

Designing Virtual Environments to Measure Behavioral Correlates of State-Level Body Satisfaction

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Abstract. Virtual reality (VR) offers a unique method for eliciting state-variable fluctuations in body satisfaction and associated behaviors by allowing near-perfect control over environmental factors. Greater variability in momentary body satisfaction is associated with more problematic eating behavior and cognitive styles predictive of eating disorders. The field currently lacks a model for understanding environmental variables and everyday events that tend to influence fluctuations in state body satisfaction. This study proposes a model of state-level body satisfaction and presents a method for measuring changes as they occur. We aim to investigate body comparison, selective attention and body checking behaviors in relation to self-report levels of state body satisfaction. We additionally assess interpersonal correlates of state body satisfaction using VR to measure personal distance between subjects and avatars of varying body sizes. 80 female college students with varying levels of weight and shape concerns will be exposed to five virtual environments designed to elicit varying levels of body dissatisfaction: (a) an empty room; (b) an empty beach; (c) a beach populated with avatars; (d) an empty party scene; (e) a party scene populated with avatars. Self-report body satisfaction was measured immediately following each exposure. A tracking system automatically tracked subjects' head orientation and body translation to measure visual gaze and personal space behavior relative to each virtual human within the environment. Data collection is currently underway and expected to be completed by May 2013. Preliminary data and development of the VR model for state-variable assessment will be presented.

Keywords. Virtual environments, body satisfaction, college women, eating disorders

Introduction

This study aims to investigate virtual reality (VR) environments designed to elicit state-level fluctuations in body satisfaction. We also intend to measure behavioral correlates of body satisfaction directly in controlled conditions during VR exposure. VR offers a unique method for eliciting state-variable fluctuations in body satisfaction and associated behaviors by allowing near-perfect control over environmental factors. This study proposes a multidimensional model of state body satisfaction based on an individual's perceived body exposure (i.e., their appearance) and prompts for social comparisons (i.e., appearance of others). We present a model for measuring changes as they occur using in vivo state measures and behavioral outcomes. Subjects will report momentary levels of body satisfaction immediately following exposure to each virtual environment using the Body Parts Satisfaction Scale [1]. We aim to assess key

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behaviors associated with body satisfaction: body comparison, body checking and selective visual attention to weight and shape related stimuli. This study also proposes a novel assessment of personal space between subjects and virtual humans of varying body shapes as a correlate of body satisfaction. We hypothesize that subjects' degree of approach and/or avoidance behaviors toward underweight, average weight, and overweight avatars within the virtual space will vary as a function of body satisfaction.

1. Background

1.1. State-level body satisfaction

State body satisfaction refers to an individual's momentary or day-to-day self-perception and feelings about her weight and shape [2]. Greater variability in momentary body satisfaction is associated with more problematic eating behavior and cognitive styles predictive of eating disorders [2]. The field currently lacks a model for understanding environmental variables and everyday events that tend to influence fluctuations in state body satisfaction. Models for understanding variables that predict changes in state body satisfaction have relied on self-report measures or retrospective accounts [2]. This study proposes a model of state-level body satisfaction based upon an individual's level of body exposure and prompts for self-comparison with others of varying body sizes. Using this model, we aim to measure fluctuations in body satisfaction directly as they occur. Recent studies have used VR with promising results to elicit fluctuations in emotional states in response to food-related stimuli [3, 4].

1.2. Behavioral correlates of body satisfaction

Several behaviors have been shown to correlate with body dissatisfaction among young women and are considered key maintaining features of eating disorders: body comparison, selective attention and body checking. "Body comparison" refers to attempts to evaluate one's own appearance by making comparisons to the appearance of another individual or image [5]. Research has shown that women frequently compare their bodies with those of peers as well as media images of thin-ideal bodies, resulting in decreased body satisfaction [6,7,8]. The literature also indicates that women with elevated weight and shape concerns selectively attend to body-related stimuli in the environment [9], but whether young women exhibit variability in the extent of attentional bias as a function of body satisfaction is unclear [10]. Body checking refers to "repeated critical scrutiny of one's body size, shape and weight" [11], often by using mirrors, pinching areas of fat, measuring body parts or engaging in other behaviors intended to evaluate body size. Body checking is considered a characteristic feature of eating disorders and is measured using self-report methods. The capabilities in VR to expose participants to controlled environmental conditions and record body checking behaviors represents a novel assessment method.

