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Abstract

Second Life (SL) is a virtual world application that enables users to create virtual representations of themselves and interact with other users. SL is increasingly being used to study important psychological questions. The current project sought to replicate within SL Asch's (1951) classic finding of group influence, in which participants often respond in accordance with choices expressed by other members of a group, regardless of the accuracy of those choices. Participants were given a series of perceptual judgment trials, in which they chose one of three stimulus alternatives that matched the length of a target stimulus. Participants were tested either alone or with three other confederate avatars whose choices were predetermined by the experimenter. On two of the trials, confederate avatars unanimously chose incorrectly before the actual participant made their choice. Results showed that on these trials participants were significantly more likely to choose in accord with the confederate's choices, relative to participants tested as single avatars. The results generally support earlier research on group influence and extend these findings to a virtual world environment.

1. Background and Introduction

Second Life (http://secondlife.com) is a 3-D virtual environment, initially created as an experiment in virtual culture, society and worlds (Carpenter, 2009). SL users create virtual representations of themselves (i.e., avatars) and interact with other avatars in a shared virtual environment. A virtual world, although not completely without its own complications, offers an exciting and novel approach to both research and education. SL in particular offers users the opportunity to create entire environments limited only by the user's imagination. A virtual world affords novel tools with which to create environments that do not or cannot exist in the real world, which in some cases relieves researchers of constraints and safety concerns often present in the physical world. Accordingly, many studies that are not feasible in real life can be conducted in a virtual world with minimal risk, costs, and complications; an advantage that becomes more prominent as our use of online- technology increases.

In order to realize its full potential, however, it is important to establish that a virtual world maintains important psychological similarities to real world situations. It has been suggested that immersing oneself in a virtual world with other individuals present, creates both a sense of 'presence' (e.g., the user's avatar becomes an extension of themself immersed in the virtual environment) as well as a sense of 'co-presence' (e.g., the attribution of other avatars as extensions of other human agents and immersed in the same virtual shared space), creating a virtual experience that is in many ways comparable to the real world (Mennecke, Triplett, Hassall, Conde, & Heer, 2011).

Although reasonable, the hypothesis that a virtual world gives users a sense of 'presence' as an avatar and 'co-presence' among other avatars, is ultimately an empirical question, and there have already been a number of studies in this area. One finding illustrating the value of a virtual world for social psychology is a study of virtual interpersonal distance (IPD). The results indicate that IPD phenomenon in the real world also appears in a virtual world, even with respect to differences among gender dyads and eye gaze (Bailenson, Beall, & Blascovich, 2002; Bailenson, Blascovich, Beall, & Loomis, 2001; Yee, Bailenson, Urbanek, Chang, & Merget, 2007). Other research has shown that the amount of IPD to an unknown virtual avatar is similar to the distance normally observed between two human strangers (Bailenson, Blascovich, & Guadagno, 2008).

More directly relevant to the issue of 'presence and co-presence' are data suggesting that people perceive other avatars as extensions of other people. As an example, Hoyt, Blascovich, & Swinth (2003) conducted a study in which participants were told to perform a task in front of either human-controlled avatars, computer-controlled agents, or alone. Participants in the human-controlled group demonstrated the highest degree of social inhibition, thereby suggesting both the power of social influence on an individual and the extension of another human agent into a virtual avatar.

Other research on self-perception has employed the use of what has been termed 'immersive virtual environment technology' (IVET), which allows researchers to manipulate the digital representation of an avatar's appearance and control the avatar's behavior using preset computer algorithms (Bailenson, Blascovich, Beall & Loomis, 2001; Loomis, Blascovich, & Beall, 1999). Being able to create an avatar that appears any way they wish, participants can also experience what it is like to perceive themselves as a different gender, ethnicity, or age, while interacting in a social situation. This kind of manipulation can prove a valuable assessment tool for a multitude of questions examined by psychologists, pertinent to social perception, empathy, aggression, personality, judgment, and other

social phenomena. Indeed, this area of research has already begun to make some striking contributions to social psychology (Bailenson, Blascovich, & Guadagno, 2008, for a review).

Another strategy used to study social perception in a virtual world involves the passive use of avatars. In these studies the participant does not engage as an avatar themselves. Rather, they merely observe or interact with avatars from a real world perspective (i.e., observing avatars on a computer screen). One such study examined the classic obedience phenomenon introduced by Milgram (1963). In the original study, participants were presented with a situation in which they were told to administer shocks to another individual if that person answered incorrectly to a given problem. Participants were told to continue increasing the level of shock with each incorrect response, even when the individual expressed discomfort and pain, or ceased responding altogether. Of course, no real shocks were administered. Nonetheless, the reaction of participants ranged from discomfort to very high levels of anxiety, even though many of these same participants ended up administering the highest level of shock available.

