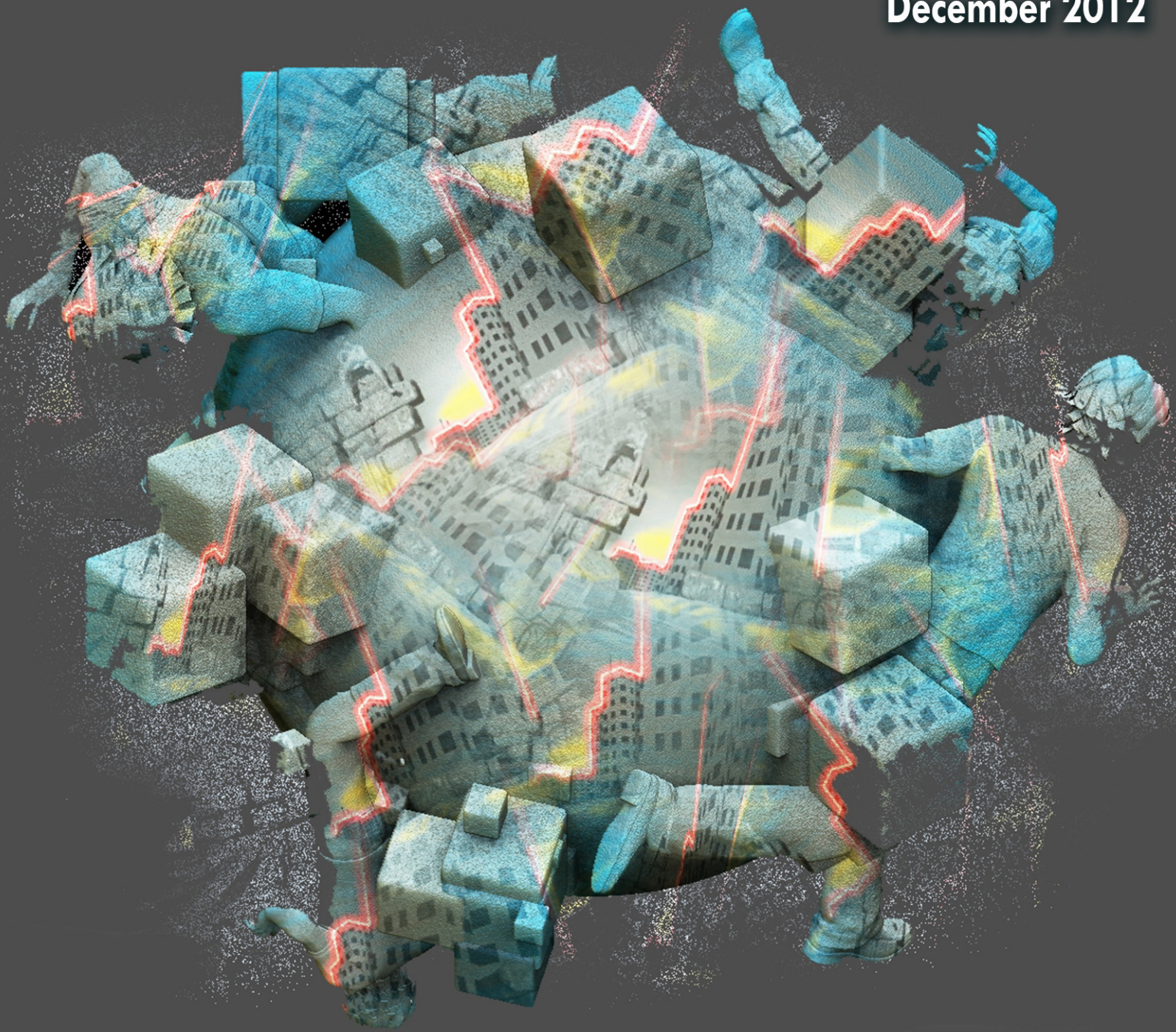
Journal of
Virtual Worlds Research
jvwresearch.org ISSN: 1941-8477

Managerial and Commercial Applications

Volume 5, No. 3
December 2012



Art: ©Tammy Mike Laufer; http://tammymikelaufer.com

Volume 5, Number 3
Managerial and Commercial Applications
December 2012

Journal of Virtual Worlds Research
jvwresearch.org ISSN: 1941-8477

Volume 5, Number 3
Managerial and Commercial Applications
December 2012

The Cowl Makes the Monk: How Avatar Appearance and Role Labels Affect Cognition in Virtual Worlds

Jorge Peña
Matthew S. McGlone
University of Texas at Austin, USA

Joe Sanchez
Rutgers University, NJ, USA

Abstract

This study examined how avatars influence operators in stereotype-consistent ways. Participants controlled formally or glamorously dressed avatars, and then created stories. Half of the participants heard a comment about the likely role of the avatar based on its looks (e.g., professor, supermodel). An automated linguistic analysis uncovered that participants using formally dressed avatars referred more to education, books, and numbers. Conversely, participants using glamorously dressed avatars used more words related to sports, entertainment, clothes, and beauty. Also, glamorously dressed avatars with a supermodel role elicited brands, exotic names, and age concerns, but the same avatar with no role stimulated descriptions of people and locations. The findings fit the assumptions of priming models and illustrate the additive effects of avatar appearance and role on users' cognition.

1. Introduction

One fundamental issue for virtual environment research is establishing how individual users make sense of their own avatar and how that process influences users' subsequent cognitive, emotional, and behavioral responses. In this context, the present study focuses on the predictions of priming models (Bargh & Chartrand, 1999; Collins & Loftus, 1975; Neely, 1977). Priming is said to occur when one thinks, acts, or feels in ways consistent with situational cues without the intention of doing so or the awareness of having done so (Bargh, 1994; Berkowitz, 1984). From this perspective, incidental elements that are salient in one's perceptual field should augment the probability of acting in accordance with the associations attached to those elements with no need for conscious thought (Bargh et al., 1996a).

Based on this approach, the appearance and role of one's own avatar is expected to draw forth associations that help users make sense of their virtual persona but may also bring other concepts to mind. For example, a "supermodel" avatar may prime the user with the concept of "exclusive brands." Fashion models tend to be young, and thus a "supermodel" avatar can also elicit less obvious thoughts such as "age" and "aging." Along these lines, a "professor" avatar may bring forth the evident connection to "education" among students but it may also remind them of a busy day at school. These associations might occur while users remain unaware of how their avatar brought such thoughts to mind (Peña, Hancock, & Merola, 2009).

