THE ASSOCIATION OF IN-WORLD AVATAR INVESTMENT WITH EXPECTATIONS OF BEHAVIORAL CHANGE

Jacquelyn Ford Morie, Sin-Hwa Kang, and Eric Chance

Institute for Creative Technologies
University of Southern California
12015 Waterfront Drive
Playa Vista, CA 90094-2536
{morie, kang, chance}@ict.usc.edu

Abstract. We explore whether watching the behavior of an avatar created by a user can affect that users' behavior in the actual world. This research aims to determine if we can achieve results similar to those obtained from an experimental design detailed in Study 3 of "Virtual Self-Modeling: The Effects of Vicarious Reinforcement and Identification on Exercise Behaviors" (Fox and Bailenson, 2009), but using avatars created by observers rather than experimenter-provided ones enhanced with a photographic likeness. Fox and Bailenson theorized that the behavioral change elicited stems from modeling the behavior of physically similar people as supported by social cognitive theory. In this study, we focused more on investigating whether people's own avatars' behavior would elicit behavioral change based on social-perception theory. Therefore, users observed their own avatars that were doing exercise or not regardless of any physical similarity between the avatars and their owners. The preliminary results showed there was a strong trend for users to engage in physical activities more when they watched their own avatars exercise, compared to observing their own avatars that did not exercise. The results also demonstrated that users with higher body mass index (BMI) engaged in physical activities more when they watched their own avatars with exercise behavior, compared to users with lower BMI. This study seeks to clarify whether or not the notions of psychological reflexivity and avatar ownership/investment are possible factors influencing avatar owners' behavioral outcomes.

Keywords: Avatar, virtual worlds, investment, VRE, self-perception theory

1 Introduction

In the last decade there has been a progression from traditional immersive Virtual Reality Environment (VRE) applications towards inclusion of these techniques within persistent, socially connected Virtual Worlds (VWs). This change now permits what was formerly a complex, stand-alone system with costly equipment to become widely connected and accessible over the Internet by a potentially limitless audience. Beyond

these differences, a major advancement separating VREs from VWs is the embodiment of the user in the form of a personalized avatar. Avatars are users' online self-representations through which they inhabit the virtual world and communicate with other beings. Users are typically able to customize their avatars and often make them to project some aspect of their physical or internal self-image. Recent research is beginning to substantiate a deep connection that forms between the user and his or her avatar with repeated use [1,2,3].

We have been exploring affordances of avatars to determine what can be leveraged to create more effective applications delivered via VW platforms. We are especially interested in what they offer to health care applications, wherein the avatar, as a personal expression of self, can make visible potentially useful cues about a person's psychological state. Inhabitants of virtual worlds take great care to form an avatar representation that relates to themselves in important ways. This may be a physical similarity, as much as can be achieved with the toolset provided by the virtual world designers, or it may be a projection of an internal state the person perceives is a more truthful representation of self than what nature has provided.

This research study aims to determine if we can achieve results similar to those obtained from an experimental design detailed in Study 3 of "Virtual Self-Modeling: The Effects of Vicarious Reinforcement and Identification on Exercise Behaviors" by Fox and Bailenson [4], but using avatars created by participants rather than experimenter-provided virtual humans enhanced with the photographic likeness of the user. Fox and Bailenson theorized that the behavioral change they found stems from modeling the behavior of physically similar people as supported by social cognitive theory. The results of their study demonstrated that when people observe a virtual representation of self (VRS) exercising, they are more likely to report an increase in subsequent exercise behavior than those who view their VRS loitering.

