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The Effect of Viewer Perceptions of Avatar Anthropomorphism and Realism on Judgments of Credibility and Homophily, and Avatar Choice

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Abstract

Avatars, or digital representations of others are increasingly used in a variety of online interactions and interfaces. The current study investigated the role of avatars, and people's perceptions of them, in the processing of information and source attribution online. Results replicate previous findings that the visual characteristics of the avatar are not as influential as people's perceptions, and categorizations, of the avatars on outcome variables. Results show that perceptions avatar anthropomorphism and realism influence judgments about homophily and avatar credibility, as well as judgments about the credibility of the source of the communication and the likelihood of choosing the avatar as a representation. Theoretical and practical implications of the variance between actual and perceived variation in characteristics of the avatar are discussed.

1. Introduction

Avatars, or computer generated visual representations, are commonplace in a variety of online applications [1, 2]. They are available in most computer interfaces, including Instant Messaging systems, blogs, e-commerce sites, and newsgroups. Companies are using avatars on webpages to personalize messages online [3]. Ikea has implemented an avatar based automated online assistant on their help center, the BBC anchored a news segment with avatars, and there companies selling products to avatars [3, 4]. The use of avatars influences the interactions in that their visual characteristics influences how the message is processed, what is remembered, and source attribution [5, 6, 7, 8, 1, 9].

The current study examines how perceptions of avatar characteristics influence information processing and source attribution using causal modeling techniques. It specifically tests the influence of perceptions of visual characteristics associated with avatars, including anthropomorphism, realism, and gender on judgments of avatar and message credibility, homophily and likelihood of choosing an avatar. This study extends our understanding of the perceptual process of avatars online, by investigating how perceptions of avatar characteristics influence information processing.

2. Information Processing Offline and Online

Information processing theory argues that attention to, and processing of, information follows a predictable pattern that is influenced by perceptions of the source as well as the way information is presented [10, 11, 12]. The process begins with attention to some stimulus or source of a message [13] and includes the assessment of the dynamism, competence, trustworthiness and likeability of the source. This process has been shown to be consistent regardless of the environment, origin of source, or context of the interaction [11, 14,] though the viewer's individual differences influence the process.

Viewer identity variables such as gender, age, and social class influence the motivation and ability to use technology such as computers. Masculinity has been found to increase use of more advanced computer applications [15]. Greater use of computers should improve efficacy with computers, increasing technological efficacy (how comfortable people are with their technological skills) which in turn should increase user efficacy (how comfortable people are with their use of computer applications). In turn, computer use is likely to impact technical efficacy such that those who spend more time using the technology will feel they are more capable of using it, and will also use computers for more, and different, things [16].

3 Viewer Evaluations of Avatars

The process of processing information described above includes the evaluation of sources and messages. This predictable pattern and occurs online and offline. Essentially, certain characteristics of the source activate personae based on familiar others encountered in the past, which influence attributions of source dynamism, competence, trustworthiness, and likeability. Dynamism has been shown to increase competence, with competence increasing trustworthiness, and trustworthiness increasing likeability [11, 17]. Offline, people use visual characteristics of the source's body to make judgments about the source's credibility and likeability [18]. The visual characteristics of avatars similarly influence the process online [15, 7, 8].

We expect that perceptions of anthropomorphism and masculinity will lead to high expectations and a desire for greater realism [15]). In turn, realism should function much like dynamism in making the source seem more compelling, resulting in higher competence ratings. Just as in offline environments, competence contributes to increase trustworthiness ratings, as viewers assess the source credibility. Finally, just as trustworthiness bolsters likeability, it should have a positive effect on homophily.

The presence of an avatar (versus no visual representation) enhances the perception that others are sociable and has positive effects on various communication outcomes, including learning [19, 20, 21]. The avatar's behavioral features, including eye gaze and head movement, have been shown to impact social aspects of communication including disclosure, nonverbal behaviors, and co-presence [6, 5], though not all avatars have the same effect on the process.

3.1. Avatar Perception and Memory

As explained above, the initial stages of information processing focuses on attention to visual information provided by the source. As with exposure to any source or message, exposure to an avatar triggers perception processes. Two key perceptions made about avatars are anthropomorphism (the extent to which the avatar is perceived to resemble human form) and where the image falls on the masculinity-femininity continuum.

