The Influence of the Avatar on Online Perceptions of Anthropomorphism, Androgyny, Credibility, Homophily, and Attraction

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Abstract

It has become increasingly common for Web sites and computer media to provide computer generated visual images, called avatars, to represent users and bots during online interactions. In this study, participants (N = 255) evaluated a series of avatars in a static context in terms of their androgyny, anthropomorphism, credibility, homophily, attraction, and the likelihood they would choose them during an interaction. The responses to the images were consistent with what would be predicted by uncertainty reduction theory. The results show that the masculinity or femininity (lack of androgyny) of an avatar, as well as anthropomorphism, significantly influence perceptions of avatars. Further, more anthropomorphic avatars were perceived to be more attractive and credible, and people were more likely to choose to be represented by them. Participants reported masculine avatars as less attractive than feminine avatars, and most people reported a preference for human avatars that matched their gender. Practical and theoretical implications of these results for users, designers, and researchers of avatars are discussed.

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Introduction

Avatars, or computer generated visual representations of people or bots, are increasingly being used in ecommerce, social virtual environments, and even for geographically separated workplace meetings (Schroeder, 2002), and are incorporated into a variety of popular consumer interfaces. For example, all major instant messaging systems, online forum systems, and massive multiuser role-playing games (Persson, 2003) include an avatar feature.

The inclusion of avatars in interfaces designed to facilitate interactions has increased without much information about the influence of such images on message

and person perception. Representing people or bots, computer processes that interact in a virtual environment, with avatars alters the range and nature of possible experiences, and this is likely to have implications for interpersonal relationships (Biocca, 1997; Biocca & Nowak, 2002; Schroeder, 1997; Schroeder, 2002). For example, it is possible that the presence of an avatar is a strong social cue that influences people's perceptions, leading them to perceive interfaces as more "social" (Nass, Steuer, Tauber, & Reeder, 1993). Similarly, how people perceive avatars may influence both the self-perception and perception of others using a particular avatar as well as message perception and retention. Thus, understanding the influence of avatars is of theoretical relevance to researchers. It is also of practical importance to users and designers of systems using avatars. Given that the avatar may be seen as the source of the message, understanding how people perceive them has important implications for the design of interfaces using them as well as for the selection of which avatars to use for different applications.

This article focuses on perceptions of static avatars, or avatars that are neither moving nor representing a person in real time. We examine how three characteristics of the user (biological sex, computer use, and computer efficacy), the gender and social cognition category of the avatar (human male, human female, animal, or object), and three visual characteristics (head or head and torso, children, and rendering quality) affect perceptions of basic classifications of avatars: *Anthropomorphism*, or the extent to which an image looks human, and *androgyny*, a rating of the avatar's (lack of) masculinity or feminity. We then examine how these classifications influence perceptions of the static avatar's interactional characteristics in terms of credibility, homophily, and attraction.

Using Avatars in Online Interactions

The most common use of computers today is for interpersonal interactions, with e-mail being the most common computer activity (though online chat rooms and instant messaging are increasing in popularity). The Pew Internet and American Life Project reported that in 2004, 91% of computer users with Internet access had sent email and 39% had used an instant messaging program (Madden, 2004). Although many of these interactions are text only, it is becoming increasingly common for users to be able to select an avatar to represent them. E-commerce is also leading to increased usage of avatars to present messages and to interact with potential consumers.

Using Avatars to Reduce Uncertainty About the People They Represent

Uncertainty reduction theory posits that people's primary goal in an interaction is to reduce uncertainty about the person they are interacting with. In reducing uncertainty, people strive to understand people's behavior during interactions as well as to predict future behavior (Berger & Calabrese, 1975; Clatterbuck, 1979; Infante, Rancer, & Womack, 1997). Thus, people strive to "get to know" or form perceptions of others, and are known to use a variety of information in this process. Uncertainty is generally reduced not by a simple sum of the total information but by a weighted

integration of information based on its perceived quality. In the natural, or non-mediated, world, people generally rely heavily on information provided by visible physical cues of the natural body in the person perception process (Bull & Rumsey, 1988; Burgoon, 1994; Burgoon, Buller, & Woodall, 1996; Dion, Berscheid, & Walster, 1972). After all, physical information is easily accessible and reliable—a person's appearance is fairly stable across encounters. In addition, the use of physical characteristics in a person's perception is functional because initial impressions based on such information have been shown to predict other people's personalities to some extent. Whether they are accurate or not, people feel that they "are able to make fairly accurate judgments of other people on the basis of minimal interactions or even mere glimpses of them" (Ambady, Hallhan, & Rosenthal, 1995, p. 518).

When people interact through computer-mediated channels, physical information about the other person may be unavailable. Evidence suggests that people in mediated interactions use avatars, or whatever information the interface provides, in the person perception process and that different types of avatars have different effects on person perception (Koda, 1996; Nowak, 2004; Nowak & Biocca, 2003; Taylor, 2002). Essentially, the avatar may be used to provide a means of identifying, recognizing, and evaluating others in the mediated world of geographically distant communication (Benford, Greenhalgh, Rodden, & Pycock, 2001; Talamo & Ligorio, 2001; Taylor, 2002). Because avatars are a visible representation of a person in an interface, evaluations based on the physical appearance of the avatar may be transferred to them (Rauh, Polonsky, & Buck, 2004). In other words, people use information related to the virtual image in a process analogous to the one they have learned and used to reduce uncertainty during their experience in natural, unmediated environments. Contrary to a face-to-face encounter, however, where the first physical impression is more permanently tied to its owner, in a mediated environment the characteristics of the avatar can be tailored to elicit any number of impressions and reactions. An avatar may represent a message on a website, or even a "bot" or computer program, and not necessarily a person at all (Oravec, 1996).

Research has consistently found that avatars influence the perception process. The results have not been consistent about which types of images have what effect, however. Some authors have argued that anthropomorphism is a key component in this process. This approach is consistent with social cognition theory, which argues that one of the basic functions of social cognition is to categorize the environment based on an entity's level of anthropomorphism in order to differentiate among inanimate objects, animals, and humans that could pose a threat or an opportunity for cooperation (Kunda, 1999). We further explore the concept of anthropomorphism and its application to avatars in the next section.

The Influence of Avatar Anthropomorphism on the Perception Process

As indicated above, social cognition theory argues that the ability to identify anthropomorphic characteristics and categorize objects in the environment as humans, animals, or objects is a basic human cognitive function (Kunda, 1999). In evolutionary

terms, it is essential to be able to differentiate between static objects and animated creatures. This is particularly true when encountering other humans, who may represent either a threat or an opportunity for cooperation. Objects, animals, and humans form the basic social categories to which people assign the things they encounter.

The *Encyclopedia Britannica* defines anthropomorphism as "the attribution of human form or other human characteristics to any nonhuman object" (Anonymous, 2004). Anthropomorphism has also been defined as the extent to which a character has either the appearance or behavioral attributes of humans (Koda, 1996; Nowak, 2004; Nowak & Biocca, 2003). Here, we examine anthropomorphism only in terms of human morphology, or appearance, and not behavior. In these terms, a more anthropomorphic image has visible characteristics that would make it appear human, or more human, than a less anthropomorphic image.

There is some debate about the influence of anthropomorphic avatars. In some studies, avatars believed to be more anthropomorphic have been rated as more credible, engaging, and likeable than less anthropomorphic images (Koda, 1996; Wexelblat, 1997), while Nowak (2004) found that people reported the less anthropomorphic image to be more credible and likeable than the more anthropomorphic image. The likely explanation for these contradictory findings is that responses to avatars depend on more than just their level of anthropomorphism. It is likely that context of interaction and other characteristics of the avatar influence this relationship as well. For example, Garau et al. (2003) found that people had similar perceptions and partner evaluations during interaction with either a high or a low anthropomorphic image, but ratings were lower if characteristics of avatars were inconsistent, i.e., a low anthropomorphic image with very realistic behavior and vice versa. Some researchers have argued that realistic avatars set up higher expectations, which may lead to disappointment when those expectations are not met (see Garau et al., 2003; Slater & Steed, 2002). Thus it seems that the influence of the avatar image, much like the influence of physical appearance, is complicated: Anthropomorphism may be influential but it is not the only predictor of how people perceive those represented by visual avatars, and future tests of anthropomorphism should control for level of realism and other factors.

