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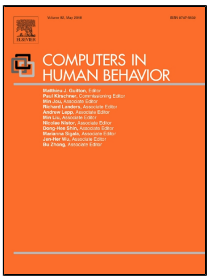

An Examination of Gender Differences versus Similarities in a Virtual World

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An Examination of Gender Similarities versus Differences in a Virtual World

Abstract

We derived competing hypotheses from the gender similarities perspective versus the gender differences perspective to examine participants' behavior in an online virtual world in which we manipulated participants' gender. To manipulate participants' gender in the virtual environment, we randomly assigned them to one of three avatars (female, male, or robot). Using a screen recording device, we measured the percentage of time participants spent interacting with empathizing (e.g., options for shopping, telephone) and systemizing (e.g., weapons, options for building) objects in a virtual reality house that we constructed to reflect evidence put forth by the differences perspective. Because we derived competing hypotheses we expected to find support for either the similarities perspective or the differences perspective; however, our results suggested support for both. Consistent with the differences perspective hypotheses, participants paid attention to objects in the environment that were consistent with the social representation of their own gender. However, our results were consistent with the similarities perspective hypotheses, such that the avatars' gender also played a role in the percentage of time participants spent interacting with empathizing and systemizing objects. Therefore, we conclude that observable differences between men and women are the consequence of both biological and social forces, and research should focus on the interaction between the two as etiologies and explanations for sex and gender differences and similarities.

Keywords: gender similarities, gender differences, virtual reality

1. Introduction

Virtual environments provide an innovative medium in which social research can occur, allowing researchers to manipulate participants' experiences (e.g., immerse them into new worlds, engage them in activities that were previously hindered by physical or ethical constraints) in ways that were impossible before such technology existed (e.g., Brainbridge, 2007; Blascovich & Bailenson, 2011; Fox, Arena, & Bailenson, 2009). As such, it can be used to test hypotheses derived from research on sex and gender similarities (which we will refer to throughout as the similarities perspective) and differences (which we will refer to throughout as the differences perspective) in novel ways. Our research seeks to empirically test the claims from these seemingly conflicting research perspectives. Accordingly, we manipulated participants' avatar gender to examine competing hypotheses derived from research on the similarities and differences perspectives to determine whether men and women share more similarities or differences in their social behavior in an online virtual world.

1.1. The Similarities and Differences Perspectives. Those who support the similarities perspective argue that the majority of observable differences between men and women are small, inconsistent, and products of socialization (Blackmore, Barenbaum, & Liben, 2009; Bluhm Jaap & Maibom, 2012; Fausto-Sterling, 2000; Fine, 2010; Fine 2012; Hyde, 1996, 2005, 2014; Marecek et al., 2004) or social pressures (e.g., stereotype threat; Steel & Aronson, 1995; Spencer, Steele, & Quinn, 1999). Noteworthy support for the similarities perspective is provided by Hyde's (2005) Gender Similarities Hypothesis, in which Hyde uses 46 meta-analyses, with 124 effect sizes from previous research on gender differences, to support her argument that men and women share more similarities than differences. A striking 78 percent of these previously reported gender differences consisted of small and insignificant effect sizes.

In contrast to the similarities perspective, Simon Baron-Cohen, a notable proponent of innate differences between men and women argues that, because of cerebral differences, women are better at empathizing and men are better at systemizing (Baron-Cohen, Knickmeyer, & Belmonte, 2005). Empathizing, according to Baron-Cohen, is the drive to understand others' emotions and respond to them accordingly, whereas systemizing is the drive to construct systems, analyze, and explore. From this reasoning, he derived three brain types: Type E (empathizing), Type S (systemizing), and Type B (balanced). According to this typology, those for whom empathizing is stronger than systemizing (a female brain) have a brain type of E. Those for whom systemizing is stronger than empathizing (a male brain) have a brain type of S. Finally, those for whom systemizing and empathizing are equal (balanced brain) have a brain type of B.