This type of study could not be replicated today because of ethical standards of research. The distress participants expressed when believing that their actions injured another human being is now ethically prohibited as an unacceptable risk. As an alternative strategy for examining what remains an interesting question -- the degree to which humans obey the commands of another -- a recent study replicated Milgram's basic design and procedure within a virtual world. An avatar, rather than a real person, was the target for shocks administered by real-world participants. Interestingly, even though participants were aware that the individual they were shocking was not real, similar findings of increased anxiety and discomfort were recorded among participants. Of particular interest is that physiological measures (skin conductance and heart rate) indicated higher levels of distress when the avatar being shocked voiced their discomfort and pain than when they communicated solely via text chat (Slater, Antley, Davison, Swapp, Guger, Barker, Pistrang, & Sanchez-Vives , 2006).

Studies of this type illustrate how a virtual world can offer many new research opportunities that are not possible, for various reasons, in real world situations. In order to better understand the possibilities and limitations of using SL and similar platforms to study psychological questions, more research is needed on the degree to which there is phenomenological symmetry between real world and virtual world situations. Our present study was intended to contribute to that objective.

We attempted to replicate a basic finding from social psychology. In his classic study of social influence, Asch (1951) found that a significant number of participants would respond according to choices expressed by other members of their group, despite the fact that these answers were incorrect. A significant amount of pressure to conform occurs when the group is composed of three or more other people and others in the group are unanimous. Larsen, Triplett, Brant & Langenberg (1979) attributed the tendency of external members to conform as a learned behavior encouraged by social rewards.

Our study sought to replicate Asch's (1951) social influence study in a virtual world. Specifically, we examined whether SL participants would conform to the group's choices when placed in a group situation and asked to perform alongside other avatars in perceptual judgment task, regardless of choice accuracy.

2. Method

2.1 Participants

Participants were undergraduate students ranging between 18 and 25 years of age, recruited from an Introductory Psychology subject pool at the University of Kentucky. Participants received research credit that satisfied a portion of their class requirements. The University of Kentucky Institutional Review Board (IRB) approved the experimental protocol as meeting standard guidelines for ethical treatment of human subjects. Participants were instructed to arrive at a research room on campus at which one of the experimenters was present to guide them through the study. Participants were randomly assigned to one of two groups: 4-avatar group (participant plus three other avatars), and 1-avatar group (participant was alone). A total of 23 students (N=12 for 4-avatar; N=11 for 1-avatar) were tested.

2.2 Confederate Participants

In the 4-avatar condition, participants were told that they would be working with three other students, each located at a different university. In reality, the non-participant avatars were controlled by confederates using computers located in separate rooms on campus. The three confederate avatars responded through a script indicating which answer they were to choose for each trial as well as the name of their fictitious university and their fictitious major. The confederates were undergraduate students earning independent research course credit under the supervision of one of the authors. Each confederate was approved by the IRB to conduct human research.

2.3 Procedure

At the start of the experiment, participants were given a choice among 6 pre-made avatars (3 male and 3 female) to serve as their avatar. After selecting their avatar, the experimenter logged the participant into SL using the chosen avatar's username and password. The participant's avatar was teleported to the SL Psych lab (located on the University of Kentucky's Island in SL). For participants in the 4-avatar condition, once they arrived in the SL Psych lab the confederate avatars were already present. Participants in the 1-avatar condition were just instructed to choose a pre-made avatar, were logged into SL, and transported to the SL Psych lab.

The virtual laboratory included a visual display screen on which the test stimuli were projected; three colored rugs labeled A, B, and C, located directly underneath the visual display screen; two chairs and two bookshelves located on the wall opposite the display screen; and a black couch placed in the center of the room facing the visual display screen. The couch was divided into four numbered seats (See Figure 1A). Regardless of condition, participants were always assigned to seat position three. In the 4-avatar condition, the confederates were assigned seats 1, 2, and 4. Once seated participants were instructed to look at the display on which would appear the test stimuli (See Figure 1B). The participant's seat was arranged so that their view of the display was clear and centered and positioned so the view seemed to be equivalent from the confederates' perspectives. While seated, the participant could clearly view the confederate avatars and the experimenter avatar as well as the display screen.