Further, although the research examining avatar anthropomorphism has made a number of assumptions about what features would make a character appear anthropomorphic, few of these assumptions have been empirically tested. In such studies (Koda, 1996; Nowak, 2004; Nowak & Biocca, 2003; Wexelblat, 1997), several characters have been used to represent a person; subjects were then asked to rate their satisfaction with the interaction or perception of the person. In these studies, participants were not asked to rate the images on their level of anthropomorphism; the differences in perception of the images have been assumed by the researchers to reflect the level of anthropomorphism. Without a manipulation check, it cannot be ruled out that the differences could have been due to a variety of other variables.

Before drawing conclusions about the influence of anthropomorphism, we must first identify which characteristics of the avatar increase or decrease people's

perception of an avatar's humanness. In addition, to clarify the effects of anthropomorphism in the person perception process, we must analyze how it relates to other variables. Previous research on the influence of avatar images has looked at the influence of anthropomorphism on credibility and person perception. One other important variable to consider is sex categorization. It may be that perceptions of sex categorization and androgyny interact with considerations of anthropomorphism.

Androgyny and Its Relationship to Perceptions of Anthropomorphism

Sex category is another of the most important characteristics that people want to know about others in an encounter. As with anthropomorphism, little is known about how the attribution of sex category influences perception in graphical virtual worlds. Here, we use the term sex categorization instead of biological sex because we refer to the attribution of the category that would influence person perception when the natural physical body is not visible, rather than the actual biological sex of the individual being perceived. Sex categorization is achieved through the application of socially defined criteria, where one has been determined as belonging to one of the two sex categories, male or female (West & Zimmerman, 1991). In this process, people use gender stereotypes to make a determination as to which category a person, or avatar, belongs in (Ashmore & Del Boca, 1979).

Contrary to early predictions that people would not make attributions of sex category in computer-mediated interactions, it seems that in some contexts sex attributions are still made, and questions about sex category are among the first asked in social interactions (Herring, 1994, 2000; Spender, 1996; Turkle, 1995; Waskul & Douglass, 1997). Nowak (2003) found that almost two-thirds of participants assigned their partners to a sex category in a text based, task-oriented interaction (though they were not necessarily accurate). Further, sex role stereotypes have been shown to apply in some online contexts (Daly, Bench, & Chappell, 1996; Dietrich, 1997; Herring, 1994; Reeves & Nass, 1996; Skitka & Maslach, 1996; Spender, 1996; Turkle, 1995; Waskul & Douglass, 1997). The influence of the avatar or its visual characteristics on the sex categorization process remains unclear, however.

At the same time, it has been argued that gender is socially constructed and thus better described (and measured) as a continuum called androgyny, rather than considered as a dichotomy of male or female (Bem, 1975, 1981). Another reason to consider the notion of sex category as a continuum is that it is possible for a person to display both feminine and masculine characteristics (Bem, 1981). This could be particularly true of images created to be used during interactions in cyberspace, where some have argued that because users have the freedom to select avatars of any shape or morphology, then they have complete control over how they appear. Some have seen the potential for cyberspace to be free from gender and class considerations, a place where the binary categorization of either male or female becomes a false dichotomy. It has been argued that in cyberspace androgyny becomes a continuum with an opportunity to be feminine, masculine, both, or neither (Biocca & Nowak, 2002; Fisher, 1997; Haraway, 1991; Turkle, 1995).

A consideration of the influence of androgyny on perceptions of virtual images may be related to people's perceptions of anthropomorphism as well. An avatar may only be perceived to be anthropomorphic if its gender is clearly indicated. Although it is unlikely, it is also possible that anthropomorphism is independent of androgyny.

How Individual Differences and Avatar Characteristics Influence Credibility, Homophily, and Attraction

Credibility, attraction, and homophily have been repeatedly studied and their importance in the communication process has been well established (McCroskey, Hamilton, & Weiner, 1974). Further, credibility is one of the primary predictors for certain interaction outcomes such as attitude change and trust. Credibility is a source trait that indicates the degree to which a person is perceived as believable, trustworthy, and competent (McCroskey & Young, 1981). Homophily corresponds to the perceived degree of psychological similarity between the images and the human psyche, or the extent to which one is perceived to be similar to the perceiver (McCroskey, Richmond, & Daly, 1975). Homophily and attraction have been investigated in conjunction with credibility; the variables are strongly related to one another (McCroskey, Hamilton, & Weiner, 1974). Those variables represent the immediate perception of sources of communication and work together to influence interaction outcomes and behaviors. While physical characteristics such as anthropomorphism and androgyny are immediate and derive from the image itself, credibility, homophily, and attraction are more abstract in the person perception process, though people generally make attributions of others on these categories largely based on physical characteristics. Thus, it is necessary to uncover how anthropomorphism and androgyny of avatars influence people's judgments of others and how these variables relate to each other.

This study has three major goals. The first is to identify how avatars of different basic social categories (object, animal, and human) and genders (male and female) are perceived in terms of anthropomorphism and androgyny. To meet this goal, we examine whether or not users perceive these four groups of avatars as meaningfully different. We also explore which avatar characteristics influence perceptions of anthropomorphism, androgyny, credibility, homophily, and attraction. Because individual differences might also have an impact on their reactions, our second goal is to investigate the extent to which people's biological sex and computer experience influence perceptions of avatar anthropomorphism and androgyny, as well as credibility, homophily, and attraction. The third and final goal is to explore the relationship among anthropomorphism, androgyny, credibility, homophily, and attraction.

Method

Participants

Participants (N = 255) were recruited from communication courses at a large northeastern American public university where they received extra credit for their

participation. There were 136 males, 115 females, and 4 participants who did not report this information.

Stimulus Materials

Images. The images were digitally created from 3D models using Poser for the human characters and 3D Studio Max for the other characters. There were 30 images (see Figure 1) divided into four *image types*: 10 human male characters (m1–m5, m1h–m5h), 10 human female characters (f1–f5, f1h–f5h), 5 animals (a1–a5), and 5 objects that represent items that would not traditionally be animated (o1–o5), such as a bottle or an apple. These four types represent a combination of the basic social categories—object, animal, and human—and the gender distinction applied to the human category. To manipulate *torso presence*, the "human" images were composed of two versions of the same character, a version where the head and torso were together (m1–m5, f1–f5) and another with only a floating head where the torso was not present (m1h–m5h, f1h–f5h). Four human images were purposefully *children* (m4, m4h, f4, f4h) and four human images (m1, m1h, f1, f1h) were purposefully of lower *quality* than the other images. All images had identifiable eyes and mouth to ensure some level of consistency, so that the images could be identified as characters, not just icons.

Measurement Instruments

Measures were taken of participants' gender, computer use, computer efficacy, and the perception of each presented avatar's anthropomorphism, androgyny, credibility, homophily, and attraction. Participants were also asked about their likelihood of choosing that avatar to represent themselves. Confirmatory factor analysis showed good internal consistency and parallelism of the scales—the Cronbach's α's for the scales range from 0.70 to 0.92.

Computer Use. This variable was measured with a 10-item Likert-type scale with a 7-point metric (1 = very rarely; 7 = very frequently). Items asked about participants' usage of various computer software types. Two factors with acceptable reliability were identified: Author/researcher software (Cronbach's α of .61), with items about text editing and reference software, and math/science software (Cronbach's α of .70) with items about spreadsheet, statistical analysis, and engineering simulation.

Computer Efficacy. This variable was measured with a 10-item 7-point Likert-type scale (1 = strongly disagree, 7 = strongly agree). This instrument is based on Eastin and Larose's (2000) Internet Efficacy scale. Items ask about the participants' ability to use and understand computer technology.