Baron-Cohen argued that, from birth, individuals pay attention to different aspects of their environment as consequences of their sex. He noted that, as children grow, boys play with building blocks and put things together; conversely, girls play with "dolls, jewelry, and dressing up" (2003, p. 29-30; 2005). To test this empirically, he argued that researchers simply make a choice of toys available and observe which toys the children choose (Baron-Cohen, 2003). According to Baron-Cohen, boys are more likely to choose systemizing toys (e.g., building blocks), and girls are more likely to choose empathizing toys (e.g., dolls). Thus, according to the differences perspective as represented by Baron-Cohen, the amount of attention men and women pay to different aspects of their environments provides the evidence for innate sex differences.

1.2. Virtual Reality. Importantly, while we are unaware of research that has specifically tested competing hypotheses derived from the conflicting similarities and differences perspectives, much research exists on sex and gender differences and similarities in virtual world

environments (e.g., Christy & Fox, 2014; Ha & Fang, 2018; Gagnon, Stefanucci, Creem-Regehr, & Cashdan, 2016; Tascon, Leon, Cimadevilla, 2016; Zhou, Jin, & Fang, 2014). Of particular importance to the current study, is research that has found individuals in virtual reality environments, such as Second Life, a fictional 3-D virtual world created entirely by its users (Linden Research, Inc. 2012), often behave in ways that are consistent with the "real world" social expectations of their avatars' genders (e.g., Cristofari & Guitton, 2014; Guadagno et al., 2011; Guitton, 2012, 2013, 2015; Lomanowska & Guitton, 2012, 2014). For example, when Guadagno et al., (2011) used Second Life, men and women using avatars reported behaving in ways that were consistent with traditional gender role expectations: women reported meeting more people and men reported building more of their own virtual property (e.g. objects). Thus, even in a virtual world in which many physical and social constraints no longer exist, individuals behave in ways that are consistent with the social norms or stereotypes associated with gender.

Importantly, while researchers estimate that most users create avatars that are consistent with their own gender (i.e., less than 25 percent of virtual world users create avatars of opposite gender; Ducheneaut et al., 2009), virtual reality still affords researchers the ability to study the effects of assigning participants avatars that are consistent and/or inconsistent with participants' own genders. Palomares and Lee (2010) randomly assigned gendered avatars to men and women and examined their subsequent use of gender-based language. They found that when the participants' gender matched the avatars, the participants used language typical of their own gender. However, when the participants' gender did not match the avatars, the participants used the typical language of the avatars' gender regardless of their own. This supports the similarities perspective in that social situations create differences between men and women, suggesting these differences are not innate. Had the differences been innate, it is more likely that participants

would have used language typical of their own gender, regardless of the social expectations created by a mismatched avatar. Therefore, in our current study, we used Palomares' and Lee's (2010) method of randomly assigning gendered avatars to participants to examine what participants would pay attention to in virtual environments when the avatars' gender matched or mismatched their own gender. We therefore tested whether men's and women's behavior is a consequence of social expectations or biological innateness, thereby supporting either the similarities or differences perspective.

1.3. The Current Study. We used Baron-Cohen's brain type hypothesis to represent the differences perspective. As such, we made the objects Baron-Cohen used as evidence for brain type E and brain type S available in virtual reality environments. We manipulated participants' identity by randomly assigning them to one of three identities: female, male, or unspecified. The unspecified avatar resembled a robot and will be referred to as such. The robot avatar is important because it allowed us to examine participants' behavior when there were no social cues for gender. Thus, we measured the effect of assigning different identities in the form of virtual reality avatars to participants on Baron-Cohen's measures of empathizing (e.g., shopping, communicating, playing with dolls,) and systemizing (e.g., building, playing sports, violence). Like Guadagno et al. (2011), to create environments in which we could manipulate objects, we used the online, virtual reality environment Second Life (Linden Research Inc., 2012) in which the participants could see the avatar and interact with objects.