3.1.1 Anthropomorphism. Anthropomorphism is a judgment about the extent to which one has appearance or behavioral attributes of humans [22, 23, 8, 24]. As defined here, a more anthropomorphic image is perceived to have visible characteristics associated with humanness.

Typically, the perceived humanness, or anthropomorphism, influences perceived social potential. In some instances, more anthropomorphic were reported as more credible [22, 8, 15, 25], although [26] reported the less anthropomorphic image to be more credible, and likeable than the more anthropomorphic image. Entities perceived to have social potential will elicit perceptions and expectations, such as credibility (Barret, 1997) and affinity [25, 27]. While it may be assumed that some avatars are always more anthropomorphic than others, we argue that individual assessments of the anthropomorphism, or humanness, of the avatar has a greater impact on the judgments made about the avatar and the person behind the avatar than any identifiable visual characterization of an avatar.

Avatars perceived as anthropomorphic elicit expectations of sociability, and elicit judgments reserved for social entities such as credibility and homophily [8]. Realistic or anthropomorphic avatars set up expectations, which lead to more negative attributions when those expectations are not met [28, 26, 29]. Perceptions of humanness lead to judgments about the social nature of the entity. Therefore we predict that viewer perceptions of avatar anthropomorphism will have a moderate

positive effect on avatar competence, even when the level of anthropomorphism of the avatars is held constant.

3.1.2. Perceived masculinity (and femininity). The categorization as either male or female is one of the primitive categories, which are thought to be the first judgments made about others and people believe this categorization provides useful information in interpersonal interactions offline [30] as well as online [31, 32, 33]. Gender is considered by many to be a continuum, with 'masculinity' on one end and 'femininity' on the other. As discussed above, people use visual information to categorize others. Even when the physical body is not visible, individuals still attempt assign a source to one of the sex categories based on whatever information is available [34, 33].

As part of the perceptual process, avatars are categorized in terms of their masculinity and femininity, and animals and objects are considered more androgynous than humans; in addition, individuals have shown a preference for highly gendered avatars over androgynous ones whose gender is ambiguous [7, 8]. The avatar's visual characteristics trigger attributions of gender. Some results indicate that stereotypical judgments are activated based upon corresponding sex categorization. For example, women as often judged to be more emotional and men as more rational, women as nurturing and men as aggressive protectors. As is often found offline, perceived masculinity of the avatar can have a positive relationship on judgment of avatar credibility [15]. Therefore we predict that viewer perceptions of avatar masculinity will have a small positive effect on avatar competence.

3.2. Orienting to Avatars and Perceiving Realism

Computer-generated avatars have varying degrees of realism [28], and different individuals perceive the same avatars to have varying degrees of realism [15]. The current study addresses the perception of realism, and its impact on information processing. The basis for judgments about online realism includes the dimensions of *plausibility* (potential of script or image to exist in the real world), *typicality*, *factuality*, *involvement/identification*, *narrative consistency*, and *perceptual pervasiveness* or "the degree to which a text creates a compelling visual illusion, independent of the degree to which the content may relate to real-world experience" [35]. These dimensions are inter-related and are not necessarily dependent on offline counterparts or experiences. [36] argues for *probability* – or the extent to which content could exist in the real world – as another dimension.

While anthropomorphism is defined as the level of perceived humanness, realism is defined in terms of the plausibility that something could exist offline. Realism and anthropomorphism have been shown to be highly correlated and perceived anthropomorphism influences perceived realism [15], and we argue that it is the perception of realism that is driving the effect on information processing more than any objective criteria.

Specific types of computer use influence perceptions of avatars including anthropomorphism, and androgyny [7]. In turn, the perceptions of avatars influenced perceptions of credibility, homophily, and the likelihood that one would choose that avatar. In that study, the operationalization of anthropomorphism combines realism and anthropomorphism as defined here. We predict that these constructs are distinct and that avatars perceived to be anthropomorphic will not necessarily be perceived as more realistic, though these variables are related. In fact, viewer perceptions of avatar anthropomorphism should have a large positive effect on the perceived realism of the avatar in most cases.