Anthropomorphism. This measure corresponds to the physical similarity of the images to a real human form. Participants rated the perceived anthropomorphism of the images using a 4-item semantic differential scale. One of the items was dropped because it did not load properly into the factor. Remaining items loaded higher than 0.73 in the factor and Cronbach's α was 0.83. Final items in the scale asked whether

Figure 1 Avatar Images.

the image "looks very human/does not look human," "looks very realistic/does not look realistic," and "looks very cartoon-like/does not look like a cartoon."

Androgyny. This variable was rated along three dimensions: femininity, masculinity, and gender. The first two dimensions were obtained through semantic differential items asking whether the image was "not feminine/feminine" and "not

masculine/masculine." Sex category was assessed through a multiple-choice question with the options "Male/Female/Undetermined." Final scales of androgyny were computed using the absolute difference (androgyny) and a multiplicative (androgyny-multiplicative) scale of the masculine and feminine dimensions. The absolute difference ranks the images such that those with similar scores in both dimensions will have high androgyny scores, while images with high scores in one dimension but low on the other will have low androgyny scores. The multiplicative scale will rank images with low ratings in any of the dimensions as low in androgyny and images with high ratings on both as high in androgyny. Differently from the absolute difference scale, where images with high and low ratings in both dimensions are clustered together, here, images with high scores in both dimension will have a very high androgyny rating and images with low scores will have a very low androgyny rating. When used together, the masculinity and femininity items had factor loadings of 0.81 and a Cronbach's α of 0.78.

Credibility. This variable was measured with three Likert-type items on a 7-point scale. The items were taken from a scale developed by McCroskey (McCroskey et al., 1974; McCrosky & Young, 1981). The items consist of two adjectives from the competence dimension ("intelligent" and "informed") and one adjective from the character dimension ("reliable") of the original credibility scale. All items loaded higher than 0.81 in the factor and Cronbach's α was 0.92.

Homophily. Ratings of homophily were obtained with a 7-point 2-item Likert scale based on a subset of scales developed by McCroskey et al. (1974) and McCroskey and Young (1981). The items used asked whether the character "is very similar to me/is very different from me" and "thinks a lot like me/doesn't think like me at all." Both items loaded 0.87 in the factor and Cronbach's α was 0.85.

Attraction. This variable was measured with a 3-item scale based on the scale published by Mccroskey and McCain (1974). One of the items did not load properly in the factor and was dropped. The remaining items were "It would be nice to work with the character" and "I find the character attractive physically." The scale had a Cronbach's α 0.70 and the items loaded 0.74 in the factor.

Likelihood of Choosing the Avatar. This behavioral variable was assessed with a one-item question asking how likely the participants would be to choose that image to represent them.

Procedure

Participants were recruited from introductory communication courses at a large northeastern university. Participants were instructed to visit a webpage, where they first filled in a survey asking demographic information and computer experience variables and then proceeded to complete a survey indicating their impressions of a selection of eight avatar images. Each participant was presented with eight randomly selected images from the total 30 (see Figure 1), and had to evaluate each image in terms of their perception of its anthropomorphism, androgyny, credibility, homophily, attraction, and their likelihood to choose it for an interaction. The

images were presented in stratified random order to control for order effects, and certain rules were applied: All participants would rate two male human images, two female human images, two animal images, and two object images. In addition, if an image was shown with the torso, its corresponding image without the torso would not be presented to that participant, and vice-versa. Images were presented one at a time at the top of the webpage with evaluation questions below them. Once the participant submitted the results for one image, he or she would view the next image and this process would continue until rating for all eight images was completed.

Results

Although we randomized the order in which the images were shown, we still tested for a potential order effect. A series of post hoc ANOVAs revealed that regardless of which image participants saw first, the first image shown was rated as more androgynous (M = 4.35, SD = 1.98) than subsequent images (M = 4.02, SD = 2.37), less anthropomorphic (M = 3.12, SD = 1.30) than the subsequent images (M = 3.59, SD = 1.88), and less homophily was felt towards the first image (M = 2.50, SD = 1.27) than towards subsequent images (M = 2.89, SD = 1.59). Finally, participants were less likely to choose the first image to represent themselves (M = 1.91, SD = 2.37) than subsequent images (M = 2.37, SD = 1.65). The same tests conducted after removing the first image shown did not indicate order effects. Therefore, unless otherwise noted, the remaining analyses were performed excluding the first image shown. These order effects results are discussed in more detail later.

The Avatars

RQ1: How do people perceive the avatars in relation to one another?

In order to obtain a broad overview of the general perception of the images and examine how each image compares to the others, we rank ordered the images according to each of the dependent variables. As is shown in Figure 2, the same images tend to be rated higher (or lower) on all of the scales, and just examining the order of participant rankings provides some interesting information. For example, the most feminine avatar was the most attractive; it is more feminine both with and without torso (ranked 1 and 2 on feminine), but only most attractive with the torso

Table 1 ANOVA results for order effects

	All images				Without first image shown			
	$df_{between}$	df_{within}	F	p	$df_{between}$	df_{within}	F	p
Anthropomorphism	7	1903	2.78	.01	6	1650	0.81	.56
Androgyny	7	1887	2.60	.01	7	1887	1.19	.30
Homophily	7	1901	2.33	.02	6	1648	0.41	.88
Likelihood of choosing the avatar	7	1893	3.89	.00	6	1641	1.47	.18

	[Image]	Anthropo-morphism	Femininity	Masculinity	Perceived Male Gender	Androgyny	Androgyny-Mult	Credibility	Homophily	Attraction	Likelihood to Choose
1		3.78	1.95	6.47	0.98	2.47	3.39	3.70	2.65	2.59	1.90
2		4.96	1.87	6.45	0.98	2.21	3.25	4.83	3.67	3.82	2.68
3		4.87	2.04	6.26	0.94	2.74	3.40	4.06	2.95	2.45	2.21
4		4.83	3.64	4.50	0.33	4.36	3.70	4.44	3.47	3.92	2.57
5		5.30	1.56	6.60	0.95	1.96	3.07	4.45	3.63	3.83	3.04
6		4.11	1.93	6.39	1.00	2.14	3.24	3.98	3.19	2.57	2.18
7		4.99	2.31	6.17	0.90	2.85	3.51	4.84	3.80	3.85	3.06
8		4.75	2.22	6.08	0.92	2.98	3.46	4.43	3.07	2.52	2.15
9		4.71	3.91	4.57	0.47	4.63	3.89	4.19	3.07	3.05	2.19
10		5.88	1.28	6.92	0.90	1.36	2.93	4.82	3.72	4.13	3.44
11		3.41	4.23	3.59	-0.48	4.50	3.55	3.91	2.79	2.79	1.59
12		4.51	5.33	2.54	-0.96	3.49	3.34	4.44	3.13	3.78	2.57
13		5.22	6.20	1.98	-0.93	2.72	3.34	5.04	3.92	4.64	3.55
14		4.86	6.61	1.44	-1.00	1.83	2.93	4.23	3.56	4.81	3.22
15		5.04	6.03	2.00	-1.00	2.97	3.29	4.91	3.61	3.77	2.97
16		3.69	5.04	3.20	-0.62	4.56	3.78	4.14	2.90	2.71	2.12
17		4.18	5.25	3.12	-0.71	3.92	3.72	4.14	3.08	3.09	2.20
18		4.86	5.96	2.04	-0.95	2.93	3.29	4.83	3.48	4.23	2.98
19		4.94	6.68	1.49	-1.00	1.81	3.01	3.89	3.41	4.03	2.49
20		5.17	6.46	1.71	-1.00	2.24	3.20	4.80	3.72	4.38	3.27
21		2.93	4.53	4.05	-0.11	6.07	4.18	3.86	2.39	2.70	2.00
22		3.38	4.19	4.92	0.10	6.20	4.44	3.83	2.57	2.74	2.47

Figure 2 Rank order of the images (Click on a variable to sort).