If differences occur because of social pressures and expectations (similarities perspective), then the gender of the avatar should affect what the participants pay attention to in virtual environments regardless of their own gender. Furthermore, because the similarities hypothesis predicts men and women are more alike than they are different, when assigned to an

avatar with an unspecified gender, and therefore no social expectations attached to a gender (i.e., the robot avatar), there should be no differences between men and women. Conversely, if what individuals pay attention to is innate, then the avatar's gender will not affect what the participants pay attention to, such that when assigned an avatar with a gender inconsistent with their own, participants should pay attention to objects consistent with their own gender, not that of the avatar. Furthermore, when assigned an avatar that has an unspecified gender, participants should behave as they innately would. Thus, there will be differences between female and male participants. We are testing competing hypotheses. Each of the "S" hypotheses below refer to hypotheses offered by the similarities perspective and each of the "D" hypotheses refer to hypotheses offered by the differences perspective.

H1S) Female and male participants assigned to female avatars will pay significantly more attention to empathizing objects than will female and male participants assigned to male avatars.

H1D) Female participants, regardless of their avatars' gender, will pay significantly more attention to empathizing objects than will male participants.

H2S) Female and male participants assigned to male avatars will pay significantly more attention to systematizing objects than will female and male participants assigned to female avatars.

H2D) Male participants, regardless of their avatars' gender, will pay significantly more attention to systematizing objects than will female participants.

H3S) Female and male participants assigned to robot avatars will pay attention to systematizing and empathizing objects similarly.

H3D) Female and male participants assigned to robot avatars will pay attention to systematizing and empathizing objects differently. Male participants assigned to robot avatars will pay

significantly more attention to systematizing item than will female participants assigned to robot avatars. Female participants assigned to robot avatars will pay significantly more attention to empathizing items than will male participants assigned to robot avatars.

2. Method

The purpose of this study was to measure the effect of assigning different gender identities in the form of video game avatars [female (FA), male (MA), and robot (RA)] to participants on measures of empathizing and systemizing. In this study, we used an online computer video game, Second Life, that we constructed to have an equal number of empathizing (Type E) and systemizing (Type S) objects (Baron-Cohen, 2003) that participants were able to interact with in the virtual environment.

2.1. Participants. We had viable data from 124 participants (68 women and 56 men).[1] Our participants were enrolled in undergraduate psychology courses at a small Midwestern public state university. Sample size was determined to be consistent with past virtual reality research (see Palomare & Lee, 2010). No additional data were collected after results were analyzed. Participants received one research credit toward course research requirements for their participation. The sample was comprised of 58 first year students, 30 sophomores, 18 juniors, and 15 seniors. The majority of the participants were Caucasian (67%). The average age of the participants was 20.61 years (*SD* = 3.26).

2.2. Materials. We utilized Second Life (Linden Research Inc., 2012) and Camtasia (1 for ALL Software GmbH, 2012). Second Life is an online 3-dimensional, virtual world in which users design avatars and the environment. We pre-designed three avatars (FA, MA, and RA) and

[1] We collected data from 148 participants; however, only 124 participants gave viable data. Reasons for excluding participants from data analysis were as follows: leaving the designated area (*n* = 13) , changing the gender of the avatar (*n* = 5), or turning off the screen capture tool (*n* = 6).

the environment. The female avatar was Caucasian, had blonde hair, and wore a skirt and a red sweater. The male avatar was Caucasian, had brown hair, and wore a button-down shirt and jeans. The robot was yellow and gray, was humanoid in shape, and had no obvious resemblance to either sex or any race. We used the empathizing and systemizing interactive objects that Baron-Cohen (2003) referenced to construct the environment in Second Life with equal parts reflecting empathizing (doll and crib, vanity with make-up and jewelry, telephone, options for shopping, options for changing the avatar's clothing) and systemizing (soccer ball and net, instrument, blocks, weapons, and options for building objects) objects in a virtual reality house. As Baron-Cohen noted, evidence for the brain types is provided by what the person pays attention to. This study operationally defined "paying attention to" as the percentage of time interacting with objects in the environment. Only times spent interacting with objects in the virtual environment were recorded, and participants therefore had a total percentage of time interacting with objects of 100%. For example, an individual could have spent forty percent of his or her time interacting with systemizing objects and sixty percent of his or her time interacting with empathizing objects. This study used Camtasia, a screen-capturing tool, to record data.

