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Motion-Based Video Game and Authentic Wall/Rock Climbing: Motivations and Perceptions of Novice Climbers

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This mixed-methods study investigated the ability of motion-based video games (MBVG) to motivate adoption of authentic wall/rock climbing. The study also explored participants' perceptions of MBVG and authentic wall/rock climbing. University students (n = 24) with no previous climbing experience were randomly assigned into the game-first (GF) or wall-first (WF) group. Both groups completed an initial questionnaire and two 30-minute sessions of their initial activity. Afterwards, both groups completed the same questionnaire and switched activities. After finishing the second activity, participants completed a post-assessment and twelve weeks later completed a follow-up questionnaire. Two one-hour focus groups were also conducted after the second activity. Findings indicated that the MBVG did not motivate participants to pursue future wall/rock climbing; rather, the authentic experience motivated future activity. The participants did not have accurate perceptions of the mental or physical demands; prior to and during the intervention, authentic wall/rock climbing was perceived to be more mentally and physically demanding than MBVG climbing.

Keywords: exergaming, eSport, instructional technology, active gaming, sport

INTRODUCTION

In the United States, video gaming is growing exponentially. From 2009 to 2013, computer and video game sales increased from US$10.1 billion to US$15.4 billion (Siwek, 2014). The Entertainment Software Association (2014) reported 59% of Americans play video games and 51% of all United States households own at least one video game system.

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Video games are especially popular among youth; 88% of youth between 8 and 18 years old play video games 3 to 4 times per week, averaging 16 hours for boys and 9 hours for girls (Gentile, 2009). Kann et al. (2014) reported that on an average school day, 41.3% of American high school students play video or computer games for at least 3 hours.

Concurrent to the rise of video game popularity, the number of overweight or obese Americans continues to grow (Institute of Medicine, 2015). Shockingly, less than one-quarter of American youth aged 12 to 15 years engage in the recommended daily amount of 60 minutes of moderate-to-vigorous physical activity (MVPA; Centers for Disease Control and Prevention [CDC], 2014). Moreover, Vandewater, Shim, and Caplovitz (2004) reported a strong relationship between sedentary video game use and increased weight status for children under 12 years old, whereas television viewing does not. Similarly, Ballard, Gray, Reilly, and Noggle (2009) revealed a negative correlation for college-age males between time spent playing video games with time spent exercising. Both studies imply that playing video games replaces MVPA.

As a result of the negative relationships found between sedentary gaming and physical activity (PA), many health agencies recommend limiting sedentary video gaming for children. The CDC (2014) recommends that children get at least 60 minutes of PA every day and reduce sedentary screen time like television, video games, and computer usage. The U.S. Department of Health and Human Services' (2014) recommends limiting daily television, videos, or video games to no more than two hours for youth ages 2 to 12 years.

LITERATURE REVIEW

MOTION-BASED VIDEO GAMES

It is important to note that not all video games are sedentary. Oh and Yang (2010) define motion-based video games (MBVG; e.g., exergaming or active video gaming) as any video games which promote PA – including cardiovascular, strength, balance, or flexibility. In concert with the popularity of video gaming, MBVG may be a way to increase MVPA and combat obesity. Motion-based video games use specialized software and motion-sensor cameras, flooring, or an infrared sensor to capture the physical movements made by the player(s) and display them via an onscreen avatar (Jenny, Hushman, & Hushman, 2013). Examples of common MBVG systems are the Xbox Kinect (Microsoft, Redmond, WA), the Nintendo Wii (Minamiku Kyoto, Japan), and the PlayStation 4 with motion camera (Sony Computer Entertainment, Tokyo, Japan).

