VR Literature Summary: Weight Loss

THE OVERVIEW

Virtual Representation of Self (VRS) – 3D Model that resembles the participant
Virtual Representation of Other (VRO) – 3D Model that resembles a neutral human
Cognitive-Behavioral Therapy (CBT), Experiential Cognitive-Behavioral Therapy Based on VR (ExCT)

Research relevant to weight loss in virtual reality has largely been centered around two themes: increasing physical activity and therapeutically developing a healthier attitude towards body image and food choices. VR immersions that involve virtual representations of the self (**VRS**/3D prototypes that resemble the participant) exercising and/or becoming thinner as a result have been shown to increase motivation to adopt healthier behaviors and even increase self-reported physical activity directly outside of VR. A great deal of non-controlled research has also been done to assess the potential uses of VR as a therapeutic supplement for those with eating disorders, allowing them a safe and controllable space to practice developing coping mechanisms. While rarely tested against other types of therapy, or of a large enough sample size to be worth extrapolating from, long-term behavioral therapeutic treatments in VR (led by an actual therapist) have been shown to be more effective than traditional cognitive-behavioral therapy (CBT) at decreasing unhealthy eating behaviors and improving body image.

On a related note outside of VR, preliminary research has also been conducted that measures the effectiveness of "Exergames" (such as WiiFit) in decreasing body anxiety, which have been shown to be effective at decreasing Body Image Dissatisfaction (BID), particularly among those who had high BID to begin with. Researchers who develop digital weight-loss methods (online calorie and physical activity trackers) believe that VR might be effective at supplementing those, but no studies have been done to measure the effectiveness of digital weight loss and VR versus digital weight loss alone.

KEY FINDINGS

Seeing a virtual representation of themselves (VRS) running in VR causes people to exercise an hour more on average in a 24-hour period outside of VR.

VR immersions that involve watching a VRS exercise have been shown to increase voluntary exercise activity outside of VR, indicating that people mimic the behavior of an avatar that they see as representative of themselves in real life. Additionally, VR immersions that show a VRS change "weight" depending on the user's activity during VR are effective at increasing physical activity while in VR. While these are both promising pieces of evidence that VR involving VRS can be used to increase levels of physical activity, it has yet to be demonstrated that virtual reality is more effective than other therapeutic weight loss methods at decreasing body weight in the long-term.[1]

- Watching a virtual representation of yourself (VRS) engage in exercise is an effective VR immersion that increases physical activity in the real world. Those who spent five minutes watching a VRS running in VR reported engaging in, on average, an hour more of voluntary exercise in a 24-hour period than those who watched a VRO running or watched a VRS loitering.
- Seeing the "weight" change (reinforcement) of your physical activity while in VR on a VRS is effective at increasing physical activity while in VR. Those who watched a VRS changing based on their level of activity during VR exercised significantly more in VR than those whose VRS did not change as a result of their activity or those who were not observing a virtual human.
- Similarly, watching a VRS exercise that resembles your "ideal" body weight (rather than a representation of your current body weight) is significantly more effective at increasing both motivation and intention to

1 "Virtual Self-Modeling: The Effects of Vicarious Reinforcement and Identification on Exercise Behaviors" -JESSE FOX and JEREMY N. BAILENSON, 2009

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increase physical activity and nutrition behavior. Participants in conditions where they watched a non-ideal VRS loiter, a non-ideal VRS exercise, or an ideal-VRS loiter exercised less than those that saw a VRS at their ideal weight exercising.[2]

Eating disorder therapies that include VR are significantly more effective at decreasing binge eating, improving body image satisfaction, and increasing self-efficacy (belief that one can change one's behavior) than traditional CBT. VR has been shown to positively affect the attitudes that individuals with disordered eating behaviors, such as binge-eating, have toward their own ability to change their behavior, arguably one of the most significant psychological barriers to behavior change. Virtual reality-based cognitive therapy treatments (as opposed to cognitive-behavioral therapy alone) have been shown to be more effective at decreasing binge eating, and increasing body awareness, body satisfaction, and physical acceptance.[3]

- VR provides an advantage over cognitive-behavioral therapy by allowing participants to "practice" in real-world environments that trigger disordered eating behaviors.
- In a controlled study of obese women (N=211), ExCT (a combination of VR and CBT) was the only treatment out of four conditions, including traditional CBT, that significantly improved body image satisfaction and self-efficacy after 6 months.
- In a similar controlled study of women with binge-eating disorder (N=36), 77% of participants in the ExCT condition had ceased binge eating versus 56% in the CBT condition after 6 months.

Those who are highly engaged with VR and watch a VRSs "weight" change based on the food they eat in VR impacts their eating behavior in the real world, causing women to restrain themselves from eating and men to mimic their avatar by eating more.

A VR immersion that showed reinforcement (changing "weight") on a VRS depending on the participant's food choices in VR inspired changes in eating behaviors outside of VR. Males ate more candy and females ate less candy, depending on how highly present (engaged) they were in VR.