2.3. Procedures. Participants signed up to participate in this study through the Psychology Research Participant Pool at their university in Blackboard. Participants were told that they would be playing a video game and giving feedback to improve it. Upon arrival, participants provided informed consent and were then randomly assigned to one of nine computers. Participants read instructions the screens: "NOTE: For the duration of this research, it is important that you do NOT leave this program. MORE IMPORTANTLY, it is important that you DO NOT leave your virtual reality home." To start, participants were given a packet that

provided a cover story in the experiment, and familiarized them with the controls and their avatar's gender identity. The packet had further instructions designed to keep participants in the house so that we could collect measurable data. The packet stated the study's purpose was to collect feedback to improve an online video game. Participants were instructed how to move the avatar (e.g., click the right arrow to make your avatar go right). The packet stated the participants would answer questions to improve the game (e.g., What would you do to improve this game?). Participants then completed a demographic survey. Participants had an hour to participate in the world of Second Life and finish their packets. After participants completed an hour in Second Life and handed in their packets, they received and completed the demographic sheet. Finally, we debriefed the participants. All materials and procedures were approved by the institution's Institutional Review Board and ethical standards for collecting data (e.g., anonymity of participants) were followed.

2.4. Design. Our design was a 2 Participant Gender [female participant (FP), male participant (MP)] x 3 Avatar Gender (FA, MA, and RA) between-groups, quasi-experiment. The dependent variable was the percentage of time spent interacting with the objects in the virtual environment categorized as empathizing versus systemizing. Because the dependent variables (percentage of time spent with empathizing or systemizing objects) are perfect complements, it was only necessary to analyze the percentage of participants' time interacting with one of the types of objects to test their demonstrated gendered behavior in the virtual environment.

2.5. Statistical Analyses. Because we are interested in mean differences, we used parametric tests, between-groups analyses of variance, to test our hypotheses. We used Tukey's post hoc multiple comparisons to compare individual cell means.

3. Results

To test our hypotheses we performed a 2 Participants' Gender (FP, MP) x 3 Avatar Gender (FA, MA, & RA) between-groups factorial ANOVA on the percentage of time participants spent interacting with items in the video game using SPSS. Again, because the dependent variables are perfect complements, only one analysis was necessary to test for the percentage of time spent with systemizing and empathizing objects. Consistent with the differences perspective hypotheses (H1D and H2D), the main effect of participant gender, $F(1, 118) = 14.09$, $p < .001$, was significant with a medium effect size, partial $\eta^2 = .11$ (see Figure 1).