Energy expenditure. To date, the majority of MVBG research has investigated energy expenditure (EE). Similar to the recommendations mentioned above, the American College of Sports Medicine (ACSM; 2014) recommends at least 20 to 60 minutes of aerobic, neuromotor, and/or sports activities at least 5 days per week at a moderate intensity or 3 days per week at a vigorous intensity. Recently, Gao, Chen, Paso and Pope (2015) performed a meta-analysis of 35 studies investigating the effects of MBVG on children and adolescents' health outcomes; they concluded that MBVG increases EE, heart rate, metabolic equivalents (METs), VO2 max, and PA from resting. Sween et al. (2014) reviewed 27 studies which researched MBVG and PA and found a strong correlation between MBVG and increased EE (up to 300% above resting levels), with the majority reaching moderate intensity – in line with the ACSM's guidelines. However, not all studies found MBVG beneficial. Bochner, Sorensen, and Belamarich's (2015) meta-analysis of 7 random control trials concluded that MBVG did not significantly affect EE, leading to no significant weight loss in children. In addition, there is now speculation that time spent playing MBVG does not replace other physical or sedentary activities (Simons, Chinapaw,

Brug, Seidell, & de Vet, 2015). Unfortunately, little research has been done comparing intensity levels between MBVG and authentic activity.

Motivation and perception. Studies have begun to examine the effectiveness of utilizing video games as instructional tools in physical education (do Carmo, Goncalves, Batlalau, & Palmeira, 2013; Jenny et al., 2013; Jenny & Schary, 2014), but few studies have looked at MBVG's ability to motivate individuals to adopt the authentic (i.e., "real-life") activity a video game emulates. Sheehan and Katz's (2010) theorized that MBVGs can increase intrinsic motivation for PA by encouraging participants through control, challenge, curiosity, creativity, and constant feedback. Adachi and Willoughby (2013) provided support by arguing that playing video games satisfies the criteria for positive youth development by increasing intrinsic motivation, concentration and cognitive effort, and cumulative effort over time to achieve a goal. These criteria may also be met in sports, clubs, and other extracurricular activities. Adachi and Willoughby (2014) conducted a four year longitudinal study with 1,492 adolescents and found that those involved in sports more frequently played sports video games than adolescents who did not play sports. In the same study, Adachi and Willoughby found evidence that playing sports video games may be an effective way to promote self-esteem and sport participation among adolescents.

While MBVG may increase motivation for authentic activity, there is little research showing how people perceive MBVG ability to increase activity levels. In one focus group study, Dixon et al. (2010) found that both children and parents perceived that MBVG offer a way to increase PA and improve fitness, but cost, game content, player age (i.e., MBVG viewed more appropriate for younger children), and lack of space in the home to play the games were perceived barriers to long-term engagement. In another study, pre-service physical education teachers perceived that MBVG were not as rigorous and failed to solicit MVPA as compared to the authentic activities (Jenny et al., 2013). Finally, Shafer, Carbonara, and Popova (2011) found that, in the context of Microsoft's Xbox 360 golf, racing, and boxing MBVG, spatial presence (i.e., the sense of actually being present in the virtual environment) and perceived reality (i.e., the degree of correspondence between the media representation and the real-world content) predicted participant enjoyment. The dearth of research surrounding perceptions needs to be addressed.

STUDY PURPOSE AND SIGNFICANCE

The purpose of this study was to examine the ability of a MBVG to motivate participants to attempt an authentic wall/rock climbing experience. This was accomplished by answering the following research questions:

1. Will playing a MBVG of wall/rock climbing motivate feelings of wanting to attempt authentic wall/rock climbing?
2. Will initial virtual and authentic wall/rock climbing experiences motivate later wall/rock climbing behavior?
3. Are MBVG and authentic wall/rock climbing environments consistent with people's perceptions of each?

This study is significant because the popularity and affordability of video games can allow individuals to use MBVG to introduce and participate in activities that may otherwise be unavailable due to logistical or financial constraints. MBVG could provide more PA opportunities for children and adults, especially if the perceived intensity level is similar to authentic activity. Finally, MBVG could be found to motivate authentic sports, thus also increasing PA.

METHOD

DESIGN AND PARTICIPANTS

As seen in Table 1, participants included a criterion-based convenience sample of 24 participants (18 female, average age *M* = 21.92, *SD* = 6.19) age 18 years or older who were students or employees of a liberal arts university located in the southeastern region of the United States. Participants had no previous rock climbing experience. A mixed-methods multiphase intervention design with two randomized groups was utilized. The intervention had two phases. In phase one, one group started with the MBVG first (GF; 8 female, average age *M* = 23.2, *SD* = 8.22), while the second group started with the climbing wall first (WF; 10 female, average age *M* = 20.5, *SD* = 2.87). During the second phase, the groups switched activities. The majority of participants had video game experience, 79.2% had played any Microsoft Xbox gaming system (GF = 9, WF = 10) and 62.5% had experience with the Microsoft Kinetic (GF = 6, WF = 9). Interestingly, 95.8% of the participants had played at least one MBVG (GF = 12, WF = 11).