23		1.61	4.18	5.44	0.37	5.65	4.64	3.38	2.35	2.75	2.26
24		1.59	4.24	5.03	0.20	5.96	4.53	3.62	2.31	2.76	2.46
25		2.43	3.92	5.34	0.16	5.31	4.35	2.58	1.55	1.49	1.54
26		1.30	3.43	5.45	0.33	4.79	4.15	3.55	2.43	2.38	2.25
27		1.38	4.90	4.72	-0.04	6.03	4.71	3.41	2.17	2.68	1.84
28		1.68	5.03	4.75	-0.05	5.63	4.73	3.36	2.31	2.37	1.95
29		1.34	4.69	4.72	0.03	5.57	4.51	2.87	2.32	2.63	2.12
30		1.50	5.20	4.33	-0.17	5.31	4.52	3.36	2.03	2.49	1.59
	Total	**3.59**	**4.19**	**4.44**	**0.02**	**4.04**	**3.81**	**3.99**	**2.90**	**3.14**	**2.39**

Figure 2 *Continued*

(ranked 6th on attractiveness without torso). Further, it was 6th in credibility, and not in the top 5 for either homophily or likely to choose. On another point, the most masculine avatar was also the most anthropomorphic, but was 6th most credible and the 2nd most likely to be chosen. The most credible avatar was ranked first on homophily and likely to be chosen, but 4th on femininity and 3rd on anthropomorphism. Further, only human images were in the top 5 for credibility, homophily, and likely to be chosen. The avatars used for this experiment covered the range of most of the scales, indicating that the images provided a good range of anthropomorphism, androgyny, credibility, and attraction values, although there is a skew towards the lower end of the scale. Homophily and the likelihood of choosing the avatar had mostly low ratings, with the higher-ranking image (f3, in both cases) reaching only a little above the midpoint of the scale (3.92 and 3.55, respectively).

Individual Differences and Avatar Image Type Influence on Image Perception

RQ2: What was the influence of participant's biological sex and avatar image type on perceptions of androgyny?

An ANOVA revealed main effects for both participant's gender, $F(1, 1612) = 27.16$, $p < .001$, and image type (human male, human female, animals, and objects), $F(3, 1613) = 418.37$, $p < .001$, on ratings of femininity. Male participants ($M = 4.44$, $SD = .06$) rated the avatars as more feminine than female participants did ($M = 4.03$, $SD = .06$). Post-hoc Scheffe tests indicated that all image types were different from each other ($p < .01$ for all comparisons). Human males ($M = 2.29$, $SD = 1.49$) were rated as least feminine and human females ($M = 5.76$, $SD = 1.52$) the most feminine. Animal avatars ($M = 4.22$, $SD = 1.61$) and objects ($M = 4.68$, $SD = 1.72$) were rated in between, with objects being perceived as more feminine than animal avatars.

Table 2 Regression results

	Perceived Gender		Femininity		Masculinity		Androgyny		Androgyny-mult	
	β	Sig.	β	Sig.	β	Sig.	β	Sig.	β	Sig.
Designed Image Male Gender	**.81**	.00	**−.63**	.00	**.67**	.00	−.01	.56	.04	.12
Animal	.03	.04	.07	.00	.09	.00	**.47**	.00	**.33**	.00
Object	−.03	.12	**.16**	.00	.06	.01	**.40**	.00	**.37**	.00
Torso Presence	.01	.95	−.03	.17	−.01	.95	.02	.40	−.02	.55
Children	**−.15**	.00	**.23**	.00	**−.23**	.00	−.01	.76	−.02	.35
Rendering Quality	−.01	.85	−.03	.10	.03	.09	**−.13**	.00	−.08	.00
Participant's Gender	−.02	.31	**.10**	.00	.01	.77	.08	.00	**.13**	.00
Comp. Use Author/Research	.01	.36	.02	.28	.03	.12	−.05	.03	.01	.81
Comp. Use Math/Science	.00	.83	.00	.84	−.03	.20	−.07	.00	−.06	.01
Computer Efficacy	.00	.92	−.01	.71	−.03	.16	.01	.64	−.03	.31
R^2	.69		.49		.54		.35		.24	
	Anthropomorphism		*Attraction*		*Credibility*		*Homophily*		*Choose*	
	Sig.	β	β	Sig.	β	Sig.	β	Sig.	β	Sig.
Designed Image Male Gender	.03	.07	**−.16**	.00	−.01	.55	−.01	.59	−.06	.03
Animal	**−.47**	.00	**−.20**	.00	**−.28**	.00	**−.26**	.00	−.08	.01
Object	**−.66**	.00	**−.19**	.00	**−.33**	.00	**−.26**	.00	**−.13**	.00
Torso Presence	−.02	.35	.06	.03	.00	.91	.01	.84	.01	.77
Children	.05	.01	**.14**	.00	−.06	.02	.02	.38	.03	.28
Rendering Quality	.05	.02	.05	.06	−.02	.45	.01	.77	.05	.11
Participant's Gender	−.02	.27	−.02	.44	−.04	.17	−.05	.07	−.01	.71
Comp. Use Author/Research	−.03	.13	−.02	.31	−.01	.64	−.08	.00	−.06	.02
Comp. Use Math/Science	.07	.00	.09	.00	−.01	.85	.06	.01	.08	.00
Computer Efficacy	.04	.05	.01	.77	.05	.08	.06	.02	.03	.35
R^2	.54		.16		.13		.12		.04	

The effect size for participant gender was very small ($\eta_p^2 = .02$), however, especially when compared to the effect size for image type ($\eta_p^2 = .44$).

For masculinity, a main effect was found for image type, F (3, 1613) = 523.46, $p < .001$, $\eta_p^2 = .49$. Again, similar to femininity, human males (M = 6.02, SD = 1.42) were rated more masculine than human females (M = 2.34, SD = 1.45). Animals (M = 4.92, SD = 1.46) and objects (M = 4.78, SD = 1.73) were again in the middle of the scale. Although animals and objects were rated between human males and human females in both the masculinity and femininity scales, in both cases they were closer to the highest group than to the lowest. That is, they were closer to the human males in masculinity and closer to human females in the femininity scale.

The perceptions of androgyny also showed main effects for gender, F (1, 1608) = 13.59, $p < .001$, $\eta_p^2 = .01$, as well as image type, F (3, 1608) = 254.92, $p < .001$, $\eta_p^2 = .32$). Men (M = 4.50, SD = .07) rated the images as more androgynous than women (M = 4.13, SD = .07) but the effect size is very small. Image type, on the other hand, had a good-sized effect on androgyny. Post-hoc Scheffe tests indicated that human male (M = 2.80, SD = 1.97) and human female (M = 3.12, SD = 2.08) images did not significantly differ in their ratings of androgyny ($p = .08$). There were also no significant differences between animal (M = 5.85, SD = 1.80) and object images (M = 5.50, SD = 1.92) in their ratings of androgyny ($p = .16$). Nevertheless, human male and female images differed from animal and object images in their ratings of androgyny ($p < .001$ for all comparisons).

A similar pattern was found for androgyny-multiplicative. The ANOVA showed a small main effect for gender, F (1, 1608) = 23.18, $p < .001$, $\eta_p^2 = .01$ and a moderate effect for image type, F (3, 1608) = 156.07, $p < .001$, $\eta_p^2 = .23$. Again, men (M = 4.05, SD = .04) rated the images as more androgynous than women (M = 3.80, SD = .04) did. Post-hoc Scheffe tests indicated that there were no significant differences between the human male (M = 3.39, SD = .79) and human female (M = 3.35, SD = .75) image ($p = .94$), nor were there significant differences between the animal (M = 4.42, SD = 1.26) and object (M = 4.54, SD = 1.36) images ($p = .52$). In addition, human male and female images differed from animal and object images in their ratings of androgyny ($p < .001$ for all comparisons).

RQ3: What was the influence of participant's biological sex and avatar image type on anthropomorphism?

An ANOVA with participant's biological sex and avatar image type as factors revealed only a main effect for image type (human male, human female, animal, and object), F (3, 1623) = 617.24, $p < .001$, $\eta_p^2 = .53$) on ratings of anthropomorphism. Post-hoc Scheffe tests indicated that there were no significant differences between the human male and human female images in their anthropomorphism ratings ($p = .05$), but that these groups were significantly different from the animals and objects ($p < .001$ on all comparisons). Human males (M = 4.79, SD = 1.32) and human females (M = 4.56, SD = 1.43) were the most anthropomorphic groups, followed by animals (M = 2.39, SD = 1.40) and objects (M = 1.45, SD = .84).