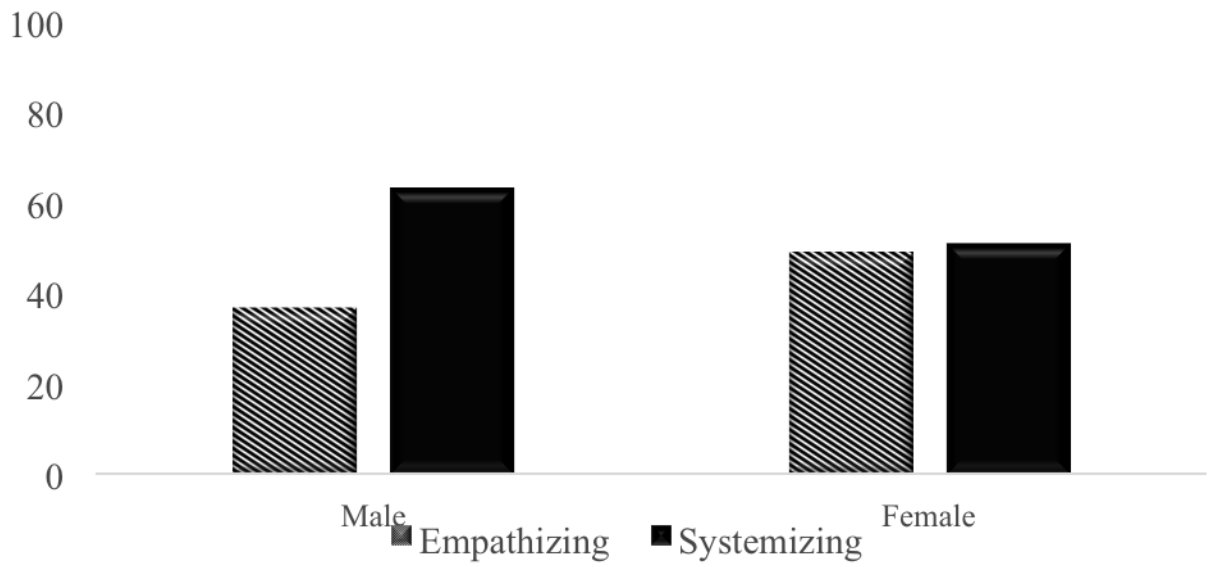

Fig. 1 Mean percentage of time spent on empathizing and systemizing objects in Second Life by male ($n = 56$) and female participants ($n = 68$).

Male participants, regardless of avatar condition, paid more attention to systemizing ($M = 63.26$, $SD = 16.80$) items and less attention to empathizing ($M = 36.74$, $SD = 16.80$) items than did female participants (Systemizing: $M = 51.06$, $SD = 15.98$; Empathizing: $M = 48.94$, $SD = 15.98$).

However, consistent with the similarities perspective hypotheses (H1S and H2S), the main effect of avatar gender was also significant, $F(2, 118) = 55.79$, $p < .001$, with a large effect size partial $\eta^2 = .49$. Post hoc multiple comparison procedures indicated that, regardless of

participant gender, participants assigned to the female avatar paid more attention to empathizing objects (M = 58.13, SD = 14.14, n = 45) than did participants assigned to the male avatar (M = 28.87, SD = 11.08, n = 42) and the robot avatar (M = 42.20, SD = 11.54, n = 37) (Tukey; ps < .001). There was also a significant difference between participants assigned to the robot avatar and participants assigned to the male avatar such that participants assigned to the robot avatar paid significantly more attention to empathizing objects than did participants assigned to the male avatar. Likewise, participants assigned to the male avatar paid more attention to systemizing objects (M = 71.13, SD = 11.08, n = 42) than did participants assigned to the female avatar (M = 41.87, SD = 14.14, n = 45) and the robot avatar (M = 57.80, SD = 11.54, n = 37). Participants assigned to the robot avatar paid significantly more attention to systemizing objects than did participants assigned to the female avatar (see Figure 2). Finally, the interaction between participants' gender and avatar gender was not significant, $F(2, 118) = 0.41$, $p = .66$.