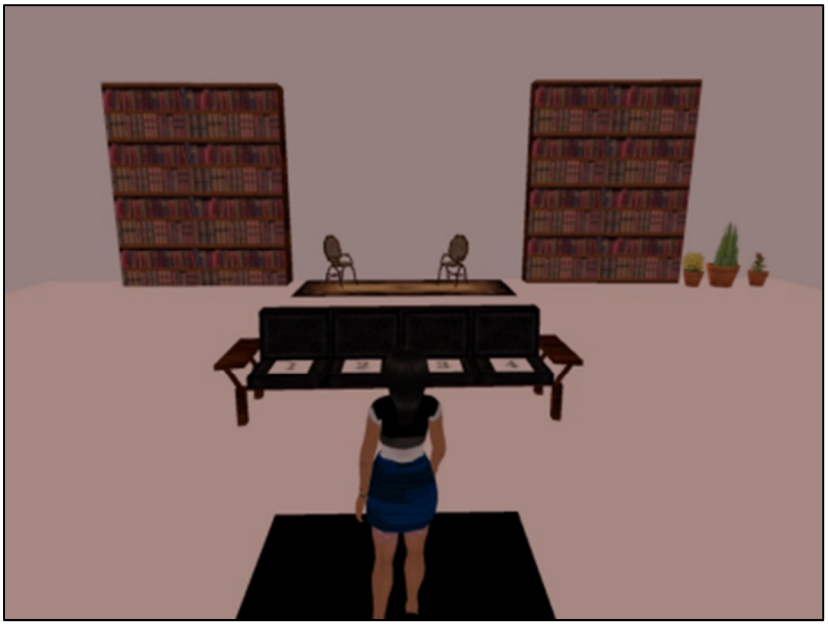

Figure 1A: Virtual Lab

Figure 1B: Test Stimuli

Prior to the start of the experiment, participants were shown how to navigate their avatar using arrow keys from their keyboard. They were also shown how to make their avatar sit in the assigned seat. Participants were then given general instructions about the task as follows:

"You will be shown an image in which there will be a target line on the left side and three comparison lines of different length on the right side, labeled A, B, and C. Your task is to locate the comparison line that matches the sample line in length. Once the test image has appeared for a brief period, it will disappear, and another image will appear with the letters A, B, and C directly above rugs labeled A, B, and C. When told to do so by the experimenter, please move your avatar to the rug representing your stimulus choice."

Each test session included two practice trials in order to provide the participant an opportunity to operate their avatar in making a choice and in returning to their seat. Prior to presenting the first sample image, the experimenter (who was in the room with the actual participant but operating an avatar that appeared on screen, located on a blue rug to the side of the couch in which all avatars were seated) instructed all participants to indicate that they were ready to view the sample image. Participants, including confederate avatars, responded by typing on their computer keyboards using the text-chat feature of SL. Participants were instructed to respond to each trial by standing and walking to a rug labeled A, B, or C located underneath the display screen. The first slide of each trial consisted of a sample line, located on the left side of the display and three comparison lines, located on the right side of the display, labeled A, B, and C, sequentially from left to right. The participant was instructed to express their stimulus choice by moving, when instructed to do so by the experimenter, to the rug labeled the same as the comparison line they judged to match the length of the sample line (see Figure 2). The first image for each trial (target line with three comparison lines) appeared for a duration of 3 s (seconds), followed immediately by a slide on which appeared only the three comparison lines (labeled A, B, and C, respectively). At this point the experimenter instructed each participant, including confederates when appropriate, to respond one at a time in a predetermined order. With this procedure, the task required participants to remember the length of the target line and choose one of the three visible comparison lines that matched it in length.