Table 1. Demographics of Game First (GF) and Wall First (WF) Groups

Variable	Game First Group	Wall First Group
Gender (%)		
Female	4 (33.3)	10 (83.3)
Male	8 (66.7)	2 (16.7)
Age (SD)	23.3 (8.22)	20.5 (2.87)
Race/Ethnicity (%)		
African American	4 (33.3)	5 (41.7)
Asian/Pacific Islander	1 (8.3)	0 (0)
Caucasian	6 (50.0)	5 (41.7)
Hispanic/Latino	0 (0)	1 (8.3)
Multi-Racial	0 (0)	1 (8.3)
Other	1 (8.3)	0 (0)
Student (%)		
Undergraduate	10 (83.3)	12 (100)
Graduate	1 (8.3)	0 (0)
Other	1 (8.3)	0 (0)
Academic Major (%)		
Athletic Training	2 (16.7)	1 (8.3)
Exercise Science	6 (50.0)	3 (25.0)
Physical Education	0 (0)	1 (8.3)
Sport Management	2 (16.7)	2 (16.7)
Other	2 (16.7)	5 (41.7)
Video Games Played – hrs/week (SD)	0.88 (1.44)	3.29 (6.04)

Recruitment entailed informational flyers, emails, classroom announcements, and word-of-mouth. To encourage participation, participants were given a chance to win one iPad mini (Apple Inc., Cupertino, CA) through a raffle. Offering incentives is an effective, common means of encouraging participation that is ethically justifiable (Brown & Merritt, 2013). Institutional Review Board approval and participant consent were obtained prior to the study's execution.

INSTRUMENTS

Questionnaire. Participants were given a 31 question internet survey (see Appendix A). The survey was designed and distributed using the Qualtrics Research Suite

(https://www.qualtrics.com). First, participants were asked demographic information (i.e., gender, age, race, type of student, academic major, and previous video game experience). Then, using a 10-point Likert scale, participants rated their interest in rock/wall climbing and MBVG (e.g., "I am interested in wall/rock climbing"), as well as their motivation to continue wall climbing and playing MBVG (e.g., "I am excited about performing wall/rock climbing on a 'real life' climbing wall"). In addition, participants rated their perceived effort level required to wall/rock climb in both the MBVG and authentic environments via rate of perceived exertion.

Rate of Perceived Exertion. The Modified Borg Rating of Perceived Exertion (RPE; Borg, 1998) was used to measure participants' PA intensity level prior to and during the MBVG and authentic wall/rock climbing experiences (see Appendix B). Instead of using a rating scale of 6 (no exertion) to 20 (maximal exertion), participants rated their level of effort from 0 (very easy) to 10 (extremely hard).

THE MVBG USED IN THIS STUDY

The video game Kinect Sports Rivals Rock Climbing (Microsoft Studios, Redmond, WA) utilizing the Xbox One (Microsoft, Redmond, WA) MBVG console was utilized in this study. Through the use of software and a motion-detection camera (without a handheld controller), the Xbox One system mimics player(s) physical movements and displays them via an on-screen avatar. In Kinect Sports Rivals Rock Climbing, players climb a series of massive structures from upturned ocean liners to cliff walls in a race to the top. Players must reach toward handholds, close their fingers/hands to grip, and then move their arms/hands down to their sides in order to climb onward. Also, players can clear a gap in handholds or avoid other traps by jumping to initiate an avatar's upward leap. Electrified handholds, wind gusts, or fellow chasing competitors who can seize an ankle and throw a player off the climbing structure are all types of traps within the game.