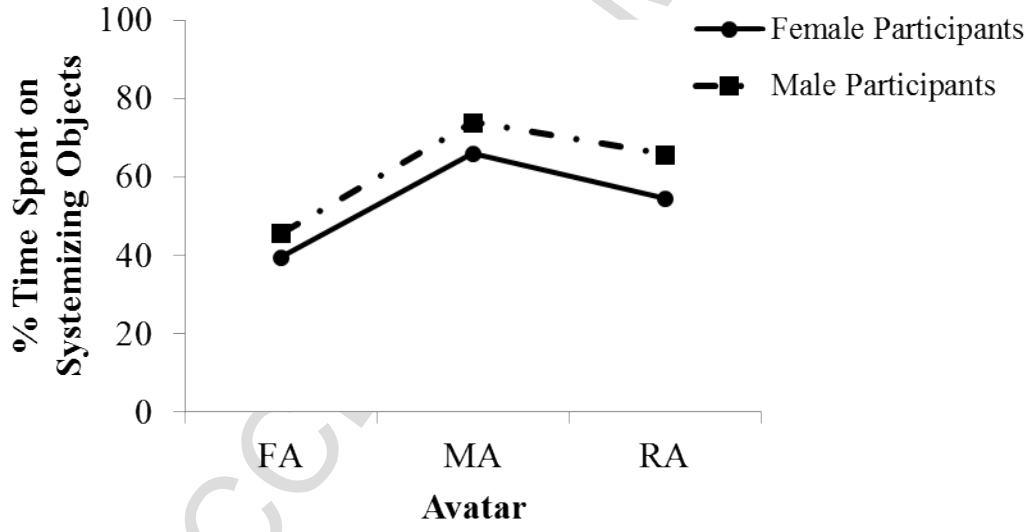

Fig. 2 Mean percentage of time spent on empathizing and systemizing objects in Second Life by female and male participants assigned female avatars (n = 45), male avatars (n = 42), and robot avatars (n = 37).

To test hypotheses 3S and 3D, we ran a planned comparison to compare only male and female participants assigned to the robot avatar. We ran a one-way ANOVA on the dependent variables empathizing and systemizing. Again, because the dependent variables are complements, only one analysis was necessary. Consistent with the differences perspective and hypothesis 3D, female participants paid less attention to systemizing objects (M = 54.45, SD = 10.83, n = 26) than did male participants (M = 65.70, SD = 9.37, n = 11), and paid more attention (M = 45.55, SD = 10.83, n = 26) to empathizing objects than did male participants (M = 34.30, SD = 9.37, n = 11), $F(1, 35) = 8.98$, p = .005 (see Figure 3), when assigned to robot avatars.