RQ4: What is the influence of participant's biological sex on the type of image they would choose to represent them?

Male participants overwhelmingly preferred choosing a human male avatar while women preferred the choice of a human female avatar. An ANOVA with participant's gender and image type as factors indicated a strong interaction between these terms, F (3,1614) = 53.07, $p < .001$. See Figure 3 for means. Interestingly, an ANOVA with the same factors on attraction produced significant results only for image type, F (3,1619) = 83.96, $p < .001$, but not for gender or any interaction. Both male and female participants had the same attraction ratings for the avatar images and post-hoc tests indicated that females were the most attractive (M = 3.82, SD = .08), followed by men (M = 3.26, SD = .06), and then by nonhumans (M = 2.51, SD = .08) and objects (M=2.51, SD=.08). Nonhumans and objects did not differ. People were more likely to choose avatars that were human-like and of the same gender (males choosing male avatars and females choosing female avatars).

RQ5: What was the influence of participant's computer usage and efficacy on the dependent variables?

Regression analysis on the dependent variables using computer usage factors, computer efficacy, age, and gender showed some significant effects. Computer usage

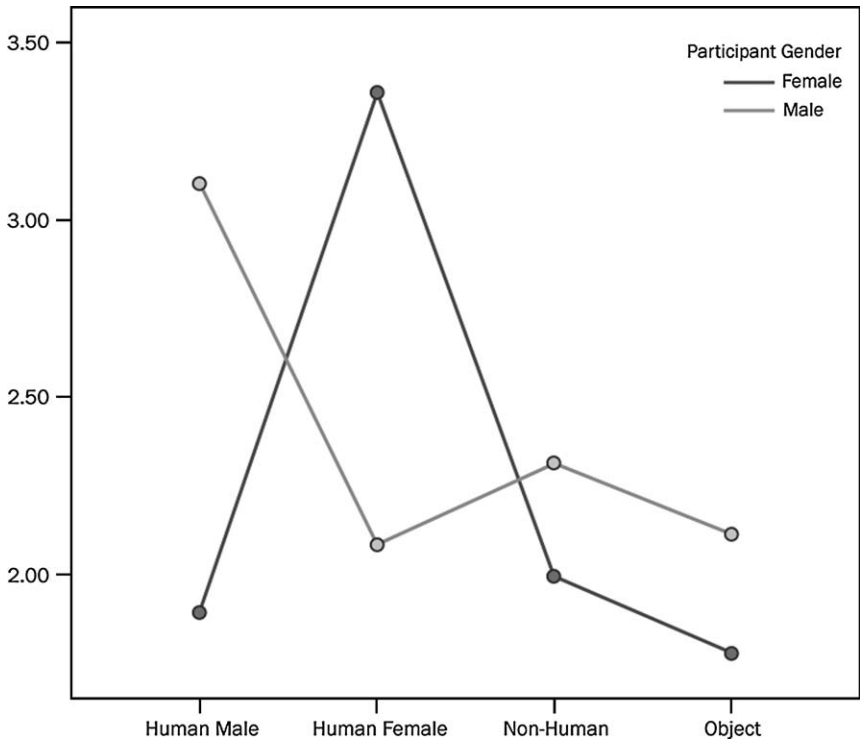

Figure 3

math/science was a significant but very small predictor of androgyny ($\beta = -.047$, $p < .01$), androgyny-multiplicative ($\beta = -.064$, $p = .02$), anthropomorphism ($\beta = .07$, $p < .01$), attraction ($\beta = .08$, $p < .01$), homophily ($\beta = .065$, $p = .02$), and likelihood of choosing an image ($\beta = .083$, $p < .01$). "Author/researcher" computer usage was also a significant but very small predictor of homophily ($\beta = -.073$, $p < .01$) and likelihood of choosing an image ($\beta = -.06$, $p = .02$). The small effect sizes, however, make it questionable to conclude that there is any meaningful influence of computer usage or computer efficacy in the dependent variables.

Features of the Avatar Image that Influenced Perception

A series of linear regressions were run with effects coded values (detailed below) to examine what design features influence the perceptions of the images. The features analyzed, effects coding, and the images that fall into each set are the following: designed image male gender (−1, female; 0, undetermined, 1 male/male: m1–m5 and m1h–m5h; female: f1–f5 and f1h–f5h; undetermined: all other images), image is of an animal (0, not an animal; 1, animal/a1–a5), image is of an object (0, not an object; 1, object/o1-o5), image has head and torso or just a head (0, head only; 1, head and torso/m1–m5 and f1–f5; head only, m1h–m5h and f1h–f5h), image is of a child (0, not a child; 1, child/m4, m4h, f4, f4h), and the image rendering quality (0, low quality; 1, high quality/m1, m1h, f1, f1h). We also included the participant's gender (−1, female; 1, male), computer usage, and computer efficacy to investigate how individual differences affected the perceptions of the images along with the images characteristics.

RQ6: What features of the avatar image influenced the perception of gender?

Looking first at the characteristics that predict the perception of the image gender, the analyses revealed that only two characteristics were significant predictors. The strongest predictor was the image designed gender ($\beta = .81$, $p < .01$). Participants could clearly identify the gender of the images as designed. Being a child character's image negatively predicted perceived gender, however, ($\beta = -.15$, $p < .01$); that is, images of children were more prone to be rated as female or undetermined.

Moving now to the characteristics that predict the perceptions of masculinity and femininity, the regression coefficients show that image designed male gender was the stronger predictor of femininity ($\beta = -0.63$, $p < .01$) and masculinity ($\beta = .67$, $p < .01$). That is, male images (coded as 1) were perceived as less feminine and more masculine, and vice versa for female images (coded as −1), with undetermined in the middle. Another predictor of femininity ($\beta = .23$, $p < .01$) and masculinity ($\beta = -.23$, $p < .01$) was whether or not the image was that of a child character. The images of children were perceived as more feminine and less masculine. Lastly, being an object was also a predictor of femininity ($\beta = .14$, $p < .01$), but not of masculinity, so if the image portrayed an object, this avatar was perceived as more feminine.

An animal image was the strongest predictor of androgyny ($\beta = .47$, $p < .01$), followed by being an object ($\beta = .40$, $p < .01$). Interestingly, the quality of the image reduced the androgyny perception ($\beta = -.13$, $p < .01$). For androgyny-multiplicative, object images ($\beta = .33$, $p < .01$) and animal images ($\beta = .37$, $p < .01$) had an effect, but not the image quality. Participant gender, however, appeared as a negative predictor of androgyny-multiplicative ($\beta = .13$, $p < .01$). Male participants perceived the images as more androgynous-multiplicative.

RQ7: What features of the avatar image influenced the perceptions of anthropomorphism?

An ANOVA revealed a main effect for image type (human male, human female, animal, and object), $F(3, 1623) = 617.24$, $p < .001$, $\eta_p^2 = .53$, on ratings of anthropomorphism. Post-hoc Scheffe tests indicated that there were no significant differences between the human male and human female images in their anthropomorphism ratings ($p = .05$), but that these groups were significantly different from the animals and objects ($p < .001$ on all comparisons). Human males ($M = 4.79$, $SD = 1.32$) and human females ($M = 4.56$, $SD = 1.43$) were the most anthropomorphic groups, followed by animals ($M = 2.39$, $SD = 1.40$) and objects ($M = 1.45$, $SD = .84$).

Anthropomorphism behaved similarly to androgyny, and being an animal or object image was the only meaningful predictor. Being an object character was a very strong negative predictor of anthropomorphism ($\beta = -.66$, $p < .01$), while being an animal was also a strong negative predictor ($\beta = -.47$, $p < .01$), though less strong than object. These results indicate that images of objects are perceived as less anthropomorphic, followed by animal images, with human images being perceived as the most anthropomorphic.