PROCEDURES AND DATA ANALYSIS

Prior to the first phase, participants from both groups completed a questionnaire. Participants randomly assigned to the GF group then completed two video gaming sessions playing Kinetic Sports Rivals Rock Climbing (Microsoft Studios, Redmond, WA), a MBVG that simulates wall/rock climbing from a third-person perspective. The game was played on the Xbox One with Kinetic (Microsoft Corporation, Redmond, WA), a MBVG console. The first session introduced the participants to the game, while the second session was just game play. Each gaming session was 30 minutes. The participants randomly assigned to the WF started by completing two wall/rock climbing sessions on a 36 foot indoor climbing wall with a top rope manual belay system controlled by certified wall/rock climbing staff. The first session was an introduction to climbing, while the second session was just climbing – each session consisted of 30 minutes of climbing.

After phase one was complete, participants took the same questionnaire before starting phase two, where the groups switched activities and followed the same protocol. At the conclusion of phase two, participants completed the questionnaire again as a post-assessment. Each participant's self-reported RPE was recorded after each gaming or climbing wall attempt during both intervention phases. Approximately twelve weeks after the second phase, participants were emailed the questionnaire a final time (20 responses, response rate of 83%).

Following the video game and rock wall sessions, a one hour focus group was done separately with each group. The focus group followed a semi-structured interview schedule. Underpinned by a constructivist perspective, focus groups allow for high-

quality qualitative data in a social setting where participants are permitted to voice their opinions in the context of the views of others (Merriam, 2009). Questions centered on the video game and wall climbing experience, allowing the participants to reflect on how the video game influenced their motivation to wall climb and their preconceived perceptions of MBVG and authentic wall/rock climbing. An Olympus digital voice recorder model VN-8100PC (Olympus Imaging America Inc., Center Valley, PA) was used as the main method of data collection for the focus group.

Qualitative analysis. Atlas.ti (Scientific Software Development, 2011) was used to assist in organizing and categorizing the focus group data. First, the data was coded for its primary categories (i.e., open coding) and then was re-analyzed around these core open coding phenomenon (i.e., axial coding). Finally findings were generated through the interrelationships of the major coded categories (i.e., selective coding). The coded categories were then used for each research question (see Table 2).

Quantitative analysis. Descriptive statistics were computed for the sample. Wilcoxon signed rank test for paired data were used to compare scores across the time points for both the GF and WF groups. The comparisons were made for each research question. The non-parametric analysis test was used due to the of the small sample size and because data were ordinal but not internal or normally distributed (Ott & Longnecker, 2010). The paired t-test was used to compare mean RPE scores (Research Question #3). Significance was set at $p < 0.05$; all quantitative analyses were conducted using IBM SPSS Statistics (IBM, 2014).

RESULTS

RESEARCH QUESTION #1

Will playing a MBVG of wall/rock climbing motivate feelings of wanting to attempt authentic wall/rock climbing?

Following the gaming session, the GF group's interest in pursuing rock or wall climbing significantly decreased from a median score of 6.5 to 5.5 ($W+ = -2.156$, $p < 0.05$). Interestingly, while not statistically significant, the median score for the WF group's interest in pursuing rock or wall climbing after the first phase increased from 6.5 to 7.0.

While all qualitative data was collected after both MBVG and authentic wall/rock climbing experiences occurred, the majority of both the GF and WF participants felt the MBVG did motivate them to want to wall/rock climb in "real life" – citing that the MBVG: increased self-confidence in climbing, created feelings of self-accomplishment, was fun, and facilitated a desire of wanting to compare their success/skill level between the game and the wall (highlighted in Theme 1 of Table 2 with sample supporting quotes). Conversely, the most commonly reported reason for a small minority of participants as to why the MBVG did not motivate them to want to wall/rock climb was that the MBVG made it appear authentic wall/rock climbing would be too difficult.

Table 2. Q*ualitative Theme Findings with Representative Supporting Quotes*

1) The *KSRRC* video game motivated the majority of both the GF and WF participants to want to wall/rock climb in "real life" because the game was perceived to…
Increase self-confidence in climbing.
"*The video game is much easier than the real wall. So I think the game will make me feel more confident for myself. So it makes me want to try it. I can really do it in real life*."