1.1 Theoretical background: Self-perception Theory

This study design was based on self-perception theory, which asserts that an altered self-representation can affect people's behavior by basing their own beliefs and attitudes on a third person perspective of themselves [7,8]. This indicates that one could alter one's own behavior and change beliefs or attitudes based on watching one's self presented via an avatar. Johnson and Downing [9] found that people who wore a costume representing a Ku Klux Klan group increased the amount of electric shock more than people wearing a nurse's uniform when they played a role of a teacher and were asked to deliver the shock to a learner who made mistakes. Yee and colleagues [8] report that people can achieve self-perception through role-play, such as a virtual setting with an avatar. This environment lends itself more easily to this kind of objective behavioral self-perception since role-playing by a user's own avatar would decrease any deliberate manipulation of behavior in his/her role-playing in the real world offline. Wolfendale [10] addresses an attached perspective as a means to explore how people associate with their own avatars. She argues that attachment to other beings allows people to create their identity through constructing relationships with others. She specifically describes that attachment to an avatar is not a drastically dif-

ferent concept from attachment to others in the real world offline because "avatar attachment is expressive of self-identity and is a means of communication with others – communication that takes place in a setting of shared values and expectations" [10].

Based on these findings, we speculate that people's behavior could be affected by watching their own avatar performing a deliberately designed behavior. For instance, regarding the Proteus Effect, Yee [11] argues (but doesn't prove) that people would engage in their usual workout more if they are represented using a physically fit avatar for themselves, compared to an average-looking avatar. The Proteus Effect provides a basis for people's behavioral change as a result of their avatars' appearance. We extend this concept to observe people's behavioral changes regarding avatars they themselves had created and therefore had some perceived investment in, whether or not they were physically similar to their offline self.

1.2 Research problems and questions

We found contradictory findings in previous work. Some researchers [4] assert physical similarity between a user and his/her own avatar is required to elicit the user's behavioral change. Other researchers [5,6] argue that a physically dissimilar avatar might work to provoke a user's behavioral alteration. Based on previous findings, we believe that the mechanism of behavioral change is unclear as to whether it results from a personal recognition factor or if a feeling of ownership/investment of the avatar is at play. In this study, we explore whether or not the notions of psychological reflexivity and avatar ownership/investment are possible factors influencing the behavioral outcomes. Users in our study observed avatars that they had created using their own desktop monitor (their usual way of participating in the virtual world). In the original study [4], authors also suggest to explore the influence of VRSs in other types of virtual worlds than immersive virtual environments, such as desktop settings. In the study, users experienced virtual reality using a virtual reality head-mounted stereo display, or HMD, but participants in our study were situated within a full online virtual world that was displayed on a desk-top computer monitor.

In this study, we specifically investigated whether people's experience with their personal avatars' behavior could alter their own behavior in the offline world, as was found with the Fox and Bailenson study [4] which used photo-graphically textured avatars as VRS. We further explored how users' BMI and the length of their ownership of their avatar are associated with the amount of their engagement in physical activities after watching their own avatars within the virtual world that were doing exercise or not.