3.3 Perceptions of Competence and Trustworthiness

Although the source evaluation process begins with exposure to visual stimuli and categorizations based upon those stimuli, the process does not end there. People use those categorizations to make judgments of message and sender competence, trustworthiness, likeability and homophily. Credibility is a multidimensional construct, including the aspects of competence, trustworthiness, and liking [37]. In turn, credibility has been shown to have a strong impact upon judgments of source-receiver similarity or homophily [38].

Attention to the avatar has been shown to activate the process and these categorizations influence impressions of the avatar, and the message or person it represents. Anthropomorphism of the avatar has been found to positively influence perceptions of avatar credibility [22, 7, 14, 25]. In addition, perceptions of avatar realism have been shown to mediate these impressions, such that avatar realism has a positive impact on evaluations of avatar credibility [28]. The realism of the online stimuli influences online processing. Therefore, we predict that viewer perceptions of avatar realism will have a positive impact on avatar competence, with competence increasing trustworthiness.

3.4. Representative Visuals and Message Evaluation

In online environments, visual characteristics of avatars send messages about the source. The goal of selecting a particular avatar for online interaction may be to convey some element of the user's identity, or information the user desires to send [39]. Toward that end, homophily becomes the key mediating variable. Avatars vary in the extent to which they accurately represent the source. Assessments of avatar similarity to self require a comparison of the image under consideration to idealized representations of self.

Gender is an aspect of identity. If the gender of the avatar is perceived to match the biological sex of the user, this should enhance the assessed similarity of the avatar to the viewer's identity. In part, matching gender should diminish the perceived gender discrepancy between self and avatar, with gender matching increasing homophily with the avatar. In addition to the degree of gender match, assessments of avatar similarity should depend on avatar realism.

Ultimately, avatars can serve as representations of an individual's identity during online interactions. The assessed homophily of an avatar has been shown to influence the likelihood that an image will be chosen for subsequent interaction, as has the trustworthiness of the avatar [7]. We predict that homophily and trustworthiness should combine to predict the likelihood of choosing an avatar, producing large and small effects respectively.

4 Interfaced Sequence Effects

The processes involved in evaluating the source and message are separate, but they do influence one another. In the context of the process examined here we predict two effects of avatar evaluation on message appraisal. First, realism should increase homophily. That is, a more realistic avatar should allow viewers to see similarities to self. This effect should be moderately small. Second, trustworthiness should have a small positive effect on selection of the avatar. Avatars that the viewer associates with safety and integrity should be more inviting as potential representations than avatars that are associated with danger or deceit. This effect is predicted to be of modest size. Only one effect of message appraisal on avatar evaluation was anticipated -- homophily should have a small positive effect on competence ratings. A source that shares receiver characteristics should be seen as more competent.

We further predict that viewer's biological sex and perceived avatar gender will interact to produce either a gender match. Second, perceived masculine gender and perceived avatar gender interact to produce gender discrepancy – the difference between the masculinity of the viewer and the masculinity of the avatar.

Computer usage can influence evaluations of the avatar, specifically anthropomorphism [9]. This effect may be due to the familiarity with online environments and avatars that comes with increased computer use. Computer use may change the expectation or standard the viewer has for classifying an avatar as anthropomorphic or even realistic. Hence, computer use should have a negative impact on perceptions of avatar anthropomorphism and realism.

5. Methodology

This study utilized a pretest-posttest between-subjects experimental design. Viewers were randomly assigned to condition, where they would read a fictional blog with one of two avatars in the top right corner about legalizing heroin in the United States. The posting to the blog was ascribed to one of two avatars – either male or female. After reading the post, viewers were taken to an online questionnaire. The match between gender of the viewer and avatar were assumed to be key predictors of homophily and likelihood of selecting the avatar for future interactions.

Viewers ($N = 310$) were undergraduate students at a large public University in the Northeast and received extra credit for

participating. Their age ranged from range of 18-24 (100%; $M = 19$); 46.3 percent of viewers were male.