Beyond providing further evidence of the unconscious effect of avatar features over users' cognition, the study's main goal is to extend the research on avatar outward form effects by examining the relative influence of avatar appearance and role on users' thoughts. Consider that previous studies might have confounded the priming effects of avatar appearance and role label by manipulating both factors simultaneously. In a recent study, the experimenter explicitly said to the participants "I'm not much of a designer; this thing came out looking kind of like a Doctor/Ku Klux Klannish/Transparent" (Peña et al., 2009, Experiment 2). This statement possibly enhanced the influence of avatar appearance as a visual prime by adding a role label. In order to separate these processes, the present study reviews the assumptions of the automaticity model of priming effects and outlines an experiment that examines the independent and additive role of avatar appearance and role label. Participants will use a female avatar dressed in gray business attire (a "professor", when a verbal label is present) or the same female avatar wearing a more fashionable red skirt (a "supermodel", when such verbal label is present). This study analyzes the stories that participants wrote about their avatar under these conditions. The following section describes priming models and their connection to the effects of avatar appearance on users.

1.1 The Automaticity Model of Priming Effects

Most social concepts can be primed and, consequently, this area of research has expanded from early studies on social perception to newer research investigating more complex priming effects on thoughts, feelings, and behaviors (Bargh, 2006). Priming mechanisms are also

influential in explaining the effects of violent video games (Bushman & Anderson, 2002; Farrar, Krcmar, & Nowak, 2006). Research examining the effects of violent video games rests on the assumption that aggressive cues (e.g., guns, blood) increases subsequent violent cognitions and behaviors (Bushman & Anderson, 2002).

The automaticity model summarizes and widens earlier research. The model proposes a perception-behavior link in which perceptual activity elicits thoughts, feelings, and action with low degrees of awareness, intention, and personal control but high efficiency (Bargh, 1994). In support of this view, participants primed with the stereotype of "professors", a group related to the concept of "intelligence", performed better in a subsequent general knowledge task in comparison to those primed with the stereotype of "supermodels", which is less related or even unrelated to "intelligence" (Haddock, Macrae, & Fleck, 2002). In addition, exposure to positive and negative concepts activated all other similarly evaluated concepts. Priming the positively evaluated word "priest" facilitated pronunciation of the positively evaluated word "fur", implying that priming effects are predicated on *shared evaluative valence processes* (Bargh, Chaiken, Raymond, & Hymes, 1996). Priming a specific concept activates all other positive and negative thoughts stored in memory, even if they share no other semantic feature other than positive or negative valence (see Bargh et al., 1996b). Environmental cues will also initiate *spreading activation effects*. For instance, priming one concept (e.g., "professor") can spread and activate linked ideas (e.g., "education") depending upon the number of common features and the strength of the relationship between concepts (Collins & Loftus, 1975; Neely, 1977).

The main difference between shared evaluative valence and spreading activation processes is that the former describes priming effects in which one concept activates all similarly evaluated concepts (e.g., "Dentist" can also activate seemingly unrelated concepts such as "Army" because both concepts share a negative valence), while the latter expects that concept activation depends on the number of features held in common and the strength of the relationship (e.g., "Dentist" should only activate concepts such as "cavity", "toothbrush", etc.) (Bargh et al., 1996b). The following section reviews studies that have applied automaticity and priming principles to examine the influence of avatar appearance on user's cognition and behavior.

1.2 The Automatic Priming Effects of Avatars in Virtual Settings

Building upon evidence that dark uniforms (Frank & Gilovich, 1988) and KKK outfits (Johnson & Downing, 1979) can elicit aggressive behaviors in wearers, a recent study hypothesized and confirmed that avatar appearance can operate as a prime for aggression. For instance, in virtual group discussions, participants using avatars in dark robes reported more aggressive intentions and attitudes in comparison to those using white-cloaked avatars (Peña et al., 2009, Experiment 1). Also, as indicated above, individual participants using a KKK avatar composed more aggressive stories in comparison to a control group using a transparent avatar (Peña et al., 2009, Experiment 2). The study's manipulation checks revealed that the vast majority of the participants remained unaware of the aims of the study, thus implying that the effect of avatar appearance was unconscious in nature.

Though these results are promising in that they show how priming is a key mechanism underlying the Proteus effect, one concern with the study by Peña and his associates (2009) is the use of compound priming manipulations. As mentioned above, participants were not only presented with a visual prime (i.e., avatars with a KKK or doctor-like appearance), but also with a verbal prime (i.e., the "KKK" or "doctor" role label mentioned by the experimenter). These manipulations should work additively, such that the joint effects of the visual prime with a congruent verbal label should be stronger than each independent prime (see Hutchison, 2003; Klauer & Musch, 2003). For example, role theory would expect a verbal label with a defined social function (e.g., "doctor") to increase expectancies about behaviors or identities to which the participants may adhere (Biddle, 1986). Below we outline the present study.

2. The Present Experiment

The priming model outlines conditions in which an avatar's appearance and role should affect the operator's ensuing thoughts and actions. These predictions will be tested by activating social stereotypes that have been featured in previous studies. As noted above, priming the "professor" stereotype among study participants resulted in comparatively better performance than priming with the stereotype of a "supermodel" (Haddock et al., 2002). In the present study, participants will be invited to use a female avatar dressed in gray business attire (a "professor", when a verbal label is present) or the same female avatar wearing a more fashionable red skirt (a "supermodel", when such verbal label is present).

The present study will collect evidence for the priming effects of avatar appearance and role on participants' cognitions unobtrusively by analyzing the language they use to craft spontaneous stories. Automated linguistic analysis is one reliable method to examine the communicational and psychological processes involved in electronic interactions (Gonzales & Hancock, 2008; Oberlander & Gill, 2006; Pennebacker, Mehl, & Niederhoffer, 2003). Although this procedure is not as subtle as other available subliminal priming methods (see Bargh & Chartrand, 2000), this approach is less obvious than using think-aloud techniques while using an avatar (e.g., Vasalou, Joinson, Banziger, Goldie, & Pitt, 2008) or asking participants to rate avatars using paper-and-pencil scales (e.g., Nowak & Rauh, 2005). In addition, the analysis of unplanned language use in participants' stories is theoretically more relevant to the present study than alternative methods. As noted, this study relies on the assumption that avatar features, unconsciously activate associations along a network of semantically related ideas, as predicted by semantic memory models which posit these social concepts are represented in memory as linguistic categories (Collins & Loftus, 1975; Neely, 1977).