RQ8: What features of the avatar image influenced the perceptions of attraction, credibility and homophily?

Attraction was negatively predicted by the image designed male gender ($\beta = -.16$, $p < .01$), whether or not the image was that of an animal ($\beta = -.20$, $p < .01$) or an object ($\beta = -.19$, $p < .01$) and positively predicted by whether or not the image was of a child character ($\beta = .14$, $p < .01$). These results indicate, for example, that the most attractive avatar would be one based on a human child image. However, although four features influenced attraction perceptions, it is important to note that this model only accounts for a small fraction of the variance in this variable ($R^2 = .16$).

Credibility was negatively predicted only by whether or not the image was an object ($\beta = -.33$, $p < .01$) or animal ($\beta = -.28$, $p < .01$). The effect sizes show that, compared to humans, animal images reduce the perception of credibility and object images reduce it even more. Homophily was also predicted only by whether the image was an object ($\beta = -.26$, $p < .01$) or an animal ($\beta = -.26$, $p < .01$). Similar to the results for attraction, the variance accounted for by the above regression models was small; the R^2 for credibility was .13 and for homophily it was .11.

RQ9: What features influenced the choice of an avatar?

The features analyzed did not have much influence on whether participants would choose that image to represent them. As reported above, participants were most likely to choose an avatar that represented the same gender, and being an object image reduced slightly how much that image would be chosen ($\beta = -.13$, $p < .01$). We must note that the variance accounted for in the model is extremely small, however ($R^2 = .03$).

Although one must be cautious when interpreting null results, it is interesting to note that one of the features analyzed had no effect on any of the dependent variables. Unexpectedly, the presence or absence of torso (vs. floating head) had no effect on the participants' perceptions. Even when the regression was run using only the human images, the presence or absence of torso had no significant effect on any of the variables. The effect sizes for head compared to head and torso in this case were $\beta = -.03$, $p = .11$ for femininity, $\beta = -.01$, $p = .95$ for masculinity, $\beta = .00$, $p = .99$ for perceived male gender, $\beta = .03$, $p = .34$ for androgyny, $\beta = -.02$, $p = .49$ for androgyny-multiplicative, $\beta = -.04$, $p = .22$ for anthropomorphism, $\beta = .06$, $p = .07$ for attraction, $\beta = .00$, $p = .93$ for credibility, $\beta = .00$, $p = .90$ for homophily, and $\beta = -.01$, $p = .87$ for likelihood of choosing the avatar.

Relationships Among the Perception Variables

The previous section examined how a variety of features influenced perceptions of anthropomorphism, androgyny, credibility, homophily and attraction. In this section, we ask how these variables relate to each other. To answer this question we computed Pearson correlations between the variables (shown in Table 3).

As expected, femininity, masculinity, and image gender were highly correlated with each other, as were the two measures of androgyny. Anthropomorphism was

Table 3 Correlations

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
1. Femininity	1	−.64**	−.74**	.16**	.39**	−.08**	.10**	−.05	−.03	−.01
2. Masculinity	−.64**	1	.79**	.08**	.38**	−.14**	−.31**	−.15**	−.12**	−.12**
3. Perceived image gender	−.74**	.80**	1	−.05	.04	−.03	−.20**	−.06*	−.04	−.04
4. Androgyny	.16**	.08**	−.05	1	.65**	−.51**	−.30**	−.30**	−.22**	−.16**
5. Androgyny−mult	.39**	.38**	.04	.65**	1	−.44**	−.33**	−.31**	−.24**	−.19**
6. Anthropomorphism	−.08**	−.14**	−.03	−.51**	−.44**	1	.45**	.46**	.45**	.31**
7. Attraction	.10**	−.31**	−.19**	−.30**	−.33**	.45**	1	.49**	.50**	.45**
8. Credibility	−.04	−.14**	−.06*	−.30**	−.31**	.46**	.50**	1	.51**	.37**
9. Homophily	−.03	−.12**	−.04	−.22**	−.24**	.45**	.50**	.51**	1	.59**
10. Likelihood to choose	−.01	−.12**	−.04	−.16**	−.20**	.31**	.45**	.37**	.59**	1

** Correlation is significant at the 0.01 level (2−tailed).

* Correlation is significant at the 0.05 level (2-tailed).

negatively correlated with androgyny ($r = -.51$, $p < .01$), androgyny-multiplicative ($r = -.44$, $p < .01$), and positively correlated with attraction ($r = .45$, $p < .01$), credibility ($r = .46$, $p < .01$), homophily ($r = .45$, $p < .01$), and the likelihood to choose the image ($r = .31$, $p < .01$). Attraction was negatively correlated with masculinity ($r = -.31$, $p < .01$), androgyny ($r = -30$, $p < .01$), and androgyny-multiplicative t ($r = -.33$, $p < .01$) but positively correlated with femininity ($r = .10$, $p < .01$) to a lesser degree. It was also positively correlated with credibility ($r = -.49$, $p < .01$), homophily ($r = .49$, $p < .01$), and the likelihood of choosing the image ($r = .45$, $p < .01$). Credibility was negatively correlated with masculinity ($r = -.15$, $p < .01$), androgyny ($r = -.30$, $p < .01$), and androgyny-multiplicative ($r = -.31$, $p < .01$). Credibility also correlated with anthropomorphism and attraction, as indicated before. Finally, credibility had a good correlation with homophily ($r = .51$, $p < .01$) and a moderately low correlation with the likelihood of choosing the image as an avatar ($r = .37$, $p < .01$). Homophily was highly correlated with likelihood of choosing the image ($r = .3$, $p < .01$). In fact, the image that received the highest homophily ratings also received the highest credibility ratings, was most likely to be chosen, and it was rated the second most attractive. Similarly, the image that received the lowest homophily ratings received the lowest credibility ratings, was least likely to be chosen, and also least attractive.

Overall, the gender-related variables were intercorrelated and the remaining variables formed another intercorrelated group. Anthropomorphism was unique in the sense that it correlated with all variables.

Discussion

The results of this study confirm that the process of uncertainty reduction takes place even in interactions with static images on web pages. Participants were fairly consistent in their assignment of avatars to the categories of humans, animals, and objects, and the majority of participants perceived these categories as meaningfully different. In addition, results show that masculinity and feminity have maintained salience and that anthropomorphism, while influential, is not as important in the perception process as an avatar's masculinity or feminity. Last, in this static context, the avatar's characteristics were more influential than the users' individual difference variables. Although there were some effects for user differences (gender and computer usage), the size of those effects was very small when compared to the effects of the avatar's visible characteristics.

Users reported a preference for choosing human avatars; the top twelve avatars most frequently chosen were humans. A non-androgynous female (4th most feminine) human avatar was found to be the most credible, the second most attractive, and the third most anthropomorphic. This image was also the one that users rated as most homophilous, and most likely to be chosen. Conversely, a green lizard avatar was the least attractive, homophilous, and credible and the one that users were least likely to choose. These results might help explain why designers have tended to create

avatars that are gendered caricatures (Clark, 1995), perhaps because users like to be represented by them.

Examples of extremely gendered avatars can be seen in most video games or by visiting any of several 3D chat rooms (Damer, 1997). As Balsamo (1995) argued, the "boundary between male and female is one border that remains heavily guarded despite new technologized ways to rewrite the physical body in the flesh" (p. 217). If anything, instead of disappearing, the distinction between feminine and masculine appears to be exaggerated in cyberspace (Biocca & Nowak, 2002).

The avatars that participants perceived to be more attractive were also found to be more credible and homophilous, and partcicpants were more likely to choose them. Participants reported masculine images as less attractive, and child-like images as more attractive, though these characteristics did not significantly influence attributions of credibility. Interface designers who wish to elicit attraction in users might consider anthropomorphic, nonandrogynous, feminine, child characters for their interfaces. Future research should examine other contexts and varied child-like images to assess the extent to which these results are generalizable.