Create feelings of self-accomplishment.
"*My first day playing the game, I achieved something; I climbed a wall. I was sweating…[my] arms are not used to staying up and…I was actually using my legs…I was trying to figure it out. But I actually felt like I climbed a wall when I left there that day…It was real*."

Be fun.
"*The video game [provided physical] activity and was really fun. It made me want to actually rock climb.*"

Facilitate a desire of wanting to compare if the participant was as successful/skillful on the wall as in the game.
"*It really did spark your curiosity as to whether you could actually make it up…the real wall in a similar way, or similar amount of time, as you did on the video game wall*."

A small minority of GF and WF participants most commonly cited the following reason why playing the *KSRRC* video game did *not* motivate them to want to wall/rock climb in "real life":

***KSRRC* made it appear rock climbing would be too difficult**.
"*I was terrible at the game which would make me think I'd be terrible in real life.*"

2) The vast majority of GF and WF participants felt they *would continue* "real life" wall/rock climbing after the *KSRRC* and authentic climbing experiences because authentic wall/rock climbing was perceived as…

A good workout (i.e., good form of exercise).
"*I definitely want to keep climbing [the wall] because that was a really good workout. It made me realize exactly how sore you can be from rock climbing. I never really thought that it was that much of a workout. But oh my goodness, that was a workout*."

"*[Rock Climbing] is physical and mental, so it's like an all-over workout. You just feel good about yourself afterwards all over*."

Challenging (particularly for self-described "competitive" participants).
"[I plan to continue to rock climb because] I'd like to challenge myself. When climbing I can only focus on keeping going – this feeling is great!"

"*[I plan to continue to rock climb] to see how far [up] I can get…If I get really good, time myself – see how fast I can get. It's just a competitive thing just to make myself better*."

A small minority of GF and WF participants felt they would *not* continue wall/rock climbing after the *KSRRC* and "real life" rock climbing experiences because authentic wall/rock climbing was perceived as…

Too difficult.
"*It was just exhausting. I'd just rather go to the gym and work out*."

3) Preconceived Perceptions of Virtual and "Real" Wall/Rock Climbing

Virtual (*KSRRC*) Wall/Rock Climbing:

More Effort than Perceived

"*You do hurt. You do use some energy…You would think: 'it is just a video game. I'm not going to break a sweat,' but I had to take off my jacket…because I was like: 'it is hot. I'm losing energy. My mouth is dry. My arms are hurting.' It was hard*."

"Real" Wall/Rock Climbing:

More Effort than Perceived

"*Real life rock climbing was more challenging than I thought it would be. The amount of hip mobility was unexpected as I thought it would be primarily upper body strength; as a result my forearms quickly became sore and made the climb more difficult than anticipated*."

More Challenging Mentally than Perceived

"*It requires more thinking than I actually thought it [would]…I thought that I could just go up the wall like Spiderman…, which didn't happen…I think strategizing to figure out which direction to go was definitely difficult*."

Note. All qualitative data was collected after both the gaming and "real life" wall/rock experiences occurred. *KSRRC = Kinect Sports Rivals Rock Climbing*; GF = game first participants; WF = wall first participants.

RESEARCH QUESTION #2

Will initial virtual and authentic wall/rock climbing experiences motivate later wall/rock climbing behavior?

As seen in Table 3, the average score for intending to wall/rock climb after the study increased after each phase for both groups. Although the differences were not statistically significant, the largest increase occurred in the WF group following their wall/rock climbing experience. In addition, the GF group's average score increased almost a full point after the wall climbing sessions but stayed the same after the gaming sessions. Similar to the first research question, the wall climbing had a larger influence on the participant's scores.

Table 3. Intention to Go Wall/Rock Climbing after the Conclusion of the Study (Mean Score)

Group	Pre	Mid	Post
Game First	5.33	5.33	6.17
Wall First	5.67	6.92	6.58

Note. Response item: "*After this study, I plan to go "real life" wall/rock climbing*." Ten-point Likert scale (1 = strongly disagree; 10 = strongly agree).

