The effects of variable and constant practice on the success of ring toss.

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Abstract

Research efforts exploring different approaches to practice during the acquisition of novel motor skills has revealed that some methods have a greater impact on learning and are more beneficial than others. The two practice methods of interest in our research were constant practice and variable practice. Constant practice consists of participants practicing the same version of a single motor skill repeatedly and without varying the parameters of the skill. Variable practice, however, involves participants practicing different versions of a single motor skill by modifying one or more variable parameters. Previous research has demonstrated that variable practice is the more advantageous of these two methods, as it forces participants to adapt to the environmental changes of each version of the skill and modify their execution of the skill appropriately, which is a crucial ability to have during real-life/real-game situations. In the current study, we sought to observe and compare the success of ring toss performance between a constant and variable practice group over the course of four weeks. The effects of these two methods of practice was done by measuring the success of a constant and variable practice group over the course of four weeks and with ring toss being the novel motor skill. We found that there was no effect between the two group's performance during this time period. However, our results do indicate an improvement in the variable practice group's performance throughout the four weeks.

The Effects of Variable and Constant Practice on the Success of Ring Toss

Research efforts exploring types of practice when learning a new motor skill has been a highly debated topic in recent years. Throughout findings in literature, the pairing of constant and variable practice are two methods that have produced various effects on performance. Variable practice refers to the acquisition of a motor skill through the use of multiple versions of that skill (Yao, DeSola, & Bi, 2009). Contrarily, constant practice describes the learning of a motor skill using only one single version of that skill (Yao et al., 2009). Variable practice is often implemented because it allows for participants to be prepared for the diversification of their learned skill in performance situations. For example, in a competitive basketball game, players won't be able to consistently shoot from one specific location on the court at all times. Players will have to adjust each shot accordingly based on the different situations they will encounter during a game (free throw, three-pointers, lay-ups, passes to teammates, etc.). Through the use of variable practice, the athletes will have already needed to make adjustments, so these motor programs are readily available in their memory for recall. However, constant practice is also a popular teaching method because of the need to become efficient in one particular action of a new motor skill. For example, staying with the basketball theme, if a player needs to improve their free-throw shooting, they will only be practicing from one constant spot on the court because that is where they shoot from in a real game in all free-throw situations. With the above information known, and a new motor skill to explore, we question which method of practice, constant or variable, will have the greatest positive effect on the success of ring toss performance.

Literature thus far has not concluded which type of practice, constant or variable, would lead to a successful ring toss. We are conducting this study to determine which of these practice methods will generate a more successful performance of this motor skill. Leving, de Groot, Vegter, and van der Woude (2016) completed a study testing the effects of variable practice on the motor learning of manual wheelchair propulsion. Their findings established that variable practice led to increased mechanical efficiency and propulsion technique. However, this study did not observe variable practice relative to constant practice and which had a greater effect on efficiency and technique. In the execution of our study we will be examining the different impacts of these two methods in regard to ring toss performance. In addition, a study carried out by Shoenfelt, Snyder, Maue, McDowell, and Woolard (2002) investigated a group of participants under one constant practice condition and three variable practice conditions for basketball free throws. They discovered that the group that had the most variable practice performed just as well as the constant group during testing although they had lower practice performance. This brings to light that although participants may have decreased performance during acquisition, that does not mean that that will be the case during testing. Also, even during testing variable and constant conditions could be equal in performance, as they were in this study. A study done by Breslin, Hodges, Steeson, and Williams (2012) looked at whether constant or variable practice led to increased accuracy during basketball free throws. Their findings were that the constant practice group did not have a higher accuracy than the variable practice group. Another study, carried out by Shea and Kohl (1989), had comparable results showing that variable practice lead to greater retention during a force production task. Our study will be similar to this study in which we are

measuring whether the variable practice group will have increased accuracy, relative to the constant practice group, in ring toss performance.