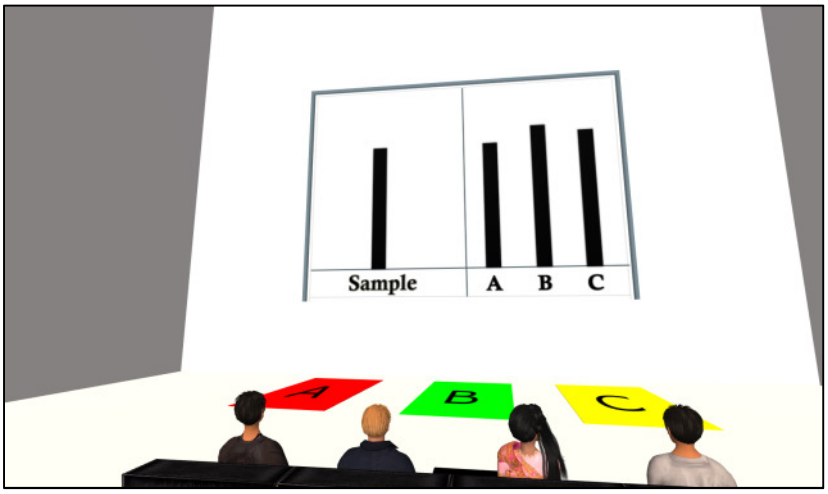

Figure 2: Comparison slide

A total of ten trials were administered: eight 'control' trials, in which the confederate participants chose correctly, and two experimental trials, in which the confederates unanimously chose incorrectly. Participants responded sequentially in an apparently semi-random order that was actually predetermined by the experimenter, with the constraint that the actual participant always chose last on Trials 4 and 10 (the two experimental trials). After all participants had made their selections, they were instructed to return to their assigned seat on the couch. The experimenter recorded the participant's choices for each trial and then asked all participants to indicate via text chat that they were ready to view the next trial. The length of time between trials varied between 30-40 s, depending on how quickly the participants were able to return to their seats.

3. Results

The results indicate an overall percentage accuracy score for the eight control trials of 95.70% for the 4-avatar group and 90.91% for the 1-avatar group, and this difference was not significant as revealed by an independent samples t-test, $t(179) = 1.29$, $p = .20$. When comparing the performances of the two groups in terms of accuracy for the two experimental trials (Trials 4 and 10), a Fisher's exact probability test revealed a significant difference between the two groups on Trial 4, $p = .005$; however, there was no significant difference between the two groups on Trial 10, $p = .155$ (See Table 1). The main finding was that on the first trial in which the confederate participants unanimously chose an incorrect answer, over half of the participants in the 4-avatar condition made the same incorrect choice as the confederates, whereas none of the participants in the 1-avatar condition chose incorrectly on the same trial.

Table 1: Fisher's Exact Probability Tables for Experiment 1A

Trial 4

Group	Choice A *	Choice B	Choice C **	Totals
4-avatar	7	0	5	12
1-avatar	0	0	11	11

Trial 10

Group	Choice A	Choice B *	Choice C **	Totals
4-avatar	0	5	7	12
1-avatar	0	1	10	11

(*) Indicates the choice made by the confederate participants in the 4-avatar group.
(**) Indicates the correct choice for that trial.

4. General Discussion

The results suggest that when placed in a situation in which other members of a group respond in unison to an incorrect choice, participants will frequently choose in accord with the group's choice. The fact that participants in the 1-avatar condition performed significantly more accurately than those in the 4-avatar condition on Trial 4, and did not make the choice of the three confederates in the 4-avatar condition, suggests that participants in the 4-avatar condition demonstrated the Asch effect of social influence. This result indicates that a real world phenomenon, social influence, also appears in a virtual world, at least within the specific context and parameters of the present experiment. The pattern of results differed on Trial 10, the other trial in which confederates responded inaccurately. This result suggests that the social influence effect apparent on trial 4 dissipated by Trial 10. Interestingly, accuracy on Trial 10 was slightly higher for participants in the 4-avatar condition (fewer participants chose incorrectly as compared with Trial 4). Perhaps after their experience on Trial 4, participants become aware of the deception and came to ignore the responses of other group members. Research in social psychology has shown that the impact of deception can be transitory, dissipating quickly over experimental trials (Sansone, Morf, & Panter, 2004).

This study examined social influence in a virtual world setting by using a general design and procedure similar to those employed in the classic Asch (1951) studies of social influence. Asch found that individuals placed in a group situation would often make choices that other members of the group

make, despite those choices being incorrect. Based on the assumption that people feel a sense of 'co-presence' with avatars in a virtual world, which creates the feeling of being in a physical space with other individuals, social influence can be expected to occur in a virtual world. Our findings support this conclusion.

The results further support the finding that not all people succumb to social influence. Asch (1951) observed that a fourth of his participants gave correct answers in defiance of the group's incorrect choices, but the majority of the participants chose in accordance with the group's choices on at least one trial or more. The fact that approximately half of our participants in the 4-avatar condition chose the same incorrect choice as was made by the confederate participants, and given relatively small sample sizes, lends evidence that the effect of social influence can be rather robust in a virtual world.