Along these lines, it is important to highlight that the present experiment is akin to conceptual and semantic priming studies because it employs a language use task conducted while participants operate an avatar in third-person view. According to Bargh and Chartrand (2000), in conceptual and semantic priming studies, participants can be aware of what they perceived (e.g., an avatar), but should remain unaware of the influence of what was perceived on their subsequent cognitions, emotions, and behaviors (e.g., language use in stories.) Thus, for conceptual and semantic priming studies, participants' awareness of influence is more critical to

control than participants' awareness of exposure to a given experimental prime (Bargh & Chartrand, 2000). On this point, Bargh and Chartrand (2000) argued that if participants remain unaware of the intended effect of experimental manipulations (e.g., avatar appearance and role labels and their intended effects on language use), then researchers can more confidently conclude that priming mechanisms are driving the observed effect. Considering this, the present study utilizes a cover story and a manipulation check to elucidate individual participant's awareness level.

To summarize, if automatic priming along a semantic network of concepts is associated with how users make sense of their own avatar, then we should expect avatar appearance to exert spreading activation effects on participants' cognition such as that:

H1 When writing stories, participants controlling formally dressed avatars will spontaneously make more references to stereotype-consistent concepts than those using glamorously dressed avatars.

H2 When writing stories, participants controlling glamorously dressed avatars will spontaneously make more references to stereotype-consistent concepts than those using formally dressed avatars.

In an attempt to improve upon previous research (e.g., Peña et al., 2009), participants in the present study will be either assigned to experimental conditions, presenting a role label that is congruent with the avatar's appearance (e.g., "professor" when the avatar is dressed formally, "supermodel" when the avatar is dressed glamorously), or to experimental conditions with no verbal label for the avatar. Based on principles derived from the automaticity model of priming effects it is expected that:

H3 When writing stories, participants controlling formally dressed avatars with a "professor" role label will make more unplanned references to stereotype-consistent information (e.g., education) than those using formally dressed avatars with no label.

H4 When writing stories, participants controlling glamorously dressed avatars with a "supermodel" role label will make more unprompted references to stereotype-consistent concepts (e.g., exclusive brands) than those using glamorously dressed avatars with no role label.

3. Method

3.1 Participants

97 students enrolled in communication courses in a large Southwestern university volunteered to participate in the study for extra course credit. On their arrival to the laboratory they were randomly assigned to one of the visual ("formally" versus "glamorously" dressed avatar) and verbal ("professor" or "supermodel" role label versus no role label) priming

conditions. Thus participants partook in a 2 x 2 factorial experiment with a total of four conditions. Five participants were eliminated from the analysis because they were aware of the aims of the avatars and the experiment (see the Awareness check section). Therefore the present study had 92 experimentally naïve participants.

The majority of the participants (67%) were females. The participants were of Caucasian (60.8%), Asian (17.5%), Hispanic (12.4%), African American (6.2%), and Other (1%) racial heritage. The majority of the participants (85.6%) were native English speakers. The participants were 21.36 years old in average (SD = 2.55 years). Although the majority of the participants had ample years of experience using computers (M = 12.05, SD = 2.31 years), only 26 of them devoted some weekly time to playing video games. Among these, video game use ranged from 30 minutes to 20 hours per week.

3.2 Materials

The third author of this paper constructed the avatars and the virtual environment using Second Life, a popular online virtual world. The avatar looked like a thin and tall young woman. One version of the avatar was dressed in gray with formal, business-like attire; the other version of the avatar wore a more glamorous red skirt (see Figure 1). A pilot study (N = 46) using seven-point semantic differentials indicated that the avatar dressed in grey gave the impression of being more formal (M = 2.83, SD = 1.19) while the avatar dressed in a red skirt was comparatively perceived as more glamorous (M = 5.57, SD = 1.24), $t(44) = 7.65$, $p < .001$.

The virtual environment was minimal to prevent participants from getting lost or too distracted. Therefore the virtual environment consisted of a simple linear platform (see Figure 1). The avatar was placed at the entrance of the virtual platform. A mirror was placed close to the entrance of the platform.

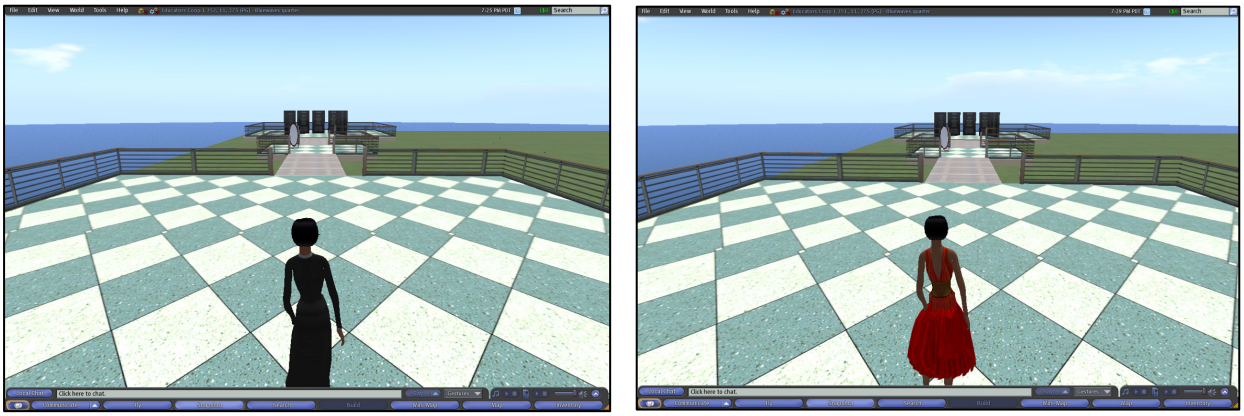


Figure 1: Experimental manipulations of avatar appearance (formal vs. glamorous).

