Summer 8-1-2018

The effect contextual interference has on trajectory aim

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by

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B.A., Monmouth College, 2016

A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
Master of Science in Education

Department of Kinesiology
in the Graduate School
Southern Illinois University Carbondale
August 2018

RESEARCH PAPER APPROVAL

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Approved by:

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Graduate School
Southern Illinois University Carbondale
August 2018

ACKNOWLEDGMENTS

I would like to thank Dr. Porter for the assistance and patience it took to complete the editing process of this research paper.

Special thanks to Dr. Porter, Dr. Partridge, Dr. Yoh, Dr. Park, Dr. Ambati, as well as Kristiana Feeser for assisting me in recruiting participants for the experiment.

I appreciate all the students that participated in the experiment; without the students, this would not be possible. I would like to thank Southern Illinois University for supplying me with great professors.

Lastly, I would like to thank my mother, Nyela Malone for giving me the drive to complete my master's degree at her alma mater.

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CHAPTER 1

INTRODUCTION

Effectively teaching to produce the most optimal learning experience is a topic that has received much research attention. Both the teacher and the student contribute to the learning process. The characteristics needed to successfully perform a motor skill must be communicated from teacher to student clearly, and the student must retain what they have learned. Zetou, Michalopoulou, Giazitzi, and Kioumourtzoglou (2007) suggest that the organization and the variety of skills being taught are the most significant components that influence the acquisition of a motor skill. For the sake of this experiment; "organization" is pertaining to the arrangement of the trials and "variations" is pertaining to the variety of techniques used to perform a motor skill. Previous research indicates that gradually increasing contextual interference at a suitable rate will effectively challenge the learner (Porter & Saemi, 2010). Contextual interference is determined by how quickly or slowly a task is integrated and practiced in the context of other tasks (Landin & Hebert, 1997). Incorporating contextual interference even in the most basic motor skills has been shown to effectively benefit learners (Giuffrida, Shea, & Fairbrother, 2002). Research also supports that high contextual interference enhances learning for novices even when faced with a difficult task (Keller, Li, Weiss, & Relyea, 2006). Motor learning research generally concludes that the overall organization of the learning environment, as well as incorporating high contextual interference into practice situations plays a significant role in the skill acquisition process.

Fazeli, Taheri, and Kakhki (2017) found that novice learners that practiced motor skills in a random practice arrangement imagined a more structured mental depiction of a task when compared to those who practiced the same task in a blocked practice schedule. Additionally, Fazeli et al. (2017) concluded that practicing with high contextual interference improved students' capability to retain information for a longer period of time. Hall, Domingues, and Cavazos (1994) stated that random practice is beneficial in the earlier stages of learning a skill because it facilitates critical thinking and the overall process of achieving a desirable outcome. Furthermore, Shea and Morgan (1979) state that motor skills are more difficult to perform with high contextual interference compared to low contextual interference during practice or in the context of practice. Due to this higher amount of difficulty, participants practicing with random scheduling were forced to utilize numerous processing strategies during acquisition trials while such processing strategies were not necessary for the blocked group during acquisition (Shea & Morgan, 1979). This increase in processing strategies effectively challenged learners to constantly accommodate to the practiced task. As a result, this variation of skill arrangement improved motor learning. Porter and Beckerman (2016) suggest that increasing contextual interference challenges learners to modify their coordination patterns while executing a given task, rather than performing preplanned movements.

Essentially, learners must modify their coordination patterns when practicing in a serial and random schedule. Practice that incorporates a serial schedule offers similar benefits compared to random scheduling. A serial schedule is a predetermined pattern that is repeated. The repeating pattern creates less contextual interference compared to a random schedule. However, this form of practice creates more contextual interference compared to a blocked schedule because each trial introduces the learner to a different motor skill. An example of a serial schedule is instructing a learner to throw beanbags at a target from start locations marked A, B, and C and repeating the same sequence of throws nine times. Landin and Hebert (1997) reported that participants practicing with moderate levels of contextual interference recorded more improvement of the motor skill during the posttest than participants that practiced with blocked and random schedules. Additionally, Giuffrida et al. (2002) reported when participants practiced in a serial schedule they performed better than participants that practiced following blocked scheduling.

When analyzing the contextual interference effect, results of experiments typically demonstrate that groups practicing with higher amounts of contextual interference usually perform significantly better during retention and transfer tests compared to groups practicing with lower amounts of contextual interference (Porter & Beckerman, 2016). Contextual interference exists on a continuum with random scheduling representing a high amount of contextual interference and blocked scheduling representing low contextual interference. A serial practice schedule is place in the middle of the contextual interference continuum because it reflects a moderate amount of contextual interference.