5.1 Procedure

Viewers were directed a website where they gave their consent to participate and completed a pre-test questions. Participants were randomly assigned to either a masculine or feminine avatar condition. Realism and anthropomorphism were held constant and only the gender of the avatar was manipulated. Both the masculine and feminine avatar used the same template image with the same message and information. As shown in Figure 1, The female dog had a pink collar and longer eyelashes and was named “Roxy”, whereas the male dog had a black, spiked collar and was named “Rocco.” After viewing the blog, participants were taken to an online questionnaire. The avatar that had been on the blog was depicted on the questionnaire and participants were asked to rate their perceptions of the avatar on anthropomorphism, masculinity, realism, competence, trustworthiness, homophily, and their likelihood of choosing such an avatar for future interactions and were debriefed.



Figure 1 Avatars used in study: Roxy and Rocco

5.2 Measures

Item quality was assessed with confirmatory factor analysis (CFA). Three criteria were imposed on items: homogeneity of content, internal consistency, and external consistency. Internal consistency was examined through standard score coefficient alpha reliabilities. Three sets of items were used to examine the premessage topic evaluation sequence: participant identity, computer use, and computer efficacy. Seven sets of items were used to assess postmessage evaluations of avatars.

5.2.1. Participant identity. Two variables were used as indicators of participant identity – age and masculinity. Age was measured with an open-ended question. The masculine

gender measure consisted of two 7-point bipolar adjectives that ranged from not masculine to masculine and not feminine to feminine ($\alpha = .95$).

5.2.2. Computer Use. Use of various applications was measured with 10 items on a 7- point metric that ranged from “Never” to “Constantly.” As in [15], the items coalesced along distinct dimensions. Four first-order factors emerged: Basic Internet ($\alpha = .51$), file sharing ($\alpha = .77$), gaming ($\alpha = .63$), and cyber collectives ($\alpha = .59$). The 3-item basic Internet scale consisted of reading websites, instant messaging, and email. The 2-item file sharing scale consisted of file sharing and music downloading. The 2-item gaming scale consisted of playing online games and offline games. The 3-item cyber collective scale consisted of participating in online forums, virtual worlds, and chat rooms. Analysis indicated that the first-order factors of file sharing, gaming, and cyber collectives formed a second-order factor of advanced Internet use ($\alpha = .73$).

5.2.3. Computer efficacy. The efficacy with which a person uses computers was measured with 10 Likert-type items on 7- point metric that ranged from “Strongly Disagree” to “Strongly Agree.” As in [17], the items coalesced along distinct dimensions. Two factors emerged: technical efficacy ($\alpha = .85$) and user efficacy ($\alpha = .81$). The seven technical efficacy items included: “I understand terms describing computer hardware”, “I am good with computers”, “I understand how computers work”, “I feel confident in my ability to trouble shoot computer problems”, “I can usually explain why a computer is not working”, and “I know more than average about computers and the Internet”. The three user efficacy items included: “I have a strong understanding of the internet”, “With the right training and tools, I could do almost anything with computers and technology” and “I am able to learn and use most computer programs.”

5.2.4. Perceived avatar masculinity. Perceived avatar masculinity was measured with a 2 item 7-point semantic differential scale [9]. The two items were *not masculine/masculine* and *not feminine/feminine* ($\alpha = .96$).

5.2.5. Perceived avatar anthropomorphism. Viewer perceptions of avatar anthropomorphism were measured with a three-item, 7-point Likert scale that ranged from “Not at all” to “Very much” ($\alpha = .74$). Items included “does this image look human”, “does this image have human features”, and “does this image have human expressions” [7].

5.2.6. Perceived realism. Viewer perceptions of avatar realism were measured with a four-item, bipolar adjective scale that ranged from *Not at All (1)* to *Very Much (7)*. The four items ($\alpha = .70$) included *Real/Not Real*, *Cartoon-like/photorealistic*, *Natural/Artificial* and *Do you think this*

image could possibly exist outside the computer screen: Possible/Impossible.

5.2.7. Avatar credibility. The credibility of the avatar was measured with four 7-point bipolar adjectives that formed a competence scale ($\alpha = .81$) and a trustworthiness scale ($\alpha = .92$). The two items on the competence items were *intelligent/unintelligent* and *competent/incompetent*. The two items on the trustworthiness scale were *trustworthy/untrustworthy* and *reliable/unreliable*.