3.3 Procedure

Individual participants took part in the experiment one at the time. Upon arrival to the laboratory the experimenter greeted the participants and showed them the experimental room. Participants were told that the study was a pilot test of unrelated materials for future research. No other explanations were given to the participants. The participants were given this cover story in order to prevent experimental demands and hypothesis guessing. The participants were then seated at a computer desk with an inactive monitor, a keyboard, and a mouse. A randomly assigned avatar was preloaded in the computer. The experimenter turned on the monitor after obtaining informed consent from the participant. This revealed the assigned avatar in third-person view. In the role label condition, the experimenter casually said "I'm not much of a designer; this thing came out looking kind of like a (professor or supermodel)" (see Peña et al., 2009). In the no-role condition, the experimenter did not comment about the avatar's appearance. Note that the verbal role labels were always congruent with the avatar's appearance. For instance, the avatar dressed formally was always referred to as "professor" while the avatar in glamorous attire was consistently labeled "supermodel."

The participants then received instructions on how to operate the avatar and how to compose text messages using their mouse and keyboard. After participants expressed comfort with the instructions they were invited to move their avatar to the front of the mirror and make a pose. This allowed the participant to more fully view their avatar (Eastin, 2006; Yee & Bailenson, 2007). The experimenter asked the participants to type a name for their avatar and press the enter key.

3.4 Tasks

After the participants provided a name for their avatar, they were invited to write a story about a day in the life of the avatar and to complete a mental rotation test. The stories were written in a word processor program. The order of these tasks was counterbalanced. The results of the mental rotation test are discussed in a different report. Recent studies have employed the writing task to prime racial stereotypes in participants (DeMarree, Wheeler, & Petty, 2005; Wheeler, Jarvis, & Petty, 2001). For example, DeMarree and collaborators (2005) asked participants to write stories about a day in the life of Tyrone Walker or Erik Walker, where Tyrone Walker was expected to prime an African American stereotype while Erik Walker was assumed to prime a Caucasian American stereotype. Instead of using storytelling as an experimental manipulation as in DeMarree and associates' (2005) research, the present study uses the writing task as a dependent measure to shed light on the cognitive effects of avatar appearance and verbal role more discreetly than alternative methods (e.g., Nowak & Rauh, 2005; Vasalou et al., 2008). Participants did not use their real names while composing stories; as a substitute they were given a handle (e.g., "Participant") to increase anonymity. The participants were given 10 minutes to compose their stories. Story transcripts were saved as a text file after the experiment was over.

The participants were then told that the study was over and invited to complete questions about their awareness of the manipulations in the experiment. Participants then logged in again to the computer to answer additional questions while in the virtual environment. These questions asked the participants to elaborate about their sense of embodiment during the experiment. Their responses are not reported here. Finally, the participants provided demographic information and were fully debriefed about the aims of the study.

3.5 Dependent measures

Participants' stories about a day in the life of their avatar were analyzed using WMatrix, a computer-based corpus analysis program (Rayson, 2008 a, b). WMatrix generates word frequency lists, compares part-of-speech tags or adjacent and related words in different corpora. It also analyzes semantic fields or key concepts contained in different text corpora (Rayson, 2008 a, b). WMatrix compares statistically significant pairwise differences in word usage between text corpora using log-likelihood ratios (Rayson, 2008b). WMatrix tags word usage into 453 semantic categories, and its semantic analysis tool is 92% accurate when analyzing text in English (Rayson, 2008a).

The lead author prepared participants' stories for linguistic analysis. This entailed deleting all avatar names created by individual participants, handles (e.g., "Participant"), timestamps, and Second Life system messages from the transcripts. Typos in the stories were corrected using a word-processing program. Text files containing all words generated in each experimental condition (e.g., formally dressed avatar, glamorously dressed avatar with "supermodel" role label, etc.) were uploaded to WMatrix to perform semantic analyses. These analyses compared the words and concepts used by the participants to craft stories in each of the four experimental conditions. Semantic analyses are particularly informative because the present study assumes that avatar appearance and role have spreading activation effects along a semantic network of related concepts.

4. Results

4.1 Awareness Check

The participants were asked whether they could guess the research hypotheses using procedures suggested by Bargh and Chartrand (2000). Two independent judges read and coded the participant's responses to the awareness checks using a forced choice measure (i.e., "Was the participant aware of the aim of the experiment or the purpose of their avatar?" 1 = Yes, 2 = No). The judges' classifications were in agreement for all (100%) cases. They classified 92 participants as unaware of the hypotheses and 5 as aware. All 5 participants classified as aware made explicit reference to the potential impact of avatar attributes on story content; 3 of these 5 also indicated that they had been told about the study hypotheses by a prior participant. As suggested by Bargh and Chartrand (2000) these participants were excluded from the analysis.

4.2 The Influence of Avatar Appearance in Language Use

WMatrix compared the relative number of words in the stories created in the experimental conditions with pairwise log-likelihood ratio (LL) analyses. The analysis automatically excluded word categories appearing less than five times. The present section only reports the results that achieved $p \leq .01$ level of statistical significance in order to represent the more conservative and robust effects. This is a more stringent criterion compared to the common convention of reporting results achieving $p \leq .05$ level of statistical significance. The results are reported using WMatrix's word categories *in italics*.

Did the avatars affect participants' language use in stories? One striking result was that participants in the formally dressed avatar condition more frequently used words related to *education in general*, $LL = 30.43$, $p < .000$), *books* (e.g., , $LL = 11.20$, $p < .000$), and *numbers* (e.g., $LL = 10.41$, $p < .001$) compared to those in the glamorously dressed avatar condition. Examples of *education* words include "class," "students," "school," "university," "professor." Examples of *book* words include "books" and "libraries." *Numbers* referred to "three," "8:30," and "eight-thirty." These results appear in Figure 2.

The formally dressed avatar also prompted participants to write stories with more words related to *time* and *frequency* than the glamorously dressed avatar ($LL = 7.98$, $p < .01$ and $LL = 7.14$, $p < .01$, respectively). Examples of *time* words include "begins" and "starts." Words related to *frequency* included "always" and "consistently." These findings appear in Figure 2.