At the six week follow-up, two participants reported enrolling in the University's rock climbing class (one from each group) and another participant reported regularly wall climbing (estimated 20 climbing sessions over six weeks). When asked why the remaining

participants did not participate in any climbing activities after the conclusion of the study, the majority stated that they did not have time. Eight participants noted that they played MBVG at least once since the conclusion of the study. Interestingly, the eight participants did not include the three participants who physically wall climbed after the study.

Qualitative data, as seen in Theme 2 of Table 2, revealed that the vast majority of GF and WF participants felt they would continue climbing after the MBVG and authentic wall/rock climbing experiences because authentic wall/rock climbing was perceived as a good workout (i.e., good form of exercise) and challenging (particularly for self-described "competitive" participants). In contrast, a small minority of GF and WF participants felt they would not continue wall/rock climbing after the initial MBVG and authentic rock climbing experiences because authentic wall/rock climbing was perceived as too difficult (i.e., too physically demanding).

RESEARCH QUESTION #3

Are MBVG and authentic wall/rock climbing environments consistent with people's perceptions of each?

As seen in Theme 3 of Table 2, participants' preconceived perceptions of MBVG and authentic wall/rock climbing centered on effort (i.e., energy expenditure). Participants felt both the MBVG and authentic wall/rock climbing required more effort than they thought they would. In addition, authentic wall/rock climbing was more challenging mentally than perceived for these novice climbers, as found in Theme 3 of Table 2. Likewise, as displayed in Table 4, all participants perceived to work harder on the climbing wall as both groups reported a statistically significantly higher RPE during the wall climbing than during the MBVG sessions.

Table 4. Average Rate of Perceived Exertion (RPE) for MBVG and Authentic Wall/Rock Climbing

Group	MBVG Session 1	MBVG Session 2	Overall MBVG Sessions	Authentic Climbing Session 1	Authentic Climbing Session 2	Overall Authentic Climbing Sessions
Game First	3.42	3.33	3.36†	5.79	5.95	5.86†
Wall First	2.97	2.73	2.89*	5.75	4.60	5.17*

Note. †Statistically significant difference ($t = 6.86$, $p \leq 0.01$). *Statistically significant difference ($t = 3.41$, $p \leq 0.01$)

DISCUSSION

RESEARCH QUESTION #1: WILL PLAYING A MBVG OF WALL/ROCK CLIMBING MOTIVATE FEELINGS OF WANTING TO ATTEMPT AUTHENTIC WALL/ROCK CLIMBING?

The quantitative results indicated that the MBVG did not motivate participants to pursue authentic wall/rock climbing. In fact, the GF groups' median score on interest in pursuing authentic wall/rock *dropped* a half-point. Thus, the present study's quantitative results challenge the popular assumption that MBVG themselves will motivate authentic activity. Sheehan and Katz (2010) stated that "children may be more inclined to attempt playing an actual sport if they have experienced the activity in the relatively safe

environment of exergaming [i.e., MBVG]" (p. 16). The climbing MBVG may have been more successful in motivating authentic activity if it was integrated into a broader strategy for motivating students. For example, Hill (2009) described how the Hierarchy for Independent Physical Activity helps instructors to structure physical activities in such a way that it encourages children to adopt the activities outside of a classroom or gym. By providing a structure to the activity, the students are given autonomy to create PA routines that could incorporate MBVG into a regular PA routine. Future research should explore a more structured approach to MBVG to promote the authentic activity.

Interestingly the results presented an internal contradiction. While the quantitative results showed a lack of motivation, the majority of focus group participants said that the MBVG made them excited to pursue authentic wall/rock climbing. This positive reaction came from the participants' perception that the MBVG helped build their confidence and create a feeling of self-accomplishment. For example, one participant commented that the "video game is much easier than the real wall. So I think the game will make me feel more confident for myself. So it makes me want to try it. I can really do it in real life." In addition, the game was perceived to be fun which appeared to heighten the anticipation for the authentic activity. Thus, the overall qualitative results revealed that playing the MBVG may have increased the participants' self-efficacy for the authentic activity, which has been shown to be a benefit of MBVG (Krause & Benavidez, 2014).