The present experiment differed from that of Asch's original (1951) study in several important ways. First, the present experiment imposed a delay between the offset of the sample slide and appearance of the choice slide. Another difference is that rather than responding verbally, participants in the present study were required to stand and move their avatar to a physical location as an indication of their choice. Consequently, deviation from the group's decision would require the participant to physically separate their avatar from the other avatars in the group. The main reason for these changes was to make the discrimination more difficult and nonconformity more conspicuous in order to enhance the opportunity to observe social influence. Although Asch found that a significant percentage of his male participants conformed to the group's decisions, the study was conducted in the 1950's, a time when individualism and adherence to authority had not yet been challenged (as it would be a decade later). Research since Asch's original study has been less successful in finding such high percentages of conformity (Perrin & Spencer, 1980), suggesting that levels of conformity can vary depending on various factors including cultural context. Our goal was to create a situation that might be especially likely to induce conformity.

Future research could assess the impact of variables such as task difficulty and the method by which participants are forced to respond. For example, if the experimental slide remains visible during the response period, participants might be less likely to conform to a group's incorrect choice. Additionally, if the participant were asked only to provide an answer via text chat or voice response, as opposed to having to separate their avatar from the group in virtual space, this too might lessen the pressure to conform and thus diminish the percentage of individuals who succumb to social influence.

Further investigation of avatar appearance would also be valuable. In our experiment participants were forced to choose from among a modest set (3 male and 3 female) pre-made avatars. It is possible that the physical appearance of the selected avatar could influence the tendency of participants to regard the avatar as a meaningful self-representation. Especially valuable would be a replication that allowed participants to create entirely their own avatars and to allow them more experience in controlling their avatars. It is reasonable to assume that the more strongly participants invest in the design and control of their avatar, the more likely they will regard the avatar as an embodied extension of themselves, which could influence the psychological context of the virtual world experience. There is evidence that a participant's behavior in a virtual world is influenced by physical attributes of their avatar. For example, Yee, Bailenson & Ducheneaut (2009) found that the height and attractiveness of an avatar influenced social behavior in a virtual world; taller avatars were more aggressive.

The main type of conformity seen in the Asch studies and in the present study has been labeled 'normative conformity', which occurs when an individual yields to group pressure in order to fit in with

and be accepted by that group (Aronson, Wilson, & Akert, 2005; McLeod, 2008). Often times, this type of conformity leads to public compliance, where the individual openly changes their behavior to fit with that of the group, but might not privately agree with the choice. Interestingly, if even one confederate deviates from the group's incorrect choices, the participant will be significantly less likely to choose in accordance with the majority answer. Morris & Miller (1975) showed that only 5-10% of their participants responded to the majority's answers when one of the confederates gave the correct answer, arguing that having even a small amount of social support helps to overcome the tendency to conform against one's personal beliefs.

Our findings have both general and specific implications. Generally, the results extend a growing literature indicating that psychological phenomena of the real world can be observed in a virtual world. To the extent that the psychology of a virtual world mirrors the psychology of the real world, there are more opportunities to use a virtual world for a broad range of applications: education, training, crisis simulations, job interviews, and other important real world activities. Specifically, the results encourage pursuit of other important questions concerning social influence research in a virtual world. For example, it would be interesting to manipulate the confederate avatars' appearances as a way of assessing whether gender, age, authority, and other factors will produce differences in levels of conformity. Social pressure may influence the participant depending on how the individual feels in the group in relation to all of the other members. Participants respond differently to avatars depending on how they perceive them within the virtual world and what image they hold of the other players represented by those avatars. Larsen *et al*. (1979) found evidence of collaborator status influencing participants' tendencies to conform in relation to subject characteristics such as gender and learned social behaviors. Awareness of characteristics of the other members of a group can cause a feeling of being in an out-group, which leads to social anxiety and then conformity. Additionally, Hayes, Ulinski, & Hodges (2010) conducted a math task experiment in a virtual world and determined that inhibition and facilitation trends occur in humans depending on the gender of the other avatar and whether the monitor perspective is in 1st person or 3rd person with the participant's avatar. In this respect, the behavior of avatars is congruent with group dynamics found in real world situations.

One of the methodological advantages to virtual world research protocols is the opportunity to more easily manipulate visible characteristic of subjects in a group situation. Gender, race and other conspicuous features that distinguish individuals can be easily created in avatars. In contrast, it is significantly more difficult to establish groups in the real world that represent such differences through selective recruitment.

Finally, although there are a number of demonstrations that social phenomena found in the real world also appear in a virtual world, the reciprocal relationship has not received much attention. Research that has been reported on this topic has produced some intriguing findings. For example, Yee *et al*. (2009) found not only that physical attributes of avatars, such as height, promote aggressive behavior in a virtual world, but also that these aggressive tendencies extended to subsequent interactions in the real world. Accordingly, perhaps users who spend considerable time in a virtual world bring different psychologies to their real world existence. These and other provocative questions suggest the need for continued exploration of virtual world psychology.

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