On the other hand, participants assigned to the glamorously dressed avatar used significantly more words related to *sports* ($LL = 20.95$, $p < .000$), *entertainment* ($LL = 18.80$, $p < .000$), *clothes and personal belongings* ($LL = 17.25$, $p < .000$), and *colors* (e.g., $LL = 12.65$, $p < .000$) than those assigned to the formally dressed avatar. Examples of *sports* words include "gym," "sports," and "exercise." *Entertainment* words included "play," "entertaining," and "nightlife." *Clothes and personal belongings* words included "dressed," "clothes," and "shoes." *Colors* included "red," "black," and "teal."

The glamorously dressed avatar also prompted more frequent use of words such as "*decided*", $LL = 6.89$, $p < .01$, and also more words connected to *judgments of beautiful appearance* (e.g., nice, fancy, look presentable, $LL = 6.86$, $p \leq .01$) than did the formally dressed avatar. These results are summarized in Figure 2.

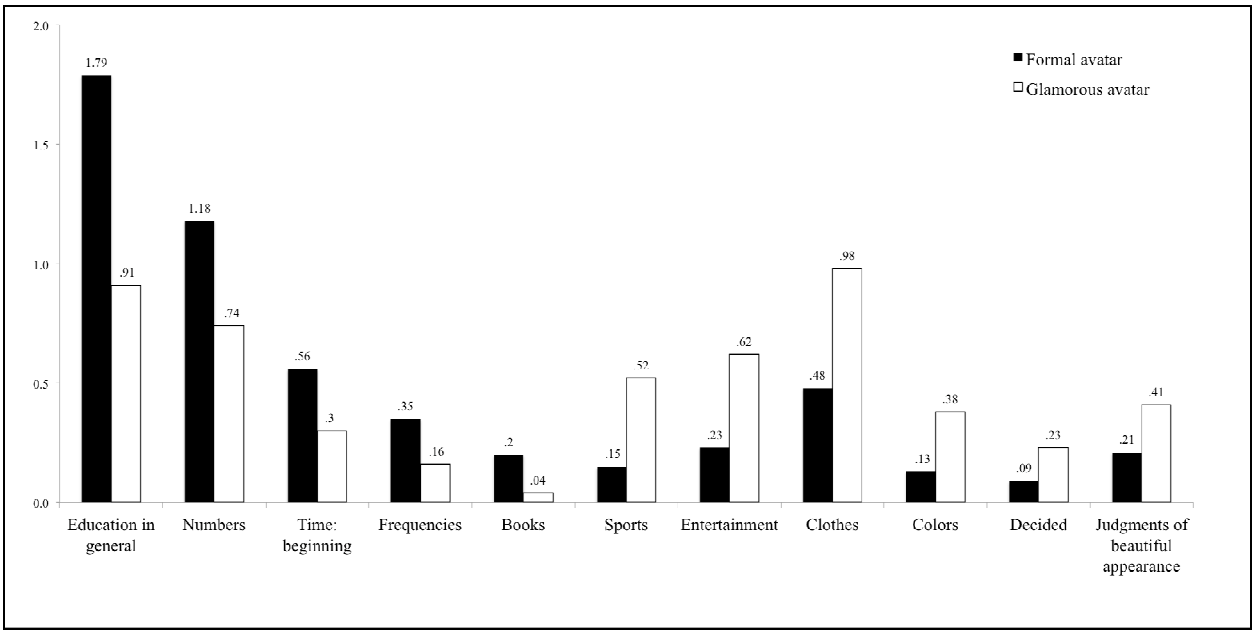


Figure 2: Relative frequencies of word usage in spontaneous stories as a function of avatar type (Y-axis represents frequency of word use.)

The results above supported H1 and H2. Participants used words related to the stereotypical associations linked to their avatar's appearance. Using the formally dressed avatar elicited stories with comparatively more words connected to education, books, numbers, frequent actions, and descriptions of timed activities. However, participants controlling the glamorously dressed avatar composed stories with more words connected to sports, entertainment, clothes and belongings, colors, and evaluations of beauty compared to participants controlling the formally dressed avatar.

4.2.1 The Influence of Avatar Appearance and Role Labels on Language Use

Did adding a verbal role label to the participants' avatar affect language use in stories? The question was investigated with a WMatrix analysis comparing the stories created in the formally dressed avatar with no label condition relative to the stories of participants in the formally dressed avatar plus role label condition. The question was also addressed by comparing the stories created in the glamorously dressed avatar with no role label condition relative to the stories of participants in the glamorously dressed avatar plus role label condition.

The results showed that adding a "professor" role label to the formally dressed avatar significantly affected participants' language use in stories. Participants in the formally dressed avatar plus role label condition used more words related to *education in general* (e.g., students, professor, $LL = 22.85$, $p < .000$), *food* (e.g., breakfast, lunch, dinner, $LL = 13.06$, $p < .001$), and *approximators* (e.g., about, around, $LL = 8.51$, $p < .01$) relative to participants in the formally dressed avatar with no role label condition. In comparison, participants in the formally dressed

avatar with no role label condition used more *personal names* (e.g., Kate, Susie) and *sales and business* words (e.g., marketing, shopping) (LL = 14.08, $p < .001$ and LL = 7.78, $p < .01$, respectively). These results appear in Figure 3.

