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Research Paper: The Effect of Self-Controlled Feedback on Motor Performance and Learning in Adolescents with ADHD

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Abstract

The aim of this study was to investigate the effect of autonomy support (i.e., in the form of self-controlled feedback) on learning and self-efficacy in a throwing skill in adolescents with ADHD. The subjects were 40 adolescents with ADHD (14 to 17 years old) and were randomly and equally divided into two groups: self-controlled and yoked. Motor task included to throw beanbags with the non-dominant arm at a target on the ground. The participants executed the pretest (10 trials), an acquisition phase including 6 blocks of 10 trials, and a retention test consisting of 10 trials. The participants in the self-controlled group received KR anytime the requested. The yoked group was matched with self-controlled group, but without having a choice to request for feedback. Prior to pretest, each block, and before the retention test, all participants completed the self-efficacy scale. Dependent measures were throwing accuracy scores and self-efficacy. Independent t test and analysis of variance (ANOVA) with repeated measures were used to analyze the data. The results showed that participants in the self-controlled group had significantly higher throwing accuracy scores in the acquisition phase and the retention test than those in yoked group. Moreover, participants in the self-controlled group reported significantly higher self-efficacy scores in the acquisition phase and the retention test than those in yoked group. The results of this study show that people with ADHD benefit from autonomy support to learn a novel motor skill.

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1. Introduction

There are various strategies for teaching new motor skills. Some of them included watching a video model (Baniasad et al, 2022; Mokhtari et al, 2007; Ghorbani & Bund, 2014; Ghorbani et al. 2020), mental practice (Afsanepourak et al., 2012), self-talk (Baniasad et al., 2022), and focus of attention (Ghorbani et al., 2020; Baniasadi et al., 2018, 2019). A recent theory that has received particular attention in the field of motor performance and learning of new motor skills is the OPTIMAL (optimizing performance through intrinsic motivation and attention for learning) theory (Wulf & Lewthwaite, 2016), which shows the important role of motivational and attentional variables in the optimal performance and learning of motor skills. In this theory, the influential variables are included a) enhancing expectancies for future performance, b) supporting learners' autonomy and (c) promoting an external focus of attention (Wulf & Lewthwaite, 2016). In the present study, we focused on the effects of autonomy support on motor performance and leaning. In the OPTIMAL theory, autonomy support refers to situations in which a person is allowed to control or choose some aspects of performance conditions. Several studies have tested the effects of the autonomy support on optimizing the motor skills and found that it positively affects performance and learning in a variety of motor tasks and across a range of age groups (Abdoshahi et al. 2022; Chiviacowsky, 2014; Chiviacowsky & Wulf 2002, 2007; Chiviacowsky et al. 2008, 2009; Ghorbani & Bund, 2020; Wulf et al. 2014, 2017). Moreover, it has been suggested that autonomy support and learners' expectancies are operationalized by the self-efficacy construct. Self-efficacy is generally defined as one's belief in one's ability to succeed in specific situations or to execute a task (Bandura, 1977; Dana, Hamzeh Sabzi, & Gozalzadeh, 2017). However, the autonomy support has received less attention in the attention deficit hyperactivity disorder (ADHD) population. Hence, the effects of autonomy support on the performance of learning of new motor skills in individuals with ADHD have rarely been investigated. ADHD is a common neurodevelopment disorders among children that can persist into adolescence and adulthood. It is associated with an ongoing pattern of inattention, hyperactivity, and/or impulsivity. Symptoms of ADHD can interfere with daily activities and relationships. It is also associated with a high rate of psychiatric problems such as mood and anxiety disorders, and cigarette and substance use disorders (Dana, Rafiee, Soltan Ahmadi, Sabzi, 2018; Eskandarnejad, Mobayen, & Dana, 2015; Farhangnia, Hassanzadeh, Ghorbani, 2020). It has been shown that people with ADHD often have learning difficulties. Therefore, it can be expected that the performance and learning of motor skills in people with ADHD will be associated with challenges. Therefore, due to the lack of research data on the use of autonomy support in improving the performance and motor learning of people with ADHD, the aim of this study was to investigate the effect of autonomy support (i.e., in the form of self-controlled feedback) on learning a throwing skill in adolescents with ADHD. In the literature, Chiviacowsky and Wulf (2002) and Chiviacowsky et al, (2008) found that autonomy support benefits performance in a sequential timing task and a throwing skill, respectively. Furthermore, Chiviacowsky (2014) found that participants of autonomy group reported greater self-efficacy at the end of the practice than yoked group. Wulf et al. (2014) demonstrated that autonomy support leads to higher self-efficacy than the yoked group. Thus, in the present study, it was hypothesized that exposing to self-controlled feedback would result in greater motor performance and learning as well as higher self-efficacy then yoked condition among adolescents with ADHD.