The increased self-efficacy does not explain the participants' conflicting perceptions of MBVG ability to motivate authentic activity. However, the stark contrast between the quantitative and qualitative results could be due to timing. Since the focus groups were conducted after the completion of both study phases, the participants' views may have changed. By reflecting back on the MBVG experience after completing the authentic climbing experience, participants may have retroactively felt the MBVG did help and/or motivate them to want to try authentic wall/rock climbing. Whereas the more negative quantitative results were collected immediately after the MBVG and before the authentic experience. Future research should examine this contradiction by conducting interviews and/or focus groups prior to starting the authentic activity.

RESEARCH QUESTION #2: WILL INITIAL VIRTUAL AND AUTHENTIC WALL/ROCK CLIMBING EXPERIENCES MOTIVATE LATER WALL/ROCK CLIMBING BEHAVIOR?

Although not statistically significant, Table 3 shows that both group's mean scores for "the intention to wall/rock climb in the future" increased after completing the authentic wall/rock climbing experience. This suggests that the authentic experience increased motivation to pursue wall/rock climbing, a trend partially supported by Sheehan and Katz (2010) who stated that it may be beneficial to expose someone to an authentic activity after playing that activity on a MBVG because MBVG can increase physical literacy (i.e., competence in a wide variety of physical activities that benefit the development of the physical, cognitive, social, and affective learning domains). Increasing an individual's physical literacy will most likely also increase an individual's self-efficacy to complete the activity, as discussed above regarding the focus group comments (Theme 1 of Table 2). Mean scores, however, either remained unchanged or lowered after playing the MBVG.

In addition, Epstein, Beecher, Graf, and Roemmich (2007) found similar results, reporting that children did not find an interactive bicycle video game more motivating than riding the bicycle alone or the bicycle plus concurrent video. Previous research has also shown that MBVG do not motivate participants to pursue the authentic version of the exercise, instead when given the choice between traditional games (i.e., sedentary board games), exercise, or MBVG, children frequently chose traditional games after they had

been physically exerting themselves with other MBVG and authentic versions of the exercise (Fleming Park Leisure Centre, 2007).

Thus, the MBVG may be improving physical literacy and self-efficacy, but similar to the quantitative result in Research Question 1, the MBVG appears to not directly be contributing to an individual's motivation to pursue the authentic activity in the future. As a result, to increase future participation in the activity, or to increase PA in general, the authentic experience may be more beneficial than the MBVG. This finding is particularly important for physical educators who desire to motivate PA in children outside of class and after graduation. It appears that the MBVG version of a PA is not as motivating as experiencing the authentic version of the PA or sport, calling into question the usefulness of MBVG in promoting later authentic PA (which typically burns more calories) in physical education. More research is needed in this area.

It should also be noted that the lack of significance in the current study is most likely due to a small sample size resulting in a lack of statistical power. Thus to statistically verify the current result's trends, future research should include a larger sample size with a longer treatment duration.

RESEARCH QUESTION #3: ARE MBVG AND AUTHENTIC WALL/ROCK CLIMBING ENVIRONMENTS CONSISTENT WITH PEOPLE'S PERCEPTIONS OF EACH?

The results indicated that participants did not have an accurate perception of the amount of effort required for either the MBVG or authentic experience. As seen in Theme 3 of Table 2, participants found both activities to be harder than expected. It appeared that the majority of participants did not think the MBVG would be physically or mentally challenging, yet when asked, one participant surprisingly admitted, "You do hurt. You do use some energy…" Interestingly, only the authentic wall climbing was seen as mentally challenging. For example, one participant noted, "It requires more thinking than I actually thought it [would]…I thought that I could just go up the wall like Spiderman…, which didn't happen…"

While it was clear that participants perceived both activities as challenging, as expected, the authentic wall/rock climbing required more physical effort than the MBVG (see Table 4). Both groups' RPE was consistently higher for the authentic climbing. The RPE scores were supported by the focus group responses, for example, as a participant said that the "real life rock climbing was more challenging than I thought it would be."