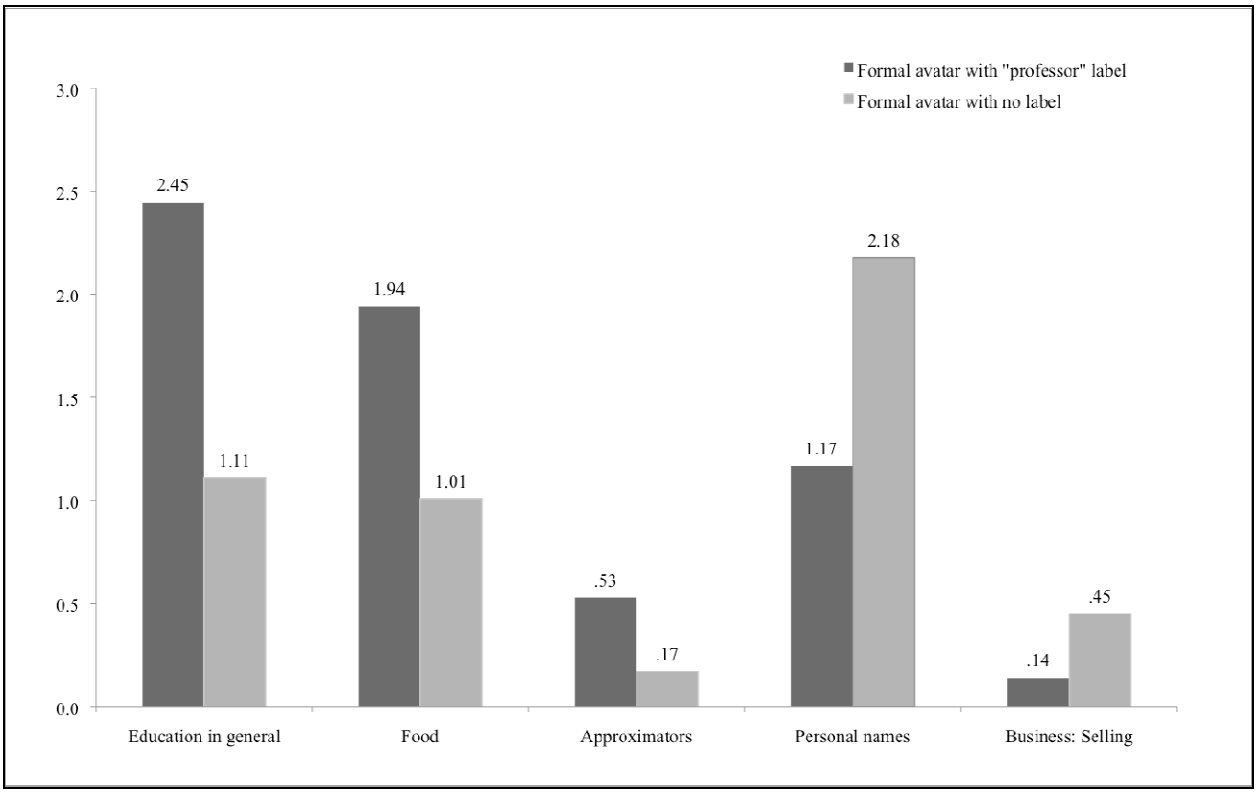


Figure 3: Relative frequencies of word usage in spontaneous stories as a function of avatar type (Y-axis represents frequency of word use.)

Overall, the results suggest that adding a verbal role label to an avatar affected participants' language use. For instance, adding a "professor" role label to the formally dressed avatar increased the use of words connected to education, attempts at crafting approximate descriptions of a character's everyday routine, and sequential food habits in comparison to participants in the formally dressed avatar with no label condition (e.g., *then* she grabbed *lunch* and went to her *next class*). In contrast, participants using the formally dressed avatar with no role label created stories about the office life of a woman (e.g., Kate) that has a business job and/or goes shopping. These findings show some support for H3.

Finally, adding a "supermodel" role label to the glamorously dressed avatar significantly affected participants' language use in stories. One indicative result was that participants in the glamorously dressed avatar plus role label condition employed more words such as "Yvette", "Ava", "Supermodel", "Dolce & Gabbana", and "haute couture" in comparison to those in the glamorously dressed avatar with no label condition, LL = 19.23, $p < .000$. WMatrix has no category for this pattern of word usage and, therefore, the program fitted them into the

unmatched category (i.e., exotic words, in Figure 4). Also, participants in the glamorously dressed avatar plus role label condition employed more words related to *time: old, new and young, and age* (e.g., one, date, age, $LL = 7.83$, $p < .01$). On the other hand, participants in the glamorously dressed avatar with no label condition used significantly more words connected to *people* (e.g., people, person, children) and *locations and directions* (e.g., this, around) in comparison to participants in the glamorously dressed avatar plus role label condition ($LL = 12.02$, $p < .001$ and $LL = 6.65$, $p < .01$, respectively). The results are summarized in Figure 4.