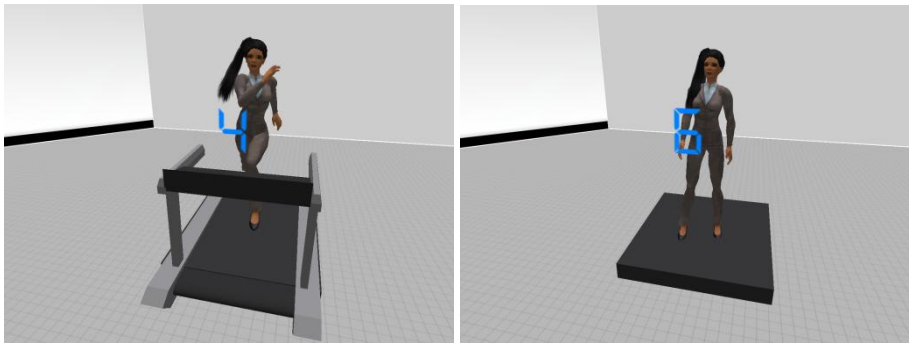
2 Study Design

The experimental design[1] was a 2 between-subjects experiment: own avatar with exercise behavior (participant's personal avatar running on a treadmill) and own avatar without exercise behavior (participant's personal avatar loitering) (see images in Fig. 1). Using a between-subjects design, participants observed an avatar in the virtual world of Second Life for 5 minutes 20 seconds in one of the experimental conditions. As in the original study, the nature of the experiment was masked, and visual attention kept on the avatar, by a visual distractor task wherein a sequence of 20 numbers flashed over the avatar for later recall. Twenty four hours after the experiment, participants were emailed a link to a survey. The main dependent variable was a physical activity scale. Before starting a main interaction with avatars, subjects filled out a general demographic survey that included questions on personality characteristics. Participants were compensated using a virtual currency in Second Life.

Participants. One hundred and forty three participants (own avatar with exercise behavior: 97, own avatar without exercise behavior: 46; 72% women, 28% men; average 37 years old) were recruited from Second Life through the posting of flyers in various user groups. Participants were told they could invite their friends to participate as well.

Measurements. Avatar age (i.e. "How long have you used this avatar?") and BMI (Body Mass Index) were assessed as explanatory variables including general demographic information in a pre-questionnaire before an actual interaction. In a post-questionnaire, the number of hours for users' engagement in their physical activities using PPAQ (Paffenbarger Physical Activity Questionnaire, [12]) was measured as a dependent variable. The questionnaire has nine items and the sample items include "Sleep, rest" and "Standing, washing dishes or cooking, driving a car or truck."

Fig. 1. Two experimental conditions



(a) Condition 1: Own avatar with exercise behavior

(b) Condition 2: Own avatar without exercise behavior

[1]The experimental design in this paper was part of a more extensive design involving three conditions.

3 Preliminary Results

We first ran a MANOVA (Multivariate Analysis of Variance) to investigate users' own avatars' activity type in owners' behavioral changes. The independent variable was the two types of condition: own avatar with exercise behavior and own avatar without exercise behavior. The dependent variables were the amounts of users' nine physical activities. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and multicollinearity. We further ran a Pearson's Correlation to find the associations of users' BMI and own avatar age with the amount of their physical activities. Preliminary assumption testing was performed to check for normality, linearity and homoscedasticity, with no serious violations observed. The average of BMI was 27 for the "own avatar with exercise behavior" condition and 32 for the "own avatar without exercise behavior" condition. The average avatar age was 2.8 years for the "own avatar with exercise behavior" condition and 3.2 years for the own avatar without exercise behavior" condition. In this preliminary data analysis, we wanted to find the specific types of physical activities users performed more after their participation in the study, so we did not run a Factor Analysis to combine the original items of the physical activities into a smaller number of factors. Other analyses of the associations between other variables are currently in progress.

3.1 Results of MANOVA analysis

The results showed that there was a moderately significant difference between two conditions regarding the "Sitting quietly, watching television, listening to music, or reading" activities [$F(1, 141)=3.823$; $p=.053$; Wilks' Lambda=.878; $\eta^2=.026$ (see Table 1)]. For these sedentary type of activities, users in the "own avatar without exercise behavior" condition ($M=3.78$, $SD=2.788$) reported higher amount of their activities than users in the other condition ($M=2.92$, $SD=2.308$).

The results also showed that there was a strong tendency of difference between two conditions regarding the "Bicycling to work for pleasure, brisk walking, painting or plastering" activities [$F(1, 141)=3.916$; $p=.050$; Wilks' Lambda=.878; $\eta^2=.027$ (see Table 1)]. For these vigorous type of activities, users in the "own avatar with exercise behavior" condition ($M=.65$, $SD=1.128$) reported greater amount of their activities than users in the other condition ($M=.30$, $SD=.511$).

There was no statistically significant difference between two conditions regarding the other activities.

3.2 Results of Correlations analysis

We did not discover statistically significant results of correlations between the avatar age and other variables. However, we found statistically significant results of positive associations between BMI and two physical activities.

