Consider the interaction you just heard. Would you consider your partner**

Qualified 1 O 2 O 3 O 4 O 5 O 6 O 7 O Unqualified

72 **Consider the interaction you just heard. Would you consider your partner**

Intelligent 1 O 2 O 3 O 4 O 5 O 6 O 7 O Unintelligent

73 **Consider the interaction you just heard. Would you consider your partner**

Valuable 1 O 2 O 3 O 4 O 5 O 6 O 7 O Worthless

74 **Consider the interaction you just heard. Would you consider your partner**

Expert 1 O 2 O 3 O 4 O 5 O 6 O 7 O Inexpert

75 **Would you say the person you discussed your rankings with was**

Impersonal 1 O 2 O Personal

76 **Would you say the person you discussed your rankings with was**

Insensitive 1 O 2 O Sensitive

77 **Would you say the person you discussed your rankings with was**

Cold 1 O 2 O Warm

78 **Would you say the person you discussed your rankings with was**

Unsociable 1 O 2 O Sociable

79 **To what extent did you feel you got a good enough idea of how people at the other end are reacting.**

Very good idea 1 O 2 O Not good at all

80 To what extent did you feel you got a "feel" for the person at the other end?

able to get a "feel" 1 O 2 O not able to get a "feel"

81 To what extent did you feel you were able to form an impression of personal contact with your partner?

able to form an impression of personal contact / not able to form an impression of personal contact
1 O 2 O

82 To what extent did you feel you were able to assess your partners reactions to what you said?

able to assess reactions 1 O 2 O not able to assess reactions

83 To what extent was this like a face-to-face meeting?

A lot like face to face 1 O 2 O not like face to face at all

84 To what extent was this like you were in the same room with your partner?

A lot like being in the same room 1 O 2 O not like being in the same room at all

85 To what extent did your partner seem "real"?

very real 1 O 2 O not real at all

86 How likely is it that you would choose to use this system of interaction for a meeting in which you wanted to persuade others of something?

very likely 1 O 2 O not likely at all

87 To what extent did you feel you could get to know someone that you met only through this system?

very well 1 O 2 O not at all

88 Please indicate what sex you thought your partner was:

O Undetermined O Male O Female

89 You have now finished the experimental part of your participation. The following few questions are designed to give us an idea of how you felt about this experience. Please be as honest and straightforward as you can. Your comments will be used to help us design better experiments in the future. Thank you!

90 Consider the virtual body you choose to represent you. Why did you choose this one over others?

91 Consider the virtual bodies you had to choose from. Were you satisfied with the range of choices? Is there anything else you would have liked to see?

92 **Consider the virtual bodies: Do you have any other comments about them? Is there anything you would have changed?**

93 **Please take this time to indicate any questions you have about this experiment. Are there things you do not understand? Things that are unclear to you?**

94 **Do you understand the overall purpose of the experiment?**

❍ Yes ❍ No

95 **If everything is not clear, please explain what is unclear.**

96 **We find that everyone reacts differently to different situations. It would help us conduct future research if you would tell us about your feelings and reactions to the experiment. How did you feel about the proceedure? Was it a pleasant experience? Why did you answer as you did?**

97 **Was there anything in the experiment that you found odd, confusing, or disturbing?**

❍ Yes ❍ No

98 **If there was something that you found odd or disturbing, what was it, and why did you find it odd?**

99 **Please let us know if you felt anything in the procedure affected your behavior during the experiment. This will help us improve the procedure in the future.**

____

____

____

____

100 **Thank you for your involvement. Please tell the experimenter that you are finished.**

APPENDIX D

AVATAR PARTICIPANT INSTRUCTION SHEET

Instruction Sheet

Thank you for agreeing to participate in this project.

During this part of your participation, you will enter a computerized virtual environment. During your time in the environment, you can speak into a microphone to communicate with others.

Later this semester, some teams will be asked to return to the lab to participate in a virtual scavenger hunt. This may include you and your partner. As you may know, in a scavenger hunt, you are given a list of items and must retrieve all of the items on the list in the quickest amount of time possible. In this scavenger hunt, you will search the Internet for objects not only as quickly as possible, but also those offered at the best price. The best team will win $100 and other teams will win prizes just for participating. We may contact you later regarding this opportunity.