Our experiment will involve ring toss execution using variable and constant practice. A ring toss will entail a performer, standing at a set distance from an upright rubber cone on the ground, tossing a one foot-diameter foam ring aiming to land it directly around the shaft of the cone. During practice, the Constant group will toss the ring from one specific unchanging location, and will be allowed 15 attempts. The second group (Variable) will practice ring toss from three different locations and will be allowed five attempts at each of the three distances. During the test, each group will toss from the same location, a distance neither of them have tossed from prior, and will be allowed 10 attempts. In accordance with previous research findings, we predict that the group using the variable method of practice will have more successful attempts during the test than the Constant group.

Methods

Participants

Fourteen University of Victoria students (7 male and 7 female) engaged in this experiment. The mean age of the participants was 20.6 +/- 1.7 years old. The mean experience level for the participants was 3.21 +/- 2.11. The height of the participants ranged from 60 inches to 76 inches with the mean height being 68.7 inches. All participants in this study provided consent in accordance with the human subjects guidelines provided by the University of Victoria.

Task and Apparatus

In our ring toss evaluation, we used various borrowed equipment from the University of Victoria's McKinnon building Equipment Rental desk to successfully run the experiment. The set up was as follows: two upright orange traffic cones (which stand two feet tall) were stacked on top of each other, and held steady by an 8-pound kettle bell on one corner of the cone's base, and an 8-pound free weight on the opposite corner. This type of weighted-down cone contraption was implemented so that the impact of a ring toss wouldn't disassemble the cone stack or placement. The 15 rings used were circular, covered in a foam layer, one foot in diameter, and 2.5 inches thick. In order to maintain consistency among participants, yellow tape markers were labeled and stuck to the ground at various distances from the cone. The tape markers were situated around the base of the cone (so that the cone placement was easily replicated with each data collection), at 7 feet (ft) from the cone, 10 ft from the cone, 13 ft from the cone, and 16 ft from the cone.

Procedure

Each student was assigned to either constant or variable practice, with seven students assigned to each. Constant practice consisted of 15 consecutive trials of ring tossing from a 10-foot distance from the cone and each student did their best to land the ring around the shaft of the cone. Participants used their dominant hand and were free to choose a style of throwing that was most comfortable for them (e.g. standing sideways, etc.). Once all 15 throws had been tossed, the student received a short break before moving directly into the test. The amount of time from practice to the test varied depending on how long it took to pick up the rings and how long until the participant was ready to throw (usually around 30 seconds). The test consisted of 10 trials again with each toss right after the other, but this time standing 13 feet away from the

cone. We chose 13 feet, 9 feet, and 11 feet as the distance for our tests as neither the variable nor the constant group practiced at this distance. These varying test distances are called transfer tests. The other 7 students assigned to variable practice also were given 15 practice trials but instead were instructed to toss 5 rings from a distance of 7 ft, 5 rings from a distance of 10 ft, and 5 rings from a distance of 16 feet, respectively. As with constant practice, students used their dominant hand and threw the rings in the way that felt most natural to each. Variable practice students participated in the same test identical to that of the constant group and were allowed 10 tosses all from the specified test distance. In this experiment, we only counted the number of successful ring tosses (i.e. those that landed around the shaft of the cone) during each test. Each participant was given a score out of 10 based on how many successful ring tosses they had. For example, if a student landed three rings around the shaft of the cone during the test, he or she would be given a score of 3/10.

Data Collection

Our experiment measured whether or not a variable or a constant practice group would be more accurate in ring toss. We measured the success of the ring toss based on if the ring went all the way around the shaft of the cone. An unsuccessful ring toss was when the ring missed the cone or hit the cone but then bounced off. We collected this data in a spreadsheet in Excel, counting the number of successful ring tosses they performed and what group, constant or variable, they were a part of. The measure of success of ring toss uses frequency count as its unit of measurement.

Data Analysis

We computed means, standard deviation, and created T-tests between the two groups. We converted our collected raw scores into percentage scores. On the two last days of collection, the groups performed a transfer test where each group threw from an entirely new distance that none of the participants had thrown from prior. This was to prevent people from learning to throw and improving performance at their assigned distances. The transfer test was also to prevent the floor and ceiling effects, which is when a task is either too difficult or too easy, so that even with consistent practice they cannot be successful and benefit from the acquisition phase. Additionally, at each time point, we calculated the mean and standard deviation for each group. We collected data from the two groups over four days, and therefore have 8 points we can compare. Through our data analysis, we compared how both groups performed over the course of the experiment. T-tests were used to compare and analyze the differences between the groups' performances.