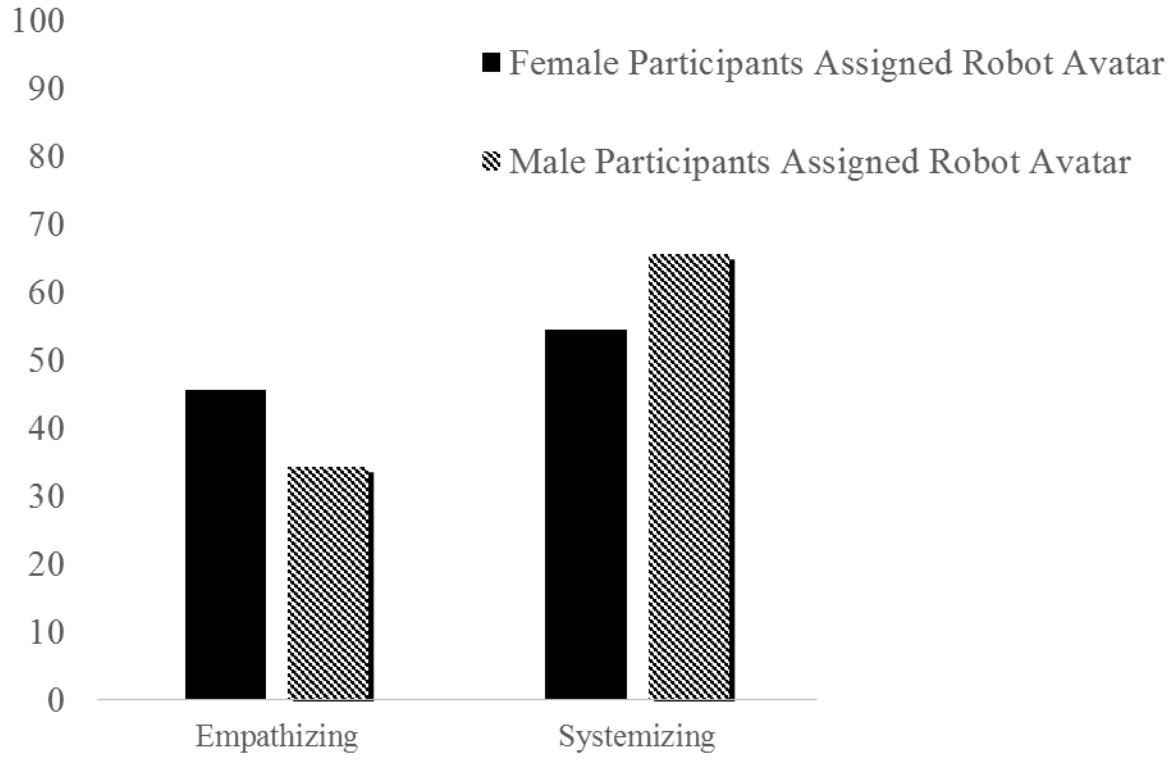

Fig. 3 Mean percentage of time male (n =11) and female (n = 26) participants assigned robot avatars spent with empathizing and systemizing objects.

4. Discussion

We examined if assigning different gender identities to male and female participants in virtual reality environments would produce behaviors that supported the differences versus similarities perspective in explaining the differences between men and women. Overall, the results supported both perspectives. Consistent with hypotheses derived from the differences perspective (1D, 2D, and 3D), regardless of the avatar gender, male and female participants behaved in ways that were consistent with Baron-Cohen's proposed brain types. When no gender cues were given, participants behaved in accordance with their own gender, suggesting that participants' inherent or biological sex played a role in their behavior. Our results were also consistent with hypotheses derived from the similarities perspective (1S and 2S) such that the avatar's gender also influenced participants' behavior. Importantly, the effect size for the avatars' gender was larger than that for the participants' gender, indicating the avatars' gender explained more of the variance than did participants' inherent sex. Thus, both the main effect of avatar gender and the comparison of effect sizes indicate that social aspects of sex and gender also played a crucial role in influencing participants' behaviors.

Consistent with the differences perspective, women in our study spent a greater percentage of time interacting with empathizing objects, and men spent a greater percentage of time interacting with systemizing objects. However, similar to prior research that examined the visual appearance of avatars in association with behavior (Cristofari & Guitton, 2014; Guadagno et al., 2011; Guitton, 2012, 2013, 2015; Lehdonvirta et al., 2012; Lomanowska & Guitton, 2012, 2014; Palomares & Lee, 2010; Yee & Beilenson, 2007), our study found that participants behaved in accordance with the avatars' genders. Participants spent a greater percentage of time interacting with empathizing objects when assigned to female avatars compared to when they were assigned male avatars. Similarly, participants spent a greater percentage of time interacting

with systemizing objects when assigned to male avatars compared to when they were assigned female avatars. This is consistent with the similarities perspective, such that manipulating the gender of the avatars altered the behavior of the participants. Therefore, this study supports arguments, and hypotheses derived, from both the differences perspective and the similarities perspective.

Importantly, mismatched gendered avatars may have given our participants freedom to act without their actual gender constraints (i.e., not having to behave as their own gender dictates). However, the adoption of the avatars' gender may bring the social expectations, stereotypes, and constraints of that gender. When assigned avatars' genders that did not match their own, participants' behavior (i.e., the percentage of time spent interacting with various objects) indicated that they behaved consistently with the avatars' genders instead of their own. Simply stated, as proponents of the similarities perspective argued, we found that participants behaved the way the genders of their avatars were supposed to behave (e.g., Bohan, 1993, Shields, 2002, West & Zimmerman, 1987). However, consistent with the differences perspective, when participants were assigned robot avatars, and thus given no gender cues for their behavior, participants behaved in accordance with their own gender. As such, our study implies that differences between men and women, especially those associated with measures of empathizing and systemizing, are the consequence of both biology and social construction. Furthermore, our results suggest that the mutually exclusive sides of the debate may be too simplistic and more polarized than is necessary, such that an interaction between the biological and the social aspects of gender exists.

Because this was a synthetic (i.e., virtual reality) environment in a laboratory setting, it is important to note that everyday behaviors in real world environments may produce different

results. Although seeing third-person avatars on screen was a salient independent variable in our Second Life experiment, we believe immersive technology would allow researchers to examine more complicated behaviors (e.g., interactions between men and women in relationships). Because we used Second Life, an online virtual reality environment, the measurable behaviors were restricted to screen-recorded behavior in virtual reality houses with participants viewing their avatars on screen. With advances in technology, researchers may be better able to simulate real life, and immerse participants into virtual environments that may be more powerfully manipulated to test the competing hypotheses offered by the differences and similarities perspectives.