These perceptions are important, particularly regarding the amount of physical effort, because of MBVG are increasingly becoming a popular vehicle to increase caloric expenditure, especially among children and adolescents. As previously mentioned, the results indicated that the amount of physical effort required to play the MBVG was not perceived to be equal to the authentic activity. Previous research has come to similar conclusions showing that the energy expenditure of MBVG activity is similar to moderate-intensity walking, falling below the recommended intensity for cardiovascular fitness (Graf, Pratt, Hester, & Short, 2009; Graves, Ridger, Williams, Stratton, Atkinson, & Cable, 2010). In addition, Jenny et al. (2013) revealed that pre-service physical education teachers do not feel that MBVG are as effective in eliciting MVPA as other authentic activities. Jenny et al.'s (2013) conclusion supports the current study's perceptions that PA is greater with the authentic activity than the MBVG version.

It is important to note that RPE is a subjective measure; thus, the results may not objectively reflect the required effort and/or energy expenditure. To address this limitation, future research could use multiple measures of effort, as well as objective measures (e.g., accelerometers, heart rate, etc.) to track energy expenditure to compare the virtual and authentic experiences.

CONCLUSION

The current study used a mixed-method, intervention-based design to explore the effects of MBVG and authentic wall/rock climbing to motivate future activity adoption. It was shown that MBVG do not adequately increase immediate or long-term authentic wall/rock climbing. In addition, the study found that the individuals' physical and mental perceptions were inaccurate for both MBVG and authentic climbing. Authentic climbing was pre-conceived and found to be more physically and mentally demanding than MBVG climbing. Please note that the results may not generalize beyond the specific sample or MBVG (*Kinect Sports Rivals Rock Climbing*) used in the study. Future studies should also utilize a larger sample drawn from different populations (e.g., children, adults, athletes) and different MBVG (e.g., tennis, bowling, dancing). Despite the study's limitations, it revealed that an authentic experience may be more beneficial than a MBVG to increase effort and caloric expenditure, as well as promote future PA adoption.

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APPENDIX A

Participant Questionnaire

Demographic Information

1. Gender?
- A. Male
- B. Female
- C. Other (Please Specify)

2. Age (in years)?

3. Race/Ethnicity?
- A. African American
- B. American Indian or Alaska Native
- C. Asian/Pacific Islander
- D. Caucasian
- E. Hispanic/Latino
- F. Multi-racial
- G. Other (Please Specify)

4. Type of Student?
- A. Undergraduate
- B. Graduate
- C. Other (Please Specify)

5. Major?
- A. Athletic Training
- B. Exercise Science
- C. Physical Education
- D. Sport Management
- E. Master of Science in Sport & Fitness Administration
- F. Other (Please Specify)

Video Gaming Experience

5. About how many hours do you spend playing video games (i.e., computer, gaming system, arcade, etc.) each week?

Wall/Rock Climbing Experience

6. Have you ever rock/wall climbed before?

A. Yes

B. No

7. Have you ever played the Kinect Sports Rivals game "Rock Climbing" on the Xbox One before?

A. Yes

B. No

Interest of Wall/Rock Climbing

Please indicate your level of agreement with each statement below:

8. I am interested in wall/rock climbing.

9. After this study, I would like to wall/rock climb more.

Intention to Wall/Rock Climb

Please indicate your level of agreement with each statement below:

10. I am excited about playing wall/rock climbing video games.

11. I am excited about performing wall/rock climbing on a "real life" climbing wall.

12. Playing a motion-based rock climbing video game will motivate me to want go wall/rock climbing in "real life."

13. After this study, I plan to go "real life" wall/rock climbing.

Perceived Effort

14. What is your perceived effort level required to play the "Rock Climbing" video game on the Xbox One?

15. What is your perceived effort level required to Wall/Rock Climb in "real life"?

Note. Participants indicated their level of agreement using a 10-point Likert scale (1 = strongly disagree; 10 = strongly agree) for items 8–13. Participants utilized the Modified Borg Rating of Perceived Exertion (Appendix B; 0 = nothing; 10 = maximum) for items 14 and 15.

Appendix B

Modified Borg Rating of Perceived Exertion

Your perceived effort level:

Noth-ing	Very, Very Weak (just notice-able)	Very Weak	Weak (light)	Mod-erate	Some-what Strong	Strong / Heavy		Very Strong			Max-imum
0	0.5	1	2	3	4	5	6	7	8	9	10

Note. Borg (1998).