5.2.8. Avatar homophily. Viewer appraisal of the homophily with the avatar was measured with a modified scale from [37, 38]. The four items were in a 7-point format that ranged from *not at all* to *very much* ($\alpha = .88$). The four items included: *this image is like me*, *this image is similar to me*, *how much do you identify with this image*, *does this image represent something in you*.

5.2.9. Likelihood to choose. Likelihood to choose the avatar was measured with nine, 7-point Likert items ($\alpha = .94$). Items included such questions as: *How likely is it that you would choose this image to represent you in an online social interaction with friends?* *How likely is it that you would choose this image to represent you in an online social interaction with your parents?*

5.2.10. Gender discrepancy. The absolute value of the difference between the masculine gender measure and the perceived avatar masculinity was taken as an indication of gender discrepancy. Larger values of gender discrepancy should correlate negatively with sex match and homophily.

6. Results

Before testing the process discussed above, a manipulation check was conducted for the effect of manipulated maleness on perceived masculine gender.

6.1 Manipulation Check

The manipulated maleness variable was effect coded so that it ranged from -1 (female) to 1 (male). The perceived masculine gender scale was the average of the perceived image masculinity item and the perceived image femininity (reverse scored) item, with a range from 1 to 7. The male avatar was perceived as more masculine ($M = 5.82$, $SD = 1.23$) than the female avatar ($M = 1.76$, $SD = 1.07$). This difference was quite large ($r = .87$), $t(267) = 28.68$, $p < .001$. Thus, the avatar maleness manipulation generated massive differences in perceived masculine gender. The manipulated maleness variable did not produce any differences on realism, $t(262) = 1.06$, $p = .66$; nor did it produce any differences on anthropomorphism, $t(267) = -.92$, $p = .11$.

6.2 Test of the Proposed Causal Model

The seven variables in the topic (task) evaluation sequence, the four variables in the message evaluation sequence, and the six variables in the source evaluation sequence were correlated. Based on the predictions outlined above, four types of effects were anticipated. The hypothesized model was tested with the causal modeling program PMOD. The test of the proposed model can be found in Figure 2. The model showed good fit with a Root Mean Squared Error (RMSE) of .06, $\chi^2(100, 310) = 57.23$, $p < .42$.

6.2.1 Task evaluation sequence. Basic Internet use led to more advanced Internet use ($\rho = .27$) and technical efficacy increased user efficacy ($\rho = .73$). These effects reflect the pattern of users graduating from simpler applications to more complex applications. Male sex enhanced technical efficacy in two ways. First, male sex led to masculine gender ($\rho = .87$), with masculine gender increasing technical efficacy ($\rho = .20$). Second, masculine gender led to more advanced Internet application use ($\rho = .28$), with advanced Internet use increasing technical efficacy ($\rho = .28$). Finally, age increased technical efficacy ($\rho = .08$). All seven of the effects shown in Figure 2 were as predicted. The size of the effects shown in Figure 2 were within sampling error of those observed in [17].

6.2.2. Source evaluation sequence. We began by considering the hypothesized process model described above and based on the process model reported by [17]. The data are consistent with the proposed sequence. As predicted, there was variation on perceptions of realism and anthropomorphism, though these were visually held constant by using the same avatar. Also, perceived anthropomorphism increased competence ($\rho = .18$), with competence increasing trustworthiness ($\rho = .77$). Perceived anthropomorphism increased realism ($\rho = .23$). The observed source evaluation effects were smaller than anticipated.

There was one effect that was not predicted: realism increased competence ($\rho = .16$). Despite the massive size of the effect of manipulated avatar sex on perceived avatar masculinity ($\rho = .89$), avatar masculinity did not have the predicted impact on perceived gender discrepancy.

6.2.3. Message evaluation sequence. Gender match did have a positive effect on homophily, as predicted. Gender discrepancy had a negative effect on homophily ($\rho = -.75$) that was larger than expected. Gender discrepancy did inhibit selection of the avatar. Gender discrepancy had a moderate negative effect on assessed homophily ($\rho = -.23$), with homophily increasing the likelihood of selection ($\rho = .33$) and there was a direct effect of gender discrepancy on likelihood of selection ($\rho = -.14$).