- Highly present males imitated the eating behaviors they saw their VRS engage in during VR by eating more candies than males who were less present, as there are fewer negative connotations around eating for males. Highly present females did not imitate the eating behaviors they saw, but rather refrained from eating candies at a significantly greater rate than females with low presence. This indicates that high presence in VR impacts behavior outside of VR regardless of the direction of the impact.[4]
  - Females who reported high presence in VR ate fewer candies outside of VR than those who had a low level of engagement (indicating restraint as a result of presence in VR).
  - Males who reported high presence in VR ate significantly more candies than males who had a low level of engagement (indicating imitation as result of presence in VR).

STUDIES OF NOTE

"Virtual Self-Modeling: The Effects of Vicarious Reinforcement and Identification on Exercise Behaviors"
-JESSE FOX and JEREMY N. BAILENSON, 2009

Three experiments were conducted assessing the effect of various types of VR immersions on physical activity. In brief: while in VR, seeing effects of your activity on something that resembles you (a VRS) is more effective at increasing activity than seeing those effects on something that does not resemble you (a VRO). Additionally, seeing a VRS

2 "An Empirical Comparison of Variations of a Virtual Representation of an Individual's Health" -ANDREAS SCHMEIL and L. SUZANNE SUGGS, 201
3 "Virtual reality based treatments in eating disorders and obesity: A review" - -MARTA FERRER-GARCIA, JOSE GUTIERREZ-MALDONADO, GIUSEPPE RIVA, 2013
4 "Virtual Experiences, Physical Behaviors: The Effect of Presence on Imitation of an Eating Avatar" -JESSE FOX, JEREMY N. BAILENSON, JOSEPH BINNEY, 2009

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running, rather than loitering, or even a VRO running, increases physical activity significantly in the real world 24 hours after VR immersion.

1. **Design:** Participants (N=63) were uniformly prompted to engage in a simple physical activity while in VR immersion. They were assigned to three conditions: **reinforcement** (VRS that gained or lost weight based on physical activity during VR immersion), **no change** (VRS that does not change based on physical activity), and **no virtual human** (no avatar, but in VR).
    a. **Results:** Those assigned to the **reinforcement** condition exercised significantly more during the immersion than those in the other two conditions, indicating that VRS reinforcement is successful at increasing physical activity.
2. **Design:** Participants (N=53) were uniformly prompted to engage in a simple physical activity while in VR immersion. They were randomly assigned to one of four conditions. **VRS reward** (VRS lost weight by exercising), **VRO reward** (VRO lost weight by exercising), **VRS punishment** (VRS gained weight while loitering), or VRO punishment (VRO gained weight by loitering).
a. Results: No difference was shown in behavior between reward and punishment conditions, regardless of VBS or VRO. However, those in the VRS conditions exercised significantly more than those in VRO conditions, regardless of reward or punishment, also indicating that VRS reinforcement is effective at increasing physical activity.
3. **Design:** Participants (N=73) observed a virtual human for 5 minutes. They were randomly assigned to one of three conditions: **VRS running** (VRS running on treadmill), **VRS loitering** (VRS loitering), **VRO running** (VRO running on treadmill). Participants completed a survey describing various types and amounts of physical activity in the real world 24 hours after the immersion.
    a. **Results:** Participants in the **VRS running** condition engaged in an hour more of voluntary exercise outside of VR than those in the VRO running and VRS loitering conditions, indicating that seeing a VRS exercising increases physical activity in the real world.

"An Empirical Comparison of Variations of a Virtual Representation of an Individual's Health"
-ANDREAS SCHMEIL and L. SUZANNE SUGGS, 2014

An experiment was conducted in which respondents were assigned to see a **VRS** in one of **4 variations:**

1. Holding a still pose, 2. mimicking healthy behavior (exercising), 3. personifying a possible future health status (being thinner than they currently are), and 4. both mimicking health behavior and personifying a possible future health status. Results showed that showing the **VRS** in any of these conditions can lead to positive changes in motivation to engage in more physical activity and healthy eating, though condition 4 was significantly more impactful than others. Additionally, many respondents who used the VRS are highly motivated to return to it for future use.

- **Design:** Participants (Total N=512) across 3 European countries (Germany N=186, Poland N=177, UK N=149) were first given a pre-test motivation to engage in more physical activity (PA), intention to engage in more PA, motivation to engage in a healthier diet, and intention to engage in a healthier diet. Respondents were then randomly assigned to one of four experimental variations (as listed above), and viewed the **VRS** for just over one minute.
    - **Results:** While respondents among all experiment variations saw positive changes in **motivation**, those whose **VRS** both mimicked their exercise behavior and also showed possible future health status (condition 4) were significantly more motivated and had a significantly higher level of intent to positively change behaviors than those in other conditions. Similarly, this group also showed the most positive and significant intent to change nutrition behavior in the next week.
    - Additionally, qualitative feedback shows that most individuals (65%) across all genders and countries were satisfied with the VR tool, saying it was a "great idea", "helpful", and as "representing themselves", while very few (11%) reported negative feedback.