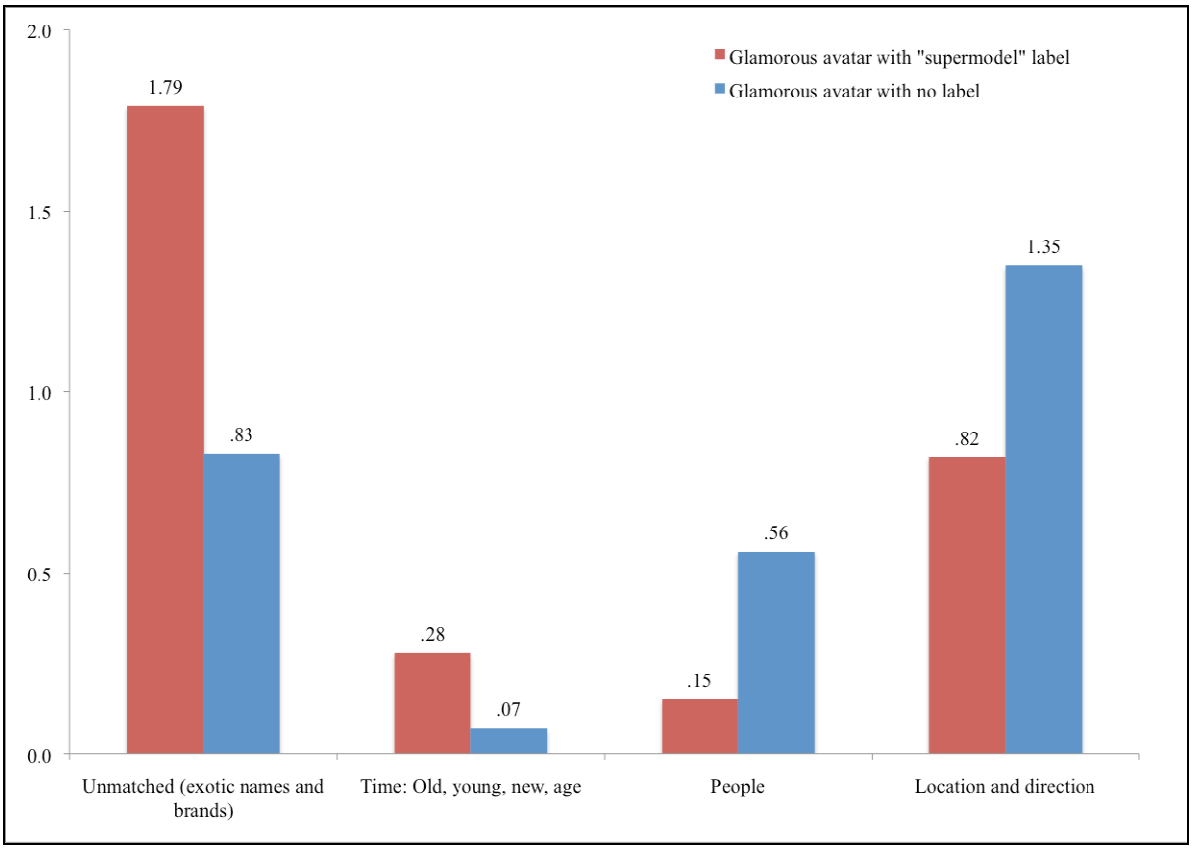


Figure 4: Relative frequencies of word usage in spontaneous stories as a function of avatar type (Y-axis represents frequency of word use.)

Overall, adding a "supermodel" label to the glamorously dressed avatar primed the use of exotic names, brands, and words concerning age. In contrast, participants using the glamorously dressed avatar wrote stories about the people and locations in the social activities of a woman. The results supported to H4. Below we discuss the implications of the findings.

5. Discussion

An automated corpus analysis of the stories that participants wrote about their randomly assigned avatars revealed how avatar appearance and role independently and additively exerted

priming effects over users' cognition. Participants using a formally dressed avatar generated significantly more words connected to education, numbers, books, and frequent activities than those using a glamorous avatar, while participants using a glamorously dressed avatar used more words linked to sports, entertainment, clothes, and judgments of appearance relative to those using a formally dressed avatar. This shows how users' virtual self-representation can reliably influence their cognition as evidenced by spontaneous language use.

One theoretical explanation for the present findings is that avatar appearance and role label primed associations along a semantic network of concepts (Collins & Loftus, 1975; Neely, 1977). For instance, using a formally dressed avatar with a "professor" role label primed the concept of "education". However, the formally dressed avatar with a "professor" label also elicited words describing frequent daily habits in the life of students (e.g., *First*, she wakes up and eats *breakfast* and *then* she goes to *class around* 9am) in comparison to the same formally dressed avatar with no role label. This suggests that the "professor" avatar not only reminded participants of the stereotype of professors, but that it also activated student's own concerns about life in college. This finding may connect to shared evaluative valence effects in which specific primes activate a gamut of loosely related concepts with a similar valence (Bargh et al., 1996b). Consider that one thing "education", "food" and "linear activities" all have in common is that these concepts pertain to student's routine activities. Along these lines, the "supermodel" avatar increased the use of references to unique brands ("Dolce & Gabbana"). The avatar dressed glamorously with a supermodel label also had less predictable effects such as increasing the use of exotic names and words representing age concerns in comparison to participants using the same avatar with no label.

On the whole, avatar visual appearance and role labels had unconscious effects over participant's language use. For example, the awareness check assured that the participants in the analysis above were unaware of the aims of the experiment. This is not surprising because the study used a cover story to minimize participants' attention to the avatars. In addition, the experiment included many subsequent tasks and lasted one hour, perhaps making it more difficult for participants to connect the manipulations to the intended effects. Overall, visual and verbal avatar primes operated at the unconscious level because participants remained uninformed of the effect and reported no intention to comply with the goals of the study (Bargh, 1994, 2006).

The methodology employed in this study also contributes to the literature on how to evaluate users' perceptions of their avatars. The automated analysis of participants' spontaneous stories is one more instrument in the researcher's toolbox that complements the use of more overt measurement techniques such as paper-and-pencil scales (e.g., Nowak & Rauh, 2005) or think-aloud procedures (e.g., Vasalou et al., 2008). Automated linguistic analyses are reliable tools that help shed light on key processes in computer-mediated communication (e.g., Gonzales & Hancock, 2008; Oberlander & Gill, 2006). This study is also a significant improvement over previous efforts. The results were also obtained at more conservative levels of statistical reliability ($p < .01$) in order to guarantee the robustness of the automated linguistic analyses. Also, while previous studies simultaneously manipulated avatar appearance and role labels (e.g., Peña et al., 2009), this experiment disentangled the priming effects of avatar appearance and role label by allowing participants to operate the same avatar with and without a role label.

More generally, the findings also provide further proof for automatic priming as a fundamental explanation for avatar appearance effects (see Peña et al., 2009). From this perspective, a user's virtual self-representation can operate as a prime for the operator and thus facilitate specific cognitive, emotional, and behavioral patterns based on the activation of known associations and stereotypes stored in memory. A real world analog to this effect is the observation that uniforms influence wearers' cognition and behaviour, in predictable ways (Frank & Gilovich, 1988; Johnson & Downing, 1979). In virtual environments, this effect manifests itself as automatic cognition that is congruent with the associations raised by one's avatar. In conclusion, in virtual worlds the cowl does make the monk.

5.1 Limitations

One limitation of the present study is the existence of alternative explanations including Bem's (1972) self-perception theory as applied to virtual environments (Yee & Bailenson, 2007). This model proposes that avatar users observe their own behavior to infer the attitudes that provoked such behavior (Yee & Bailenson, 2007). However, this explanation cannot fully account for the present results because the boundary conditions for self-perception effects are simply not present in this experiment (see Bem, 1972). For instance, the participants were not asked to state newly formed attitudes based on behavior, nor displayed over justification effects in which a situation offering minimal external rewards, sparks high intrinsic interest while situations presenting maximal external rewards decreases intrinsic interest (Bem, 1972). Instead, the findings implicate priming mechanisms because the study adapted stereotype primes introduced in previous research (Haddock et al., 2002), the participants remained unaware of the influence of their randomly assigned avatar (Bargh & Chartrand, 2000), and the findings fit neatly within the predictions of mechanisms such as spreading activation and shared evaluative valence effects.