Interface effects. Both of the effects of source evaluation on message evaluation were observed. First, perceptions of realism increased homophily ($\rho = .26$). In addition, perceived

anthropomorphism had a direct positive effect on homophily ($\rho = .22$) that was not mediated by realism. Second, trustworthiness increase likelihood of selecting the avatar ($\rho = .24$). The effect of homophily on competence was also observed ($\rho = .11$).

6.2.4. Interface effects. There was no evidence that computer use directly influenced perceptions of

anthropomorphism or realism. Instead, there was a negative effect of user efficacy on perceptions of realism ($\rho = -.10$). Hence, computer use indirectly influenced realism.

As predicted, realism increased homophily ($\rho = .26$). Unexpectedly, anthropomorphism also influenced homophily ($\rho = .22$).

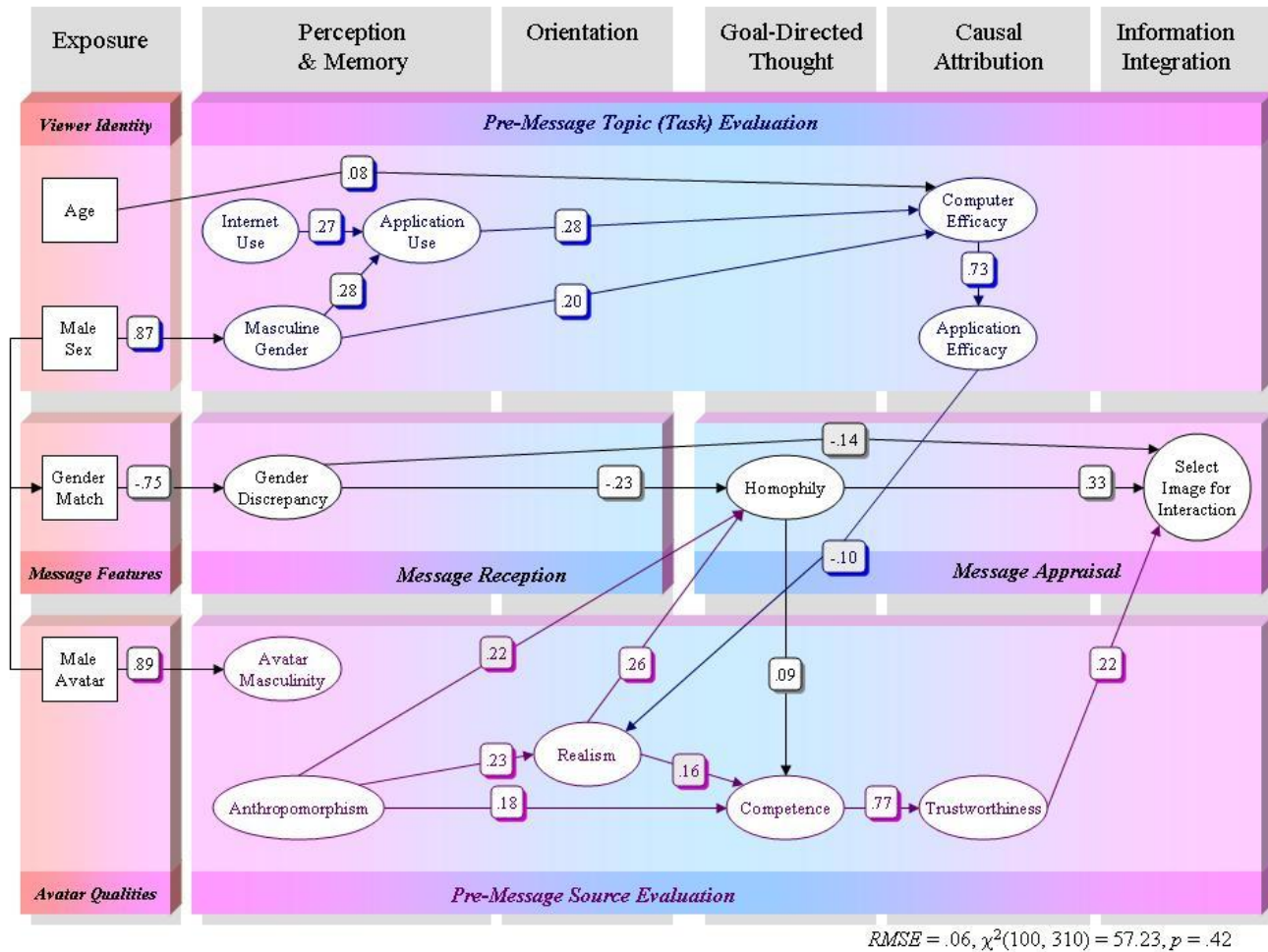


Figure 2: Test of Proposed Model

7. Discussion

The processing of avatars follows the process predicted by information processing theory. Essentially, visual stimuli attracted attention and influenced judgments about both the visual presentation and the unseen source of the communication [14, 12]. These results support the prediction that perceptions of the avatar’s visual characteristics are stimulating the categorization process, though individual differences influence these perceptions. In turn, these

categorizations are influencing judgments about the avatar and the source behind the representation. This study replicates previous findings that avatar characteristics of perceived gender, anthropomorphism, realism and homophily influence judgments of avatar credibility and the likelihood of choosing that avatar [7, 8, 15].

This study shows that it is the perception of anthropomorphism or realism that influences judgments of the avatar and source. Perhaps more importantly, it shows that individual perceptions of the anthropomorphism and realism of

same avatar vary widely. Similarly, perceived anthropomorphism directly influenced perceptions of homophily, meaning that individuals perceived those entities with human qualities to be like them in some way; this perceived likeness can then elicit high expectations and processing reserved for intelligent others.

Consistent with past findings, perceptions of an avatar as anthropomorphic were found to influence the perception of its realism [7, 8, 14, 26]; hence, categorizing some thing as having human qualities translates into being perceived as more realistic. These data indicate that social potential is also influencing perceptions of the realistic nature of the entity [27, 23]).

In addition, perceptions of anthropomorphism and realism both directly influence avatar credibility. This may be attributed to the individual's need to orient toward social objects. Although avatars are increasingly common in online environments, they are still new in comparison with the offline world where judgments of realism are not applicable.