The present study aimed to examine how altering the amount of contextual interference within a practice environment impacted the performance and learning of a novel throwing task. It was hypothesized that participants practicing the novel skill in a random and serial order would perform better on immediate and delayed retention tests compared to participants that practiced the same task in a blocked or serial sequence.

CHAPTER 2

METHOD

Participants

Male and female students (N = 60) attending a Midwestern university in the United States served as the volunteers for this study. Participants were randomly assigned to one of three practice conditions. Participants were required to sign an informed consent before participating in the experiment. The consent form as well as the methods within the experiment were approved by a university Institutional Review Board.

Task and Apparatus

Participants were instructed to perform a novice throwing task with their non-dominant hand; the dominant hand was determined by whatever hand felt most comfortable to throw with by each participant. Participants were instructed to complete 30 trials of throwing beanbags at a concentric ring surrounding a target. The center target had a circumference of 25 centimeters and each outer ring increased by 25 centimeters.

Scoring on the target ranged from 0-9. Zero's were given to beanbags that landed on the center of the target. The target had a total of nine concentric rings surrounding the center most ring. The rings were clearly labeled 1-9 from the inside going outward. Whichever ring the bean bag landed on determined the score for each trial. For example, a throw was scored a three if the beanbag landed within the third ring. If the target was missed completely, the throw was scored a nine. See Figure 1 below for a photograph of the experimental setup.

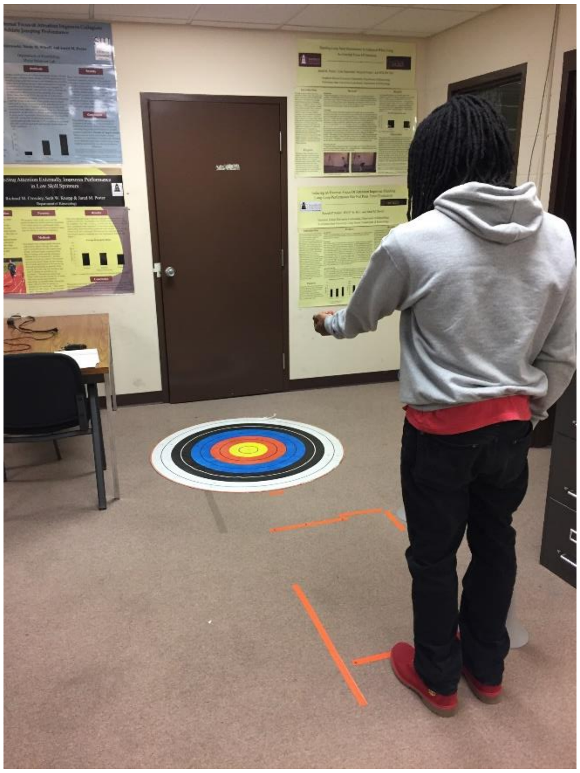

Figure 1. Experimental setup and target surface. The participant in the photograph is standing at the 2-meter start location.

Participants were required to underhand throw beanbags from three different start locations utilizing their non-dominant hand while standing and directly facing the target. The distances of the start points were: 1 meter (start location A), 2 meters (start location B), and 3 meters (start location C) away from the center of the target (see Figure 1 above). Only one beanbag was thrown at a time during each trial. Participants were tested individually, the researcher was the only other person in the laboratory during testing.

Procedures

Once the participant signed the consent form, they were given instructions regarding how to execute the task. Participants were given a total of three familiarization throws from the 1 m start location before testing initiated. Following the familiarization throws, each participant completed 30 practice throws within their respective condition. The initial 30 throws were followed by a 15-minute break, then each participant completed an additional 30 counterbalanced throws following their respective practice schedule (i.e., blocked, serial or random). Each participant returned the following day and completed an additional 30 trial post-test following their respective schedule (i.e., blocked, serial, random).

The three practice conditions that the participants were randomly assigned to were blocked, serial, and random scheduling. Throughout the practice and testing sessions the experimenter called out the letter “A, B or C” that were labeled on each of the start points. Participants in the blocked group were instructed to throw all their beanbags from all three start locations 10 times in a row. For example, a participant was instructed to perform 10 throws from start location A, 10 throws from start location B, and 10 throws from start location C. Participants in the serial order group were instructed to throw each beanbag at the target from a serial set sequence of start points. For example, a participant was instructed to perform one throw from Distance A, B, and C; then had to repeat the sequence nine more times, for a total of 30 throws. Participants in the random group were instructed to throw each beanbag following a random order of start points throughout the 30 trials with the stipulation that no more than two consecutive trials from the same start location were practiced in a row.

CHAPTER 3

RESULTS

Practice

Practice data were analyzed using a univariate analysis of variance (ANOVA), the alpha level was set at .05. The results of this analysis indicated that there were no significant differences between the three experimental conditions, $F(2, 60) = .347$, $p = .709$.