Results

In our experiments, we tested whether constant or variable practice showed a greater effect on the performance of two different groups across four days of practice. Based on the data, the constant group did not improve from Day 1 to Day 4. Table 1 shows the mean accuracy and confidence interval for the constant practice group from Day 1 to Day 4. Figure 1 shows the mean accuracy in the constant group. Based on the data in Table 1, it shows that the mean accuracy and confidence interval of the variable practice group improved over the course of the data collection period. Figure 1 shows the trends of mean accuracy in the variable group.

Table 1.

The Mean Accuracy and Confidence Interval for the Variable and Constant Practice Groups Over Four Days of Ring Toss

	Day 1		Day 2		Day 3		Day 4	
	Mean	CI	Mean	CI	Mean	CI	Mean	CI
Variable	1.29	0.01, 2.56	2.57	0.51, 4.63	3.86	2.05, 5.66	4.14	1.98, 6.31
Constant	2.43	0.51, 4.34	2.14	0.89, 3.39	5.28	3.31, 1.98	2.57	0.73, 2.57

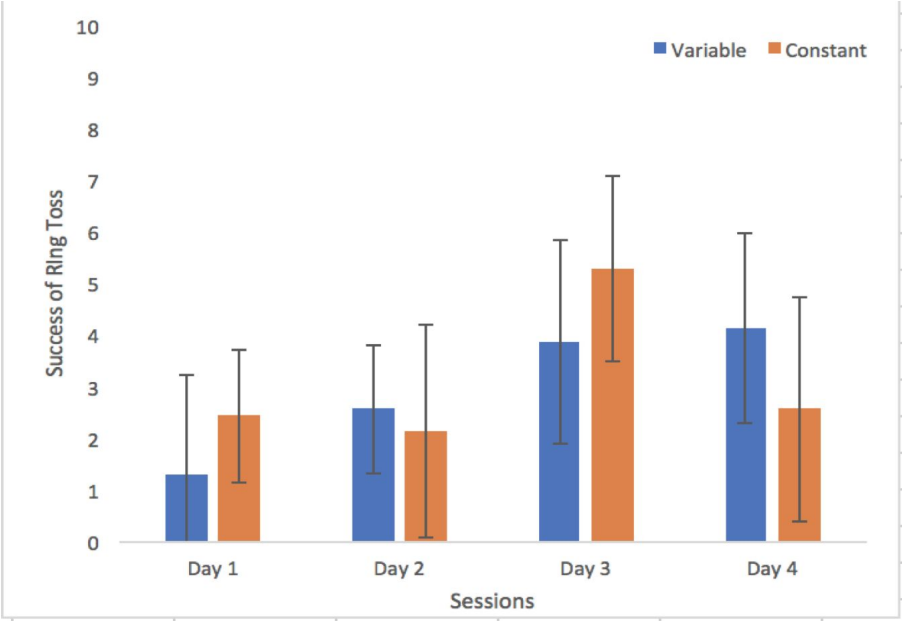

Figure 1. Comparing the mean accuracy, out of 10, between the two practice groups, constant and variable, for ring toss.

The second variable we tested for in our experiment was which group, variable or constant, performed more accurately at ring toss. Figure 1 compares the variable group's

accuracy to the accuracy of the constant group. The results showed that there was no effect between the variable and constant practice groups. Specifically, an independent samples t-test showed that the day 4 data collection proved a number more than 0.05, $t(12) = 1.34$, $p = 0.2$, $d = 0.72$. The constant group dependent samples t-test revealed that there was no trend on the fourth day of data collection, $t(6) = 0.42$, $p = 0.69$, $d = 0.16$. The variable group dependent samples t-test showed that there was an effect on the fourth day of data collection, $t(6) = 4.26$, $p = 0.005$, $d = 1.61$.