Regardless of which avatar was shown first, it was rated lower in anthropomorphism, androgyny, homophily, and was less likely to be chosen than those seen later. This order effect may be explained by a novelty effect, where people initially were uncertain about what to expect when they first began the survey but were more relaxed when evaluating subsequent images. Similarly, it may be that participants began with an expectation of the type and quality of images that they would see, and expectations were then adjusted after the initial exposure. This is more consistent with an adjustment of expectations than with a contrast effect, in which case the later images would have been ranked either higher or lower than the first depending on their relative ratings. If the first avatar seen has lower ratings than subsequently encountered avatars, designers of interfaces incorporating avatars should consider have one avatar initially greet users and then provide another similar avatar (or avatars) to continue the interaction. Future research is needed to examine whether evaluations of the first avatar would be raised to the level of subsequently encountered avatars following interactions over time.

Participants strongly preferred avatars that were both human and matched their own gender. This suggests a straightforward guideline for designers that is consistent with what most interfaces already do: Offer several options of avatars for users to choose. The fact that people prefer a choice of avatar that is aligned with their own gender and type (human) suggests that they might also tend to choose avatars with other characteristics that are similar to their own. In that case, the visible characteristics of avatars might actually provide users with valuable information about their partners. In fact, because avatars are more flexible than the user's natural embodiment, an avatar might provide as much, if not more, insight into the user's personality than his or her offline body.

The isomorphism between the avatar gender and the gender of the person being represented raises some questions. For example, in social interactions, do people

want an avatar that matches all of their physical characteristics, such as race, or hair and eye color, or is the preference limited to gender? Also, are people matching their avatars to more abstract interpersonal or psychological characteristics, such as extroversion, dominance, or charisma? The use of highly feminine avatars in video games where the majority of players are men suggests that the desire to select avatars that are "like them" is context dependent. It may be that people will focus more on matching characteristics of themselves on a social context, but will choose avatars with the highest credibility or likeability rating in a workplace context, or that some people will be more likely to match different features than others. Future work should identify what characteristics users choose, under what contexts, and why.

There are other factors that play a part in these perceptions that are important to consider as well. For example, it is important to note that these results show the maintained salience and perceived importance of both appearance and gender in cyberspace and mediated interactions. A gendered avatar (whether masculine or feminine) was more credible than an androgynous avatar and more likely to be selected. Future researchers should be careful to consider these and other variables (such as realism, androgyny) as they continue to examine the role of avatars on the person perception process in virtual worlds. Designers seeking to create credible interfaces should be aware that people may be more critical of the first avatar they see, and that human avatars may be more credible than either animals or objects.

Limitations

We recognize that this static environment is generally not how people would encounter avatars in "real" online environments. Another issue to consider is that the first image shown was perceived as less attractive and credible than other images, regardless of which image it was. This underscores the importance of examining long term or repeated exposure to the same avatar. It is possible that there are other effects resulting from the process of seeing a series of images one after another that should be explored.

This study did not examine the extent to which context, level of realism, or animation would influence people's perceptions of avatar images. Previous research has suggested that such factors are important to consider (Garau et al., 2003). The present study also examined the distinction between floating heads and heads attached to a torso (or shoulders), which had no effect on perception. It is possible that a full body would result in significantly different perceptions of avatars.

Further, we did not examine how, or if, people's responses to these images would actually influence their responses to a person who chose to be represented by a particular avatar, or how these images might influence the perception of a message sent by a person being represented by that avatar. Also, this project did not examine the extent to which a person's behavior might influence the perception of an avatar, though such work is underway. Following this study, we can only conclude that people had different perceptions of the avatar images in this static environment.

The images selected for this study were categorized into groups of humans, animals, and objects to study the effects of those groups. Human images both in interfaces and in face to face interaction are likely to be unique and evoke perceptual process that may be different from the evaluation of other types of images. Even with this relatively large set of avatars, some variables, such as image types and categories, were not examined. While these results provide some insight into the process of perception of human, animal, and object images, further exploration is required. Future research should examine the influence of a wider array of avatars, considering more individual difference variables (such as race, hair color, or other physical characteristics), in different contexts, and with more heterogeneous samples.

Conclusion

Previous research has implied that anthropomorphism would be the main predictor of credibility or attractiveness (Koda, 1996; Wexelblat, 1997), but this was not the case in the present study. Avatars that were more anthropomorphic were perceived to be more attractive and credible, and people were more likely to choose to be represented by them. The strongest predictor of these variables, however, was the degree of masculinity or femininity (lack of androgyny) of an avatar. Further, those images with strong gender indications (either more masculine or more feminine) were perceived as more anthropomorphic than images (whether human or not) without strong indications of gender. These results also support the claim that people anthropomorphize anything they encounter (Reeves & Nass, 1996), even bottles and hammers, to some degree.

Further, while all images have some level of anthropomorphism, not all images are either feminine or masculine. Some images are both masculine and feminine and others are neither. All things being equal, more anthropomorphic or less androgynous avatars are more attractive, credible, and homophilous, perhaps because androgyny and low anthropomorphism increase uncertainty. These results are consistent with the suggestion that people have higher expectations of anthropomorphic avatars and that there will be consequences for violating these expectations (Garau et al., 2003; Slater & Steed, 2002). The results suggest that less androgynous (more masculine or feminine) avatars may also carry higher expectations.

Finally, it seems that the characteristics of an avatar may at times provide useful, and relatively accurate, information about the person it represents. Although a small percentage of subjects reported a preference for androgynous avatars, a majority reported a preference for avatars that were "like" them, at least in terms of gender. This suggests that users may also want to match other characteristics such as hair color and race, perhaps sexual orientation, or even hobbies. This means that designers should continue to provide a wide variety of choices. This would not only increase user satisfaction, but could also provide useful information about people in online interactions. Finally, providing minorities, such as Hispanic and African Americans, choices of avatars that match their ethnicity or race may make them feel

more comfortable and may also help to prevent marginalizing minorities and other traditionally disenfranchized groups in online environments by making them obvious, visible participants.

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References

Ambady, N., Hallahan, M., & Rosenthal, R. (1995). On judging and being judged acturately in zero-acquaintance situations. *Journal of Personality and Social Psychology*, **69**(3), 518–529.

Anonymous (2004). *Encyclopædia britannica online*. Retrieved June 11, 2004, from http://search.eb.com/eb/article?eu=7898

Ashmore, R. D., & Del Boca, F. K. (1979). Sex stereotypes and implicit personality theory: Toward a cognitive-social psychological conceptualization. *Sex Roles*, **5**(2), 219–248.

Balsamo, A. (1995). Forms of technological embodiment: Reading the body in contemporary culture. In M. Featherstone & R. Burrows (Eds.), *Cyberspace/cyberbodies/cyberpunk: Cultures of technological embodiment* (pp. 215–237). Thousand Oaks, CA: Sage Publications.

Bem, S. L. (1975). Sex role adaptability: One consequence of psychological androgyny. *Journal of Personality and Social Psychology*, **31**(4), 634–643.

Bem, S. L. (1981). Gender schema theory: A cognitive account of sex typing. *Psychological Review*, **88**, 354–364.

Benford, S., Greenhalgh, C., Rodden, T., & Pycock, J. (2001). To what extent is cyberspace really a space? Collaborative virtual environments. *Communications of the ACM*, **4**(7), 79–85. Retrieved October 24, 2005, from http://portal.acm.org/citation.cfm?doid=379300.379322

Berger, C., & Calabrese, R. (1975). Some explorations in initial interaction and beyond: Toward a developmental theory of interpersonal communication. *Human Communication Research*, **1**, 99–112.

Biocca, F. (1997). The cyborg's dilemma: Progressive embodiment in virtual environments. *Journal of Computer-Mediated Communication*, **3**(2). Retrieved October 24, 2005, from http://www.ascusc.org/jcmc/vol3/issue2/biocca2.html

Biocca, F., & Nowak, K. (2002). Plugging your body into the telecommunication system: Mediated embodiment, media interfaces, and social virtual environments. In D. Atkin & C. Lin (Eds.), *Communication technology and society: Audience adoption and uses* (pp. 407–447). Cresskill, NJ: Hampton Press.