Immediate Retention

Similar to the practice data, the immediate retention data were analyzed using a univariate ANOVA, the alpha level was set at .05. The ANOVA revealed that there were no significant differences between the three conditions during the immediate retention test, $F(2, 60) =.554$, $p = .578$.

Delayed Retention

Lastly, performance during the delayed retention test were analyzed using a univariate ANOVA, the alpha level was set at .05. The ANOVA revealed that there were no significant differences between the three conditions during the delayed retention test, $F(2, 60) =.984$, $p = .308$.

CHAPTER 4

DISCUSSION

Overall, none of the results of the current experiment were significant. Previous research indicates that practicing with higher rather than lower amounts of contextual interference generally results in significant improvements in motor learning (Hodges, Lohse, Wilson, Lim, & Mulligan, 2014). The present experiment was designed to solely focus on the retention of a novel motor skill. The purpose of the current study was to examine the effects of contextual interference on a novice skill by comparing three different practice schedules (i.e., random, serial, and blocked) that introduced the learner to different amounts of contextual interference. It was hypothesized that participants practicing the throwing task in a random (i.e., high contextual interference) and serial (i.e., moderate contextual inference) schedule would perform better than those participants that practiced the task following a blocked (i.e., low contextual interference) order of practice trials. The results of the present experiment are not consistent with the experimenters' hypothesis. Specifically, the results revealed there were no significant differences between the three experimental conditions during practice or on the immediate and delayed retention tests.

Research suggests that contextual interference does not universally effect the learning of all motor skills. For example, an experiment by Poto (1988; as cited in Magill & Hall, 1990) found that a contextual interference effect may not occur when skill variations involve parameter modifications of the same motor program. In that study there were no significant differences between participants in blocked and random practice conditions when they practiced a rotary pursuit task varying in five speeds. The performance of all five variations of the rotary pursuit tracking task were controlled by the same generalized motor program. Similarly, in a study by

Pigott and Shapiro (1984; as cited in Magill & Hall, 1990) no group differences were observed between participants that practiced throwing beanbags of various weights in either a blocked or random order.

The methods used in the current experiment were similar to those utilized by Pigott and Shapiro's (1984), due to the same underhand throwing action being performed at three different distances (i.e., locations A, B, & C). Participants were required to perform different limb speed and force variations of the same underhand throwing task to effectively hit the targets. As a result, all three throwing variations were controlled by the same generalizable motor program (Magill & Hall, 1990). Other than limb speed and force, parameter modifications also include: overall duration, size of spatial configuration, and muscle groups recruited to perform a skill (Schmidt, 1975).

The findings of the current study support the conclusion that the contextual interference effect is not readily generalizable due to skill variations being controlled by the same motor program. Magill and Hall (1990) state that a more difficult learning environment is created when task variations are controlled by different motor programs. Practicing motor skill that are controlled by different motor programs results in more effortful processing, this increase in processing capabilities enhances the contextual interference effect. For example, the task would have required more processing for the participants in the current study if the they were instructed to perform underhand, overhand, as well as behind-the-back throws from the three distances within different practice schedule arrangements (i.e., random, blocked, and serial). Considering participants in the present study practiced skill variations that were controlled by the same generalizable motor program, it is not surprising that no significant differences were observed.

Given the contextual interference effect may not occur when skill variations involve parameter modifications of the same motor program (Magill & Hall, 1990), the methodology of the experiment was not beneficial to elicit the hypothesized outcome. The hypothesis was influenced by the assumption that the participants within the random group would be forced to utilize multiple processing strategies to enhance their performance in later trials (i.e., immediate and delayed retention) (Shea & Morgan, 1979). The non-significant results of the current experiment support the conclusion that the contextual interference effect is more likely to occur when variations of a skill (i.e., utilizing different throwing movements) are implemented rather than parameter modifications of the same motor program (Magill & Hall, 1990). Future research should consider parameter modification as a key factor when investigating the contextual interference effect. A second limitation of the present study is that only outcome measures were recorded (e.g., throwing accuracy). It would be valuable in future research to investigate performance production measures such as movement kinematics or kinetics. Although there were no observed differences in throwing accuracy, it is possible that throwing technique did vary between the experimental conditions.

Conclusion

In conclusion, the current study supports Magill and Hall's (1990) hypothesis that tasks requiring only parameter modifications may not benefit from a practice environment that introduces the learner to higher rather than lower amounts of contextual interference. From a practical perspective, clinicians desiring to incorporate contextual interference into instructional environments should consider doing this only when the practiced skill variations are controlled by different motor programs. The current study will serve as a good resource for methodology design for future experiments involving contextual interference. Also, this experiment will serve as a useful resource to aid in coaching, rehabilitation therapy, along with any other field involving teaching motor skills.

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The effect contextual interference has on trajectory aim

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