The Effect of Real-Life Movement on Shooting a Basketball: A Virtual Reality Study

Pratik Karki[2], Nicole Plantier[1], Changze Han[2], & Paige Nelson[1]

Department of Psychological and Brain Sciences[1]

Department of Computer Science[2]

University of Iowa

Keywords: accuracy, self-motion cues, real-life movement, virtual reality

Acknowledgments: The authors would like to thank Dr. Plumert, Dr. Kearney, and fellow classmates who participated in our study as subjects.

Conflict of Interest Statement: The authors have no conflicts of interest to report.

Introduction

Gaming in virtual reality (VR) is perhaps one of the most popular uses. Users can engage in intense gameplay either by themselves or with friends. Action and sporting games are among the most popular genres in virtual reality. One aspect of gaming while in a virtual environment is the accuracy of your movements. The ability of an individual to coordinate their real-life movements to the movements in VR is incredibly important to actions such as gaming. Self-motion cues generated by engaging in motion while in VR appear to have benefits; real-life movement can help an individual perform more accurately.

Cherep et al (2020) tested this in a series of experiments. They were curious as to whether the method of moving in VR had an effect on accuracy. In their experiments, they manipulated whether participants teleported through the virtual environment using a cursor, or if participants directly moved within their own environment to correspond with VR movement. Their results show that when participants physically moved, they were more accurate than when they teleported through VR space. These results suggest that mimicking real life movement in VR can lead to a more accurate performance Although this question has been investigated, there is an open question as to whether this mimicking benefit translates to other types of motion, such as throwing an object.

Our research question is: does mimicking the motion of shooting a basketball lead to greater shot accuracy when compared to a point-and click motion? To investigate this question we manipulated the method of shooting a basketball in a virtual environment using a between-subjects design. Participants either mimicked the motion of shooting a ball and launched with a trigger or they aimed their controller at the hoop and hit the trigger. We predict

that participants in the mimicked motion will have greater accuracy than the participants in the point and click group.

Methods

Design

The current study was a one-way between subjects design that examined two methods in which participants in a virtual environment threw a basketball.

Participants

Participants in the current study included 18 adults from an ongoing study, titled "The Effect of Real-Life Movement on Shooting a Basketball: A Virtual Reality Study." Participants were recruited from University of Iowa's PSY 7150:0001 Current Topics in Psychology and CS 4980:0003 Topics in Computer Science II course. Participants were eligible for this study if they were currently enrolled in the course. Enrollment for participants occurred in April 2021. Table 1 shows demographic characteristics for the sample. Participants did not significantly differ in age, gender, and handedness.

Table 1
Descriptive Characteristics of CA (N = 9) and CB (N = 9)

	Condition A	Condition B
	M or n (%)	*M or n (%)*
Age (years)	35	25
Male	4 (44%)	5 (55%)

Right-handed	8 (89%)	8 (89%)

Randomization

An online program was used to randomize participants (https://www.randomizer.org/). Participants were allocated into one of the two conditions.

Procedure

In both conditions, participants were instructed to set up their Oculus Go headset and hand controllers. From there, participants were instructed to download their APK files from the study's folder, which was sent to them prior by an experimenter. Also in the folder was a ReadMe file, which consisted of a set of instructions the participants were instructed to follow throughout the length of the experiment.

Participants randomized to Condition A, hereafter referred to as CA, were instructed to orient themselves in front of the basketball hoop and stand in front of the red line. From there, participants were instructed to press the Oculus Go trigger button to pick up the basketball. Then, participants were instructed to release the trigger button and point to the spot on or near the basketball hoop's backboard, using the Oculus Go, where they'd like to throw the basketball. Lastly, participants were instructed to press the trigger button when they were in their ideal position and ready to shoot the basketball. Participants were asked to complete ten practice trials, prior to moving on to twenty trials.

Participants randomized to Condition B, hereafter referred to as CB, were instructed to orient themselves in front of the basketball hoop and stand in front of the red line. From there, participants were instructed to press the Oculus Go trigger button to pick up the basketball. Then, participants were instructed to continue holding the trigger button, while physically orienting

themselves to their ideal position, before throwing the basketball. Participants were then instructed to throw the basketball, as they would in the real world, and release the trigger button at the peak of their throwing motion. Participants were asked to complete ten practice trials, prior to moving on to twenty trials.

Measures

Demographic Information. Demographic information was obtained for all participants using Google Forms, during which experienters asked participants to indicate their age, gender, and handedness.

Shot Accuracy. The dependent measure of interest was each participant's shot accuracy. Shot accuracy was measured as the amount the basketballs successfully shot into the basketball hoop out of a total of twenty. Each participant's shot accuracy was further broken down to percentage of shots successfully made. The ten practice trails were not taken into account for the purpose of analyses.