In the "own avatar with exercise behavior" condition, the results showed that users with a higher BMI did "standing, washing dishes or cooking, driving a car or truck" activities more than users with a lower BMI after observing their own avatars running on a treadmill [r=.220, n=97, p=.030] (see Table 2 (a)).

In the "own avatar without exercise behavior" condition, the results demonstrated that users with a higher BMI did "sleep, rest" activities more than users with a lower BMI after watching their own avatars loitering [r=.346, n=46, p=.019] (see Table 2 (b)).

There were no statistically significant associations between BMI and the other activities.

Table 1. MANOVA results with the independent variable (own avatars' activity type) and dependent variables (the hours users engaged in their physical activities)

	Own avatar with exercise behavior		Own avatar without exercise behavior		F	η^2	P
	μ	SD	μ	SD			
Sitting quietly, watching television, listening to music, or reading	2.92	2.308	3.78	2.788	3.823	.026	.053
Bicycling to work for pleasure, brisk walking, painting or plastering	.65	1.128	.30	.511	3.916	.027	.050

Table 2. Pearson's Correlation Coefficients between Avatar age, BMI, and the amount of physical activities (the hours users engaged in their physical activities)

(a) Condition 1: Own avatar with exercise behavior

	Avatar age	BMI	Sleep, rest	Standing, washing dishes or cooking, driving a car or truck
Avatar age	1	.036 (p=.724)	.033 (p=.746)	.096 (p=.350)
BMI	.036 (p=.724)	1	-.076 (p=.457)	.220* (p=.030)
Sleep, rest	.033 (p=.746)	-.076 (p=.457)	1	-.239* (p=.018)
Standing, washing dishes or cooking, driving a car or truck	.096 (p=.350)	.220* (p=.030)	-.239* (p=.018)	1

(b) Condition 2: Own avatar without exercise behavior

	Avatar age	BMI	Sleep, rest	Standing, washing dishes or cooking, driving a car or truck
Avatar age	1	-.127 (p=.402)	-.007 (p=.961)	-.222 (p=.138)
BMI	-.127 (p=.402)	1	.346* (p=.019)	-.129 (p=.394)
Sleep, rest	-.007 (p=.961)	.346* (p=.019)	1	-.243 (p=.104)
Standing, washing dishes or cooking, driving a car or truck	-.222 (p=.138)	-.129 (p=.394)	-.243 (p=.104)	1

4 Conclusions and Implications

The outcome of our study indicates that users' own behavior is affected after observing their avatars' behavior. There is a strong tendency that users engage in physical activities more when they watched their own avatars that did exercise, compared to observing their own avatars that did not. This might be explained by avatar owners' attachment to their avatars, which may increase the likelihood that they will perceive their avatars as themselves in virtual worlds online. We further observed that there were significant correlations between users' BMI and the amount of their physical activities after watching their avatars' exercise behavior. This outcome suggests that overweight users may be encouraged to engage in more physical exercise in the real world after observing their avatars' exercise behavior. However, there were no significant associations between the length of users' avatar ownership and the quantity of their physical activities. This implies that avatar creation matters regardless of how long the owner has been using it.

Our findings are supported by self-perception theory that asserts people's behavior can be altered by observing their own behavior with a third person perspective. Fox and Bailenson [4] also point out that this effect may possibly be the result of users being reminded of good memories associated with exercise that inspired them, or perhaps guilt from neglecting a healthy exercise regimen that motivates them after seeing their avatar exercise. However, that explanation would not account for the increase in rest for the own avatar without exercise condition.

We argue that the outcome of our study indicates a potential for avatars in a desktop setting to be used within a health care application regarding physical exercise similar to that mentioned by Fox and Bailenson [4], who envision a program that motivates employees to work out in the gym during lunch and subsequently see a visual reward of some sort through the avatar after logging a history of their exercise routine.

We anticipate that data from this study will help clarify whether or not the psychological relationship between the avatar and its owner should be further investigated as a factor influencing the results of behavioral changes elicited by avatar use.

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