Bull, P., & Rumsey, N. (1988). *The social psychology of facial appearance*. New York: Springer-Verlag.

Burgoon, J. (1994). Nonverbal signals. In M. L. Knapp & G. R. Miller (Eds.), *Handbook of interpersonal communication* (pp. 229–285). Thousand Oaks, CA: Sage Publications.

Burgoon, J., Buller, D., & Woodall, W. (1996). *Nonverbal communication: The unspoken dialogue* (2nd Ed.). New York: McGraw-Hill.

Clark, N. (1995). Rear-view mirrorshades: The recursive generation of the cyberbody. In M. Featherstone & R. Burrows (Eds.), *Cyberspace/cyberbodies/cyberpunk: Cultures of technological embodiment* (pp. 113–133). Thousand Oaks, CA: Sage Publications.

Clatterbuck, G. (1979). Attributional confidence and uncertainty. *Human Communication Research*, **5**(2), 147–157.

Daly, N., Bench, J., & Chappell, H. (1996). Interpersonal impressions, gender stereotypes and visual speech. *Journal of Language and Social Psychology*, **15**(4), 468–479.

Damer, B. (1997). *Avatars!: Exploring and building virtual worlds on the Internet*. Berkley, CA: Peachpit Press.

Dietrich, D. (1997). (Re)-fashioning the techno-erotic woman: Gender and textuality in the cybercultural matrix. In S. Jones (Ed.), *Virtual culture: Identity and communication in cybersociety* (pp. 169–184). London: Sage Publications.

Dion, K., Berscheid, E., & Walster, E. (1972). What is beautiful is good. *Journal of Personality and Social Psychology*, **24**(3), 285–290.

Eastin, M. S., & LaRose, R. (2000). Internet self-efficacy and the psychology of the digital divide. *Journal of Computer Mediated Communication*, **6**(1). Retrieved October 16, 2002, from http://jcmc.indiana.edu/vol6/issue1/eastin.html

Fisher, J. (1997). The postmodern Paradiso; Dante, cyberpunk, and the technosophy of cyberspace. In D. Porter (Ed.), *Internet Culture* (pp. 106–122). London: Routledge.

Garau, M., Slater, M., Vinayagamoorthy, V., Brogny, A., Steed, A., Sasse, M. A. (2003). The impact of avatar realism and eye gaze control on perceived quality of communication in a shared immersive virtual environment. *Proceedings of CHI'03*. ACM Press.

Haraway, D. (1991). A cyborg manifesto: Science, technology, and socialist-feminism in the late twentieth century. In *Simians, Cyborgs and Women: The Reinvention of Nature* (pp. 149–181). New York: Routledge. Retrieved October 20, 2005, from http://www.stanford.edu/dept/HPS/Haraway/CyborgManifesto.html

Herring, S. (1994, June 27). *Gender differences in computer-mediated communication: Bringing familiar baggage to the new frontier*. Paper presented at the American Library Association Annual Convention. Miami, Florida.

Herring, S. C. (2000). Gender differences in CMC: Findings and implications. *Computer Professionals for Social Responsibility Journal* (formerly *Computer Professionals for Social Responsibility Newsletter*), **18**(1). Retrieved October 25, 2005, from http://www.cpsr.org/publications/newsletters/issues/2000/Winter2000/herring.html

Infante, D., Rancer, A., & Womack, D. (1997). *Building Communication Theory* (3rd ed.). Prospect Heights, Illinois: Waveland Press, Inc.

Koda, T. (1996). Agents with faces: The effects of personification. *Proceedings of HCI 1996*. London.

Kunda, Z. (1999). *Social cognition: Making sense of people*. MIT Press: Cambridge, MA.

Madden, M. (2004). *America's online pursuits: The changing picture of who's online and what they do*. Pew Internet and American Life Project Report.

McCroskey, J., & McCain, T. (1974). The measurement of interpersonal attraction. *Speech Monographs*, **41**, 261–266.

McCroskey, J., & Young, T. (1981). Ethos and credibility: The construct and its measurement after three decades. *The Central State Speech Journal*, **32**, 24–34.

McCroskey, J. C., Hamilton, P. R., & Weiner, A. N. (1974). The effect of interaction behavior on source credibility, homophily, and interpersonal attraction. *Human Communication Research*, **1**(1), 42–52.

McCroskey, J., Richmond, V., & Daly, J. (1975). The development of a measure of perceived homophily in international communication. *Human Communication Research*, **1**(4), 323–332.

Nass, C., Steuer, J., Tauber, E., & Reeder, H. (1993, April 24–29). *Anthropomorphism, agency, & ethopoea: Computers as social actors*. Paper presented at the InterChi '93. Amsterdam, Netherlands.

Nowak, K. L. (2004). The Influence of Anthropomorphism and Agency on Social Judgment in Virtual Environments. *Journal of Computer Mediated Communication*, **9**(2). Retrieved October 24, 2005, from http://jcmc.indiana.edu/vol9/issue2/nowak.html

Nowak, K. L. (2003). Sex categorization in computer mediated communication (CMC): Exploring the utopian promise. *Media Psychology*, **5**(1), 83–103.

Nowak, K. L., & Biocca, F. (2003). The effect of the agency and anthropomorphism on users' sense of telepresence, copresence, and social presence in virtual environments. *Presence: Teleoperators and Virtual Environments*, **12**(5), 481–494.

Oravec, J. (1996). *Virtual individuals, Virtual groups: Human dimensions of groupware and computer networking*. Cambridge: Cambridge University Press.

Persson, P. (2003). Exms: An animated and avatar-based messaging system for expressive peer communication. *Proceedings of GROUP '03*. ACM Press.

Rauh, C., Polonsky, M., & Buck, R. (2004). Cooperation at first move: Trust, emotional expressiveness and avatars in the prisoner's dilemma game. Poster presented at *ISRE 2004—Conference of the International Society for the Research on Emotions*. New York, NY.

Reeves, B., & Nass, C. (1996). *The media equation: How people treat computers, television, and new media like real people and places*. Stanford, CA: CSLI Publications.

Schroeder, R. (1997). Networked worlds: Social aspects of multi-user virtual reality tecnology. *Sociological Research Online*, **2**(4). Retrieved October 24, 2005, from www.soresonline.org.uk/socresonline/2/4/5.html

Schroeder, R. (2002). Social interaction in virtual environments: Key issues, common themes, and a framework for research. In R. Schroeder (Ed.), *The social life of avatars: Presence and interaction in shared virtual environments*. London: Springer-Verlag.

Skitka, L., & Maslach, C. (1996). Gender as schematic category: A role construct approach. *Social Behavior and Personality*, **24**(1), 53–74.

Slater, M., & Steed, A. (2002). Meeting people virtually: Experiments in shared virtual environments. In R. Schroeder (Ed.), *The social life Of avatars: Presence and interaction in shared virtual environments* (pp. 146–171). London: Springer-Verlag.

Spender, D. (1996). *Nattering on the Net: Women, power and cyberspace*. Melbourne, Australia: Spinifex Press.

Talamo, A., & Ligorio, B. (2001). Strategic identities in cyberspace. *CyberPsychology & Behavior*, **4**(1), 109–122.

Taylor, T. L. (2002). Living digitally: Embodiment in virtual worlds. In R. Schroeder (Ed.), *The social life of avatars: Presence and interaction in shared virtual environments* (pp. 40–62). London: Springer-Verlag.

Turkle, S. (1995). *Life on the Screen: Identity in the age of the Internet*. New York: Simon & Schuster.

Waskul, D., & Douglass, M. (1997). Cyberself: The emergence of self in on-line chat. *The Information Society*, **13**(4), 375–397.
West, C., & Zimmerman, D. (1991). Doing gender. In J. Lorber & S. A. Farrell (Eds.), *The social construction of gender* (pp. 13–37). Newbury Park, CA: Sage Publications.
Wexelblat, A. (1997). Don't make that face: A report on anthropomorphizing an interface. Retrieved October 24, 2005, from http://wex.www.media.mit.edu/people/wex/anthro-expt-paper/Anthro-r.htm

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