Another limitation is that we used only one representative gendered behavior inspired by the differences perspective (i.e., Baron-Cohen's work). More research is needed to examine the differences perspective as it relates to other domains in which men and women may differ. This is especially crucial because real world decisions are made based on men's and women's "different" hardwiring (i.e., having female versus male brains). For instance, math classes in elementary and middle school are sometimes split into female and male classes with the justification that girls and boys learn differently because of their different hardwiring (see Goswani, 2006, for review).

Relatedly, it could also be argued that simply paying attention to objects deemed as empathizing and systemizing objects is an inadequate measure of empathizing and systemizing. As such, future research could explore other ways in which to measure empathizing and systemizing. For instances, instead of deeming various objects "empathizing" and "systemizing" researchers could examine how individuals interact with objects (i.e., do they interact with objects in empathizing or systemizing ways). For the purposes of this study, we used the

operational definition provided by previous research on the topic (Baron-Cohen, 2003; Baron-Cohen, Knickmeyer, & Belmonte, 2005), but research that replicates these findings with other operational definitions is certainly warranted. Further, it could be that our participants simply behaved in ways in which they believe men and women are supposed to behave instead of identifying with their ascribed avatars. Future research should measure how much individuals identify with their ascribed avatars for more robust results.

Finally, we categorized sex/gender into a binary system in which participants could participate in the online world as either male or female, and offered a seemingly neutral avatar (i.e., a robot avatar) as a third option. However, gender scholars define sex and gender as complex constructs that are multi-level, and often reject a binary-system in which individuals are categorized as either male or female (e.g., Fausto-Sterling, 2000). Thus, we were unable to capture the full complexity of gender in our study.

Researchers have already suggested that adhering exclusively to either side of the debate in the etiology of gender differences is problematic because it is nearly impossible to disentangle the biological and social causes of behavior (e.g., Chizzola, 2012). Future research should therefore examine the relationship between the biological and the social aspects of sex and gender. For example, researchers could approach sex and gender with the biopsychosocial model (Engel, 1977) of behavior that indicates the impact of biology on behavior is dependent upon social experiences. Immersive virtual reality offers new ways for researchers to examine other important gendered social phenomena, such as stereotype threat and individuals' performance. For instance, researchers could mismatch the participants' gender with the avatars' gender to study stereotype threat with math performance. Would male participants who were assigned female avatars perform more poorly on math tests when facing stereotype threat than

would male participants who were assigned male avatars? Would women be able to overcome the consequences of stereotype threat (e.g., performing worse on math related tasks after stereotype threat) if they were assigned male avatars?

4.1. Conclusions

Researchers and scholars have attempted to reconcile the differences and similarities perspectives on the etiology of gender differences. They have used logical arguments and evidence from numerous studies to support the idea that these opposing perspectives are not incongruent (e.g., Buss & Schmitt, 2011; Vandermassen, 2010). This study is complementary to their argument and contributes a novel method in which we empirically tested competing hypotheses inspired by the differences versus the similarities perspective in a virtual reality environment. We assert that neither side is incorrect, and agree with researchers who claim that the two perspectives are not incongruent (Buss & Schmitt, 2011; Vandermassen, 2010), and that advocating for only one perspective is problematic (e.g., Chizzola, 2012). We recommend that future research focus on the interaction between biological and social forces as etiologies and explanations for sex and gender differences and similarities. This would not only provide a more holistic picture of the differences and similarities between men and women, but would perhaps allow for a more nuanced understanding of these differences and similarities that is less constricted by opponent and seemingly mutually exclusive perspectives.

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Highlights

- We tested competing gender hypotheses in the virtual environment, Second Life.
- Results of comparing men and women in Second Life supported both hypotheses.
- Results suggest gender differences are driven by both biological and social forces.