1.3. Applications of VR

Researchers have begun investigating VR treatments for disturbances in eating behavior and body image with promising results [12]. Studies have shown that virtual

exposure to food-related stimuli elicits similar emotional responses as would be expected in reality among women with eating disorders [12, 13]. However, the field currently lacks a model for understanding and measuring state-level changes in body satisfaction using VR.

2. Methods

2.1. Participants

Eighty female undergraduate students ages 18-30 will be screened and sorted into two groups: at-risk for developing an eating disorder (n=40) or healthy controls. Subjects will participate in the study for course credit.

2.2. Apparatus

Subjects wore a head-mounted display to view the immersive VR environments. Stereoscopic images were rendered at an average frame rate of 60 Hz and the viewer's perspective was continually updated according to the subject's head movements for an immersive experience. The subject's position along *x*, *y* and *z* planes was tracked with an optical tracking system.

2.3. Procedure

The lead researcher and one undergraduate research assistant were present for each trial. Participants were read a description of the study and the researcher assisted the participant in putting on the head-mounted display. When the virtual environment was loaded, the participant saw a virtual room that was modeled exactly on the physical lab room. In the virtual lab room, the participants were prompted to walk to different areas in the room in order to confirm that the equipment was working properly and familiarize the subject to VR. Before entering the first experimental environment, participants completed the Body Parts Satisfaction Scale, a 10-item measure of body satisfaction, by reading the items in the head mounted display and speaking their answers aloud. Answers were audio-recorded by the blinded research assistant.

The participants were exposed to the four virtual experimental conditions randomly to control for ordering effects. All participants were exposed to the lab room, an empty beach, a beach populated with avatars, an empty party scene and a party scene populated with avatars. Populated environments contain three groups of three avatars, with two females and one male per group. The relative body sizes of the female avatars varied between the groups; thin-ideal, average and overweight body sizes respectively. The groups were placed in fixed positions within virtual space, equidistant from the participant.

In environments containing avatars, subjects are first instructed to view all three groups from their starting point and then to approach ("join") each group in the order of the subject's choosing. Participants are allowed to spend 15- 20 seconds observing each group. After the subject had approached each of the three groups, the researcher prompted the participant to return to the starting point in the center of the room and stand so that she could not see any of the three groups. Remaining in that position,

subjects were asked recall five details they remember about any or all of the three groups. The research assistant audio-recorded responses. In environments without avatars, participants were instructed to approach three areas of interest in the environment and observed each area for 15-20 seconds and were also asked to recall five details about the environment. Immediately following each virtual environment, subjects report their levels of state body satisfaction using the Body Parts Satisfaction Scale using the same method described above.

The order in which subjects are exposed to the virtual environments is randomized to control for ordering effects. Similarly, the positioning of the groups of avatars is counterbalanced between- and within-subjects to control for environmental factors that may influence approach behavior. A tracking system will automatically track subjects' head orientation and body translation to measure visual gaze and personal space behavior relative to each virtual human within the environment.

3. Results

Data collection is currently underway and expected to be completed by May 2013. Preliminary data and development of the VR model for state-variable assessment will be presented. We will investigate self-report levels of body satisfaction, body position within virtual space relative to virtual humans, visual attention within the virtual environment and frequency of body checking behaviors during VR. We hypothesize that state body satisfaction will vary as a function of the individual's perceived level of exposure (i.e. her appearance) in VR and the availability of prompts for social comparisons (i.e. others' appearance). We further hypothesize that greater reductions in state body satisfaction will be associated with visual attentional bias for weight and shape related stimuli, reduced approach behavior and increased body checking behavior, especially among subjects whose cognitive and behavioral features at baseline place them at risk for developing eating disorders.

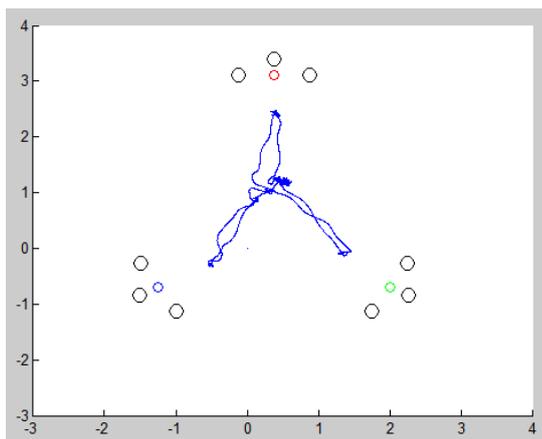


Figure 1. Sample interpersonal distance output. Avatars represented by black circles. Blue line represents the participant's body position on the x, y and z planes captured at a rate of 60 frames per second.