6. Conclusion

Avatar appearance and social role affect operators' thoughts in ways congruent with the stereotypical implications of such cues. While some of these associations were expected (e.g., a "professor" avatar reminding participants of "education", or a "supermodel" avatar reminding participants of exclusive brands), other effects were less predictable (e.g., a "professor" avatar reminding student participants of their own sequential activities in a busy day, or a "supermodel" avatar priming words representing age concerns). This evidence suggests that priming and automaticity assumptions are central mechanisms explaining cognition in virtual environments. Avatar features prompted coherent effects on users' cognition without raising their awareness. This research provides concrete implications for future studies examining how social cues in graphical virtual environments affect players' thoughts and actions, and also introduce empirically tested principles and tools that can guide the design and evaluation of the automatic effects of video games, virtual worlds, and simulation-based training programs.

References

Bargh, J. A. (1994). The four horsemen of automaticity: Awareness, efficiency, intention, and control in social cognition. In R. S. Wyer Jr. & T. K. Srull (Eds.), *Handbook of social cognition* (2nd ed., pp. 1-40). Hillsdale, NJ: Lawrence Erlbaum.

Bargh, J. A. (2006). What have we been priming all these years? On the development, mechanisms, and ecology of nonconscious social behavior. *European Journal of Social Psychology, 36*, 147-168.

Bargh, J. A., Chaiken, S., Raymond, P., & Hymes C. (1996). The automatic evaluation effect: Unconditional automatic attitude activation with a pronunciation task. *Journal of Experimental Social Psychology, 32*, 104-128.

Bargh, J. A., & Chartrand, T. L. (1999). The unbearable automaticity of being. *American Psychologist, 54*, 462-479.

Bargh, J. A., & Chartrand, T. L. (2000). The mind in the middle: A practical guide to priming and automaticity research. In H. T. Reis & C. M. Judd (Eds.), *Handbook of research methods in social and personality psychology* (pp. 253-285). NY: Cambridge University Press.

Bargh, J. A., Chen, M., & Burrows, L. (1996). The automaticity of social behavior: Direct effects of trait concept and stereotype activation on action. *Journal of Personality and Social Psychology, 71*, 230-244.

Bem, D. (1972). Self-perception theory. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 6, pp. 1-62). New York: Academic Press.

Biddle, B. J. (1986). Recent developments in role theory. *Annual Review of Sociology, 12*, 67-92.

Bushman, B. J., & Anderson, C. A. (2002). Violent video games and hostile expectations: A test of the general aggression model. *Personality and Social Psychology Bulletin, 28*, 1679-1686.

Collins, A. M., & Loftus, E. F. (1975). A spreading activation theory of semantic processing. *Psychological Review, 82*, 407-428.

DeMarree, K. G., Wheeler, S. C., & Petty, R. E. (2005). Priming a new identity: Effects of non-self stereotype primes and self-monitoring on the self-concept. *Journal of Personality and Social Psychology, 89*, 657-671.

Eastin, M. S. (2006). Video game violence and the female game player: Self- and opponent gender effects on presence and aggressive thoughts. *Human Communication Research, 32*, 351-372.

Farrar, K. M., Krcmar, M., Nowak, K. L. (2006). Contextual features of violent video games, mental models, and aggression. *Journal of Communication, 56*, 387-405.

Frank, M. G., & Gilovich, T. (1988). The dark side of self- and social perception: Black uniforms and aggression in professional sports. *Journal of Personality and Social Psychology, 54*, 74-85.

Gonzales, A. L., & Hancock, J. T. (2008). Identity shift in computer-mediated environments. *Media Psychology, 11*, 167-185.

Haddock, G., Macrae, C. N., & Fleck, S. (2002). Syrian science and smart supermodels: On the when and how of perception-behavior effects. *Social Cognition, 20*, 461-479.

Hutchison, K.A. (2003). Is semantic priming due to association strength or feature overlap? A microanalytic review. *Psychonomic Bulletin & Review, 10*, 785-813.

Johnson, R. D., & Downing, L. L. (1979). Deindividuation and valence of cues: Effects on prosocial and antisocial behavior. *Journal of Personality and Social Psychology, 37*, 1532-1538.

Klauer, K. C., & Musch, J. (2003). Affective priming: Findings and theories. In J. Musch & K. C. Klauer (Eds.), *The psychology of evaluation: Affective processes in cognition and emotion* (pp. 7-49). Mahwah, NJ: LEA.

Neely, J. H. (1977). Semantic priming and retrieval from lexical memory: Roles of inhibitionless spreading activation and limited-capacity attention. *Journal of Experimental Psychology: General, 106,* 226-254.

Nowak, K. L., & Rauh, C. (2005). The influence of the avatar on online perceptions of anthropomorphism, androgyny, credibility, homophily, and attraction. *Journal of Computer-Mediated Communication, 11*(1), article 8. http://jcmc.indiana.edu/vol11/issue1/nowak.html

Oberlander, J. & Gill, A. J. (2006). Language with character: A corpus-based study of individual differences in e-mail communication. *Discourse Processes, 42*, 239-270.

Pennebaker, J. W., Mehl, M. R., & Niederhoffer, K. (2003). Psychological aspects of natural language use: Our words, our selves. *Annual Review of Psychology, 54*, 547–577.

Peña, J., & Hancock, J. T., & Merola, N. A. (2009). The priming effects of avatars in virtual settings. *Communication Research, 36*, 838-856.

Rayson, P. (2008). *Wmatrix: A web-based corpus-processing environment*. Retrieved January 2, 2009, from Lancaster University, Computing Department Web site: http://ucrel.lancs.ac.uk/wmatrix/

Rayson, P. (2008). From key words to semantic domains. *International Journal of Corpus Linguistics, 13*, 519-549.

Vasalou, A., Joinson, A., Banziger, T., Goldie, P., & Pitt, J. (2008). Avatars in social media: Balancing accuracy, playfulness and embodied messages. *International Journal of Human-Computer Studies, 66*, 801-811.

Wheeler, S. C., Jarvis, W. B. G., & Petty, R. E. (2001). Think unto others: The self-destructive impact of negative racial stereotypes. *Journal of Experimental Social Psychology, 37,* 173–180.

Yee, N., & Bailenson, J. (2007). The Proteus effect: The effect of transformed self-representation on behavior. *Human Communication Research, 33*, 271-290.