In the offline world, the realistic quality of an object is not questioned, and communication partners are almost always human. However, online people can represent themselves as non-human entities and can vary the realistic nature of the presentation. Hence, those representations that are perceived to have a more realistic quality and more human-like are judged to be more credible because they better approximate the offline world and may help create a sense of certainty about the environment and the interaction.

This is also reflected in the finding that both avatar homophily and competence influence likelihood to choose, with homophily mediating much of this process. This is consistent with previous findings that indicate that people want to be represented by images that are both credible but represent an image with which they can identify [15].

As predicted, perceptions of the avatar did influence perceptions of the source of the communication. This result not only points to the influence of visual characteristics on the person perception process but that this process is also occurring online as people use the avatar characteristics to make subsequent judgments about the source of the communication.

Conclusions

The results from this study are consistent with past findings [7, 8, 14, 26]) that people categorize the avatar into gender, anthropomorphic, and realistic categories and that those categorizations then impact judgments about the avatar, including homophily, credibility and likelihood to choose. Extending previous results, these data show that judgments about the avatar influence judgments about the source of the communication; this process has been found in both static and dynamic communication environments, indicating that the process is robust across communication contexts.

The influence of individual differences, related to computing technology efficacy and use, that previous work

found influenced the perceptual process was not replicated with these data. This result could simply be due to sampling error or the previous findings may have been the result of some artifact. Further testing should be done to better understand this anomaly.

It is clear that people's perceptions of avatar homophily and credibility influence a user's choice of avatar; what is not clear is whether this process depends on context. Past research indicates that people perceive online communication and communication partners differently across communication context variations, including anticipated future interaction and goal of communication (task/interpersonal) [39]. Future research should explore the user's choice of avatar in various communication contexts to better understand the process.

Finally, researchers and developers should be aware that variation in avatar characteristics may not be perceived similarly by users across contexts. While both realism and anthropomorphism were held constant in this study, there was considerable variability in participants' assessment of the realism and anthropomorphism of the avatars. Thus, the perception of these characteristics drove the effects and accounted for variation in other variables. Which variables are responsible for these individual differences is unknown and is an important area for future research.

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