The optical tracking system will measure the interpersonal distance between the subject and each of the three groups of avatars in the virtual environments. We will calculate the minimum distance between the participant and each avatar. A sample visual representation of interpersonal distance data is provided in Figure 1.

4. Conclusions

Existing interventions to improve body satisfaction have limited effects. This study proposes a virtual assessment of body satisfaction focused on state variable fluctuations and interpersonal behavioral correlates. A clearer understanding of momentary changes in environmental predictors of state-level body satisfaction will allow researchers to develop empirically based VR treatments to improve body satisfaction and disordered eating behaviors. The level of environmental control provided by VR allows us to investigate behavioral correlates of body satisfaction in order to better understand the clinical correlates of elevated body dissatisfaction. This understanding may allow researchers to design future clinical interventions that more effectively improve body satisfaction by focusing on behavior change.

References

- [1] T.A. Petrie, M.M. Tripp, P. Harvey, Factorial and construct validity of the Body Parts Satisfaction Scale – Revised, *Psychology of Women Quarterly*, **26** (2002), 213–221. = 1
- [2] J.A. Rudiger, T.F. Cash, M. Roehrig, J.K. Thompson, Day-to-day body image states: Prospective predictors of intra-individual level and variability, *Body Image*, **4** (2007), 1-9.
- [3] C. Perpiña, C. Botella, R. Baños, H. Marco, M. Alcañiz, and S. Quero, Body image and virtual reality in eating disorders: Is exposure to virtual reality more effective than classical body image treatment? *CyberPsychology & Behavior* **2** (1999), 149 – 155.
- [4] M. Ferrer-García, J. Gutierrez-Maldonado, A. Caqueo-Urizar, E. Moreno, The validity of virtual environments for eliciting emotional responses in patients with eating disorders and in controls, *Behavior Modification* **33** (2009), 830 – 854.
- [5] H.K. Schutz, S.J. Paxton, E.H. Wertheim, Investigation of body comparison among adolescent girls. *Journal of Applied Social Psychology*, **32** (2002), 1906–1937.
- [6] E.H. Wertheim, SJ Paxton, HK Schutz, SL Muir, Why do adolescent girls watch their weight? An interview study examining sociocultural pressures to be thin. *Journal of Psychosomatic Research*, **42** (1997), 345–355.
- [7] M.C. Martin and P.F. Kennedy. Advertising and social comparison: Consequences for female preadolescence and adolescents. *Psychology and Marketing*, **10** (1993), 513–530.
- [8] S.J. Paxton, “Individual risk factors and socio-cultural contexts for disordered eating,” In: Gaskill D, Sanders F, editors. *The Encultured Body: Policy Implications for Healthy Body Image and Disordered Eating Behaviors*. Brisbane: Publications and printing unit, Queensland University of Technology, (2000), 24–33.
- [9] N. Siep, A. Jansen, R. Havermans, and A. Roefs, Cognitions and emotions in eating disorders, *Behavioral Neurobiology of Eating Disorders*, **6**, (2010), 18 – 30.
- [10] R. Glauert, G. Rhodes, B. Fink, K. Grammer, Body Dissatisfaction and attentional bias to thin bodies, *International Journal of Eating Disorders* **43** (2010), 42–49.
- [11] R. Shafran, M. Lee, E. Payne, C.G. Fairburn, An experimental analysis of body checking, *Behavior Research and Therapy*, (2007), 113 – 121.
- [12] J. Gutierrez-Maldonado et al., Body image in eating disorders: The influence of exposure to virtual reality environments, *CyberPsychology and Behavior*, **5** (2010), 521-531.
- [13] A. Gorini, E. Griez, A. Petrova, and G. Riva. Assessment of the emotional responses produced by exposure to real food, virtual food and photographs of food in patients affected by eating disorders. *Annals of General Psychiatry* **9** (2010).