Table 2 illustrates the average heights and levels of previous ring toss experience. As shown in the table, the constant group had a higher mean height (higher than the variable group by 2.29 inches), and the constant group had a higher mean experience level (above the variable group by 0.71).

Table 2.

Mean Height and Level of Experience for All 14 Participants (7 in each group) in both the Constant and Variable Group

	Mean Height (in)	Mean Experience Level (scale of 1-10)
Constant	69.86	3.57
Variable	67.57	2.86

Discussion

Our research explored the question, which method of practice, constant or variable, would have the greatest positive effect on ring toss performance. Our data provided evidence supporting that there was no significant difference, p-value > 0.05, between the constant and variable groups. However, there was a significant change, p-value < 0.05, between the variable group from day 1 to day 4. There was no significant change between day 1 and day 4 for the constant group.

Our proposed hypothesis stated that variable practice would lead to better ring toss performance than would constant practice. Our results showed that our hypothesis was incorrect because there was no meaningful difference between the variable and constant groups. As can be seen in Figure 1, the variable group did improve steadily over the course of the four days of data collection, illustrated by the change between day 1 and 4. As mentioned above, however, the constant group did not significantly change over the course of data collection. A study done by Shoenfelt et al. (2002) found that variable and constant practice groups performed the same during a test for basketball free throws. This study coincides with the results we found in our study, in that the variable and constant groups performed similarly. However, not all literature we found was similar to our results. Leving et al. (2016) found that the implementation of the variable practice method led to an improvement in mechanical efficiency. In agreement with the findings of Leving et al. (2016), Breslin et al. (2012) experienced similar data, and concluded that the participants using the constant practice method had worse accuracy in basketball shots than did those using the variable practice method.

While our study may not show similar results to that of previous research, it may be due to the limitations of our study. We were working with a limited time frame of approximately 1.5 hours per week, for 4 weeks. Analyzing two practice groups multiple times per week over the span of 10 weeks, for example, would have allowed more time for the methods of practice to prove their effects. An extended data collection period would also allow for modifications to be made in order to accommodate for lack of outside control, such as the mental and physical stresses that students endure over the course of the experiment. Additionally, we lacked control of the participants outside of the experiment in which it is a possibility they could have been practicing on their own time and therefore acquiring better skill performance than the other participants. Another limitation of our study that should be adjusted in the future was our sample size of only 14 participants, 7 subjects in each of the 2 groups. A larger sample size would have made for more trustworthy results if a larger number of students that were all in the same practice group were experiencing the same effects. If we addressed some of the limitations in the previous paragraph such as the amount of time and the sample size, future research would perhaps provide a different outcome. Additionally, if our limitations were lessened, our results could better match the findings from our research. An additional impactful restriction in our study were the variances in skill level and learning speeds among participants. In future research, the subjects involved could all have similar prior experience with the skill of ring toss, in an attempt to gather more reliable data. This would more ensure that the learning that occurs in these participants is due to the type of practice rather than “natural talent”, previous experience in ring toss, or previous experience in other skills that could assist learning a ring toss.

Although our study was met with multiple limitations, including lack of control of the participants outside of the experiment, a small sample size, and a short data collection period, the experiment showed strength in other aspects. Some of the positive features involved in our research were relatively low levels of previous ring toss experience among participants, the subjects' overall enjoyment of our skill, the quickness of our skill completion, and the ease of set up. Additionally, our research regards a skill that has not previously been explored in any depth, at least in the field of motor learning. Although several other skills have been analyzed as to which form of practice would have the greatest positive impact on learning, our question is unique as it explores a new skill and can be used as a building block for future study in this area.

We analyzed the performance of each participant in the two different groups, constant and variable, by counting the number of successful ring tosses they completed during the test on each of the four days. We found that while constant practice did not have a significant effect on ring toss, variable practice did show to have a positive effect on the fourth day of data collection. To answer whether the constant or variable group had a more positive effect on ring toss performance, there was no significant difference between the two groups. Our future directions with ring toss, in addition to reducing our limitations, would be to compare other types of practice, such as massed and distributed or random and blocked practice, and whether they positively affect the success of ring toss performance.

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