2. Method

The present study applied a causal-comparative method. The subjects of this study were 40 adolescents with ADHD in the age range of 14 to 17 years and were randomly and equally divided into two groups: self-controlled and yoked.

Motor task: Motor task in the present study included to throw beanbags with the non-dominant arm at a target on the ground. At the center of the target, there was a circle with a radius of 10 cm. The distance between the participant and the center of the target was three meters. Around the center of the target there were concentric circles with radiuses of 20, 30, 40, 50, 60, 70, 80, 90, and 100 cm. These circles were used to determine the accuracy of the throws. If the beanbag landed in the center of the target, then the score was 100. If it landed in one of the other circles, then the score was 90, 80, 70, 60, 50, 40, 30, 20, or 10 points, respectively. Finally, if it landed outside the circle, then a score of 0 was recorded.

Procedure: Participants were tested individually on two consecutive days. Prior to data collection, participants were given general information about the experimental procedure and asked to complete a questionnaire regarding information such as age, laterality, and previous experiences with motor task. Finally, participants were given brief instructions about the beanbag throwing task, which consisted of holding the beanbag with the non-dominant hand and throwing it at the target. To perform the protocol, the participants first executed the pretest, including 10 trials. During the acquisition phase, participants performed 6 blocks of 10 trials each, and one day later, they completed the retention test, consisting of 10 trials each without knowledge of result (KR). The participants were allowed to look at the target before each block, but during the pretest, practice, and retention phases they were prevented from viewing the outcomes by wearing opaque swimming goggles. To add autonomy support in the protocol, the participants in the self-controlled group received KR anytime the requested. It included the number of attempts, the score, and the direction of the landing relative to the center of the target. That is, if the beanbag landed in the upper part of the target, then a plus sign was added to the throwing score (e.g., +50). Conversely, if the beanbag landed in the lower part of the target, then a minus sign was presented before the throwing score (e.g., -50). Therefore, KR included information about the result's distance from the center of the target, as well as information about the direction of the error. The yoked group was matched with self-controlled group, but without having a choice to request for feedback. The participants were given six seconds to execute each throw. Time was measured with a digital chronometer. Prior to pretest, each block, and before the retention test, all participants completed the self-efficacy scale, in which they were asked to rate how confident they were, on a scale ranging from 10 (*not confident*) to 100 (*absolutely confident*), that they would be able to throw the beanbag at a target (i.e., a score of 100) on one of the following trials.

Data analysis: In the present study, the dependent variable included throw accuracy and self-efficacy in pre-test, acquisition phase, and retention test. Independent t test was used to analyze the research variables in pre-test and retention test. Analysis of variance (ANOVA) with repeated measures was used to analyze the data in the acquisition phase. The level of statistical significance was used at P <0.05.

3. Results

Figure 1 shows the accuracy scores across the pretest, acquisition phase, and the retention test.

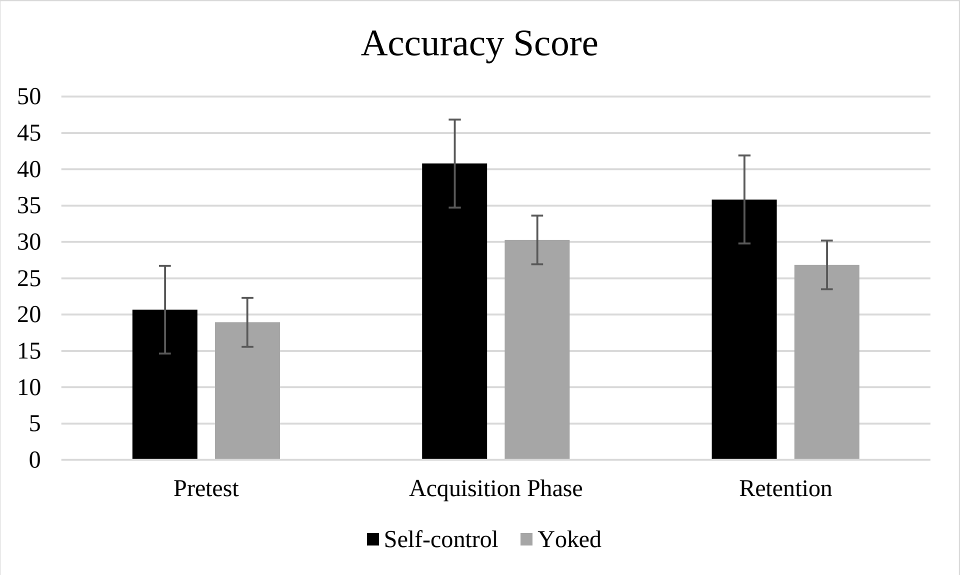