Your assignment for today is to meet your partner who is a student at another university. Please begin by introducing yourself and then, once your partner does the same, summarize your skills and experience that will be relevant and/or helpful in carrying out this task and they will do the same. First, tell your partner who you are and they will do the same. Following this brief introduction, you should discuss your skills and experience, relevant to online searches for telecommunication technologies, or Internet searches generally. Please tell them all they need to know, including previous experience and favorite search engines or tools. You will only get one turn to tell them about your skills due to time and technology constraints, but you can speak for as long as you feel you need during your turn. Please speak slowly and clearly so they can understand.

Note: When you have finished introducing yourself, please push the button on the screen to indicate that your turn is over and you are ready to listen to your partner. This interaction environment is the one you will use for the scavenger hunt, so try to get a feel for it and a sense of your partner as well.

If you have any questions at this point, please ask the experimenter. Otherwise, you may use the back of this page to draft your introduction and think about how you will introduce yourself and which skills will best help your team in the future project.

Please let the experimenter know when you are ready.
Thank you.

Summary of Instructions

1. Press appropriate button
2. Briefly introduce yourself
3. Press button to indicate your turn is over
4. Listen to your partner's introduction
5. Describe your skills and experience relevant to an Internet scavenger hunt
6. Press button to indicate your turn is over
7. Listen to your partner's skills and experience
8. Let us know you are finished.

To avoid repetitions or difficulty, we recommend that you draft your skills in the space below. This will allow you to read your skills to your partner so you do not forget anything and so you can be clear and concise when you speak.

APPENDIX E

AGENT PARTICIPANT INSTRUCTION SHEET

Instruction Sheet

Thank you for agreeing to participate in this project.

During this part of your participation, you will enter a computerized virtual environment. During your time in the environment, you can speak into a microphone to communicate with others.

Later this semester, some teams will be asked to return to the lab to participate in a virtual scavenger hunt. This may include you and your partner. As you may know, in a scavenger hunt, you are given a list of items and must retrieve all of the items on the list in the quickest amount of time possible. In this scavenger hunt, you will search the Internet for objects not only as quickly as possible, but also those offered at the best price. The best team will win $100 and other teams will win prizes just for participating. We may contact you later regarding this opportunity.

Your assignment for today is to meet your partner who is a bot, programmed at another university to interact with you. Please begin by introducing yourself and then, once your partner does the same, summarize your skills and experience that will be relevant and/or helpful in carrying out this task and they will do the same. First, tell your partner who you are and they will do the same. Following this brief introduction, you should discuss your skills and experience, relevant to online searches for telecommunication technologies, or Internet searches generally. Please tell them all they need to know, including previous experience and favorite search engines or tools. You will only get one turn to tell them about your skills due to time and technology constraints, but you can speak for as long as you feel you need during your turn. Please speak slowly and clearly so they can understand.

Note: When you have finished introducing yourself, please push the button on the screen to indicate that your turn is over and you are ready to listen to your partner. This interaction environment is the one you will use for the scavenger hunt, so try to get a feel for it and a sense of your partner as well.

If you have any questions at this point, please ask the experimenter. Otherwise, you may use the back of this page to draft your introduction and think about how you will introduce yourself and which skills will best help your team in the future project.

Please let the experimenter know when you are ready.
Thank you.

Summary of Instructions

9. Partner will introduce themselves (red "wait" button will be on)
10. Briefly introduce yourself
11. Press green "done" button to indicate your turn is over
12. Listen to your partner's skills and experience
13. Describe your skills and experience relevant to an Internet scavenger hunt
14. Press green "done" button to indicate your turn is over
15. Your partner will sign off
16. Sign off with your partner and press green "done" button
17. Let us know you are finished.

To avoid repetitions or difficulty, we recommend that you draft your skills in the space below. This will allow you to read your skills to your partner so you do not forget anything and so you can be clear and concise when you speak.

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