Results

The research question asked is: does mimicking the motion of shooting a basketball lead to greater shot accuracy when compared to a point-and click motion? To answer this question, we conducted an independent samples t-test on the accuracy scores for each condition. For condition A, the mean score was 6.67 ± 4.64. For condition B, the mean score was 4.22 ± 4.27. We conducted an independent-samples t-test and found that there was not a significant difference between the groups, $t(16) = 1.16$, $p = .262$. This is depicted in Figure 1 below.

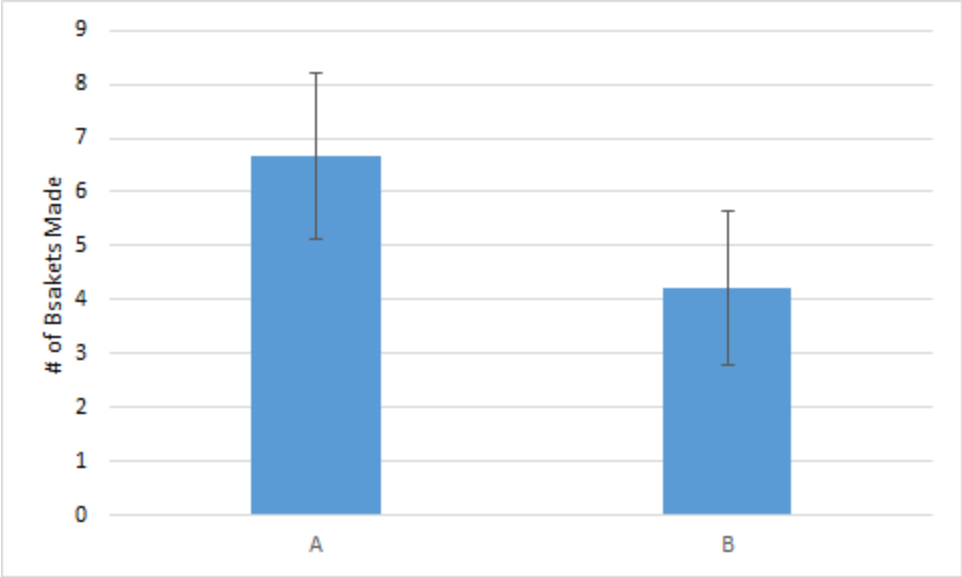

Figure 1. Mean scores of number of baskets made for CA and CB.

Discussion

The primary goal of the current experiment was to manipulate the method in which participants shot a basketball in a virtual environment. Half of the sample mimicked the motion of throwing a basketball using a press-and-release method with the Oculus Go hand controller's trigger button. The other half of the sample mimicked the motion of throwing a basketball as they would naturally in the physical world. There was no significant difference found between conditions on shot accuracy.

As stated above, we did not find a significant difference between the conditions. It seems that mimicking the natural shooting motion did not provide a benefit to participants. If anything, our results seem to be trending in the opposite direction than what we had predicted. Although not significant, the mean accuracy for the point and shoot condition was higher than the natural shooting motion condition. With more trials and more participants this difference may have reached significance. Our sample consisted of participants who probably have more

computer/gaming experience than the average person. Because of this, while participants did not experience a mimicking benefit in the natural shooting motion condition, they may have benefited from their experience as computer science students and gamers. The point and click condition uses similar motions that are used in video gaming.

There were various limitations to the current study. First, the sample size was small; there were nine participants in each condition. Second, there were too few trials and only one block. Last, and most importantly, a better measure of shot accuracy could have been used. For example, if a participant missed the basketball hoop but hit the backboard, they received the same score (i.e., 0 points) as someone who could have thrown the basketball in the opposite direction of the basketball hoop. If there was more time to complete the current study, we would have measured each participant's distance from the basketball hoop on every trial, during which participants who would have shot closest to the basketball hoop received a higher score than those who did not.

As previously stated, we did not find a significant difference between the two conditions. There does not seem to be a benefit to mimicking natural motion to shoot a basketball. Although we did not find a significant result in our study there is future work that could be done on this topic. For example, in our experiment we couldn't examine trajectories of learning in each participant, let alone each condition. As stated in the limitations, if the current study included four to five blocks, per say, of twenty trials in each block, we could have examined learning using mixed-effects modeling in R and ask interesting questions. For example, do participants learn to shoot the ball more accurately as trials go on? If so, is there a difference in the learning curve for the mimicking shooting motion condition and the point and shoot condition? It would also be interesting to look at whether there are individual differences in the way participants

learn to shoot the ball. For example, how many trials does it take to accurately learn to shoot the ball? All of these questions would be interesting to conduct more research on in the future.

References

Cherep, L. A., Lim, A. F., Kelly, J. W., Acharya, D., Velasco, A., Bustamante, E., ... & Gilbert, S.B. (2020). Spatial cognitive implications of teleporting through virtual environments. *Journal of Experimental Psychology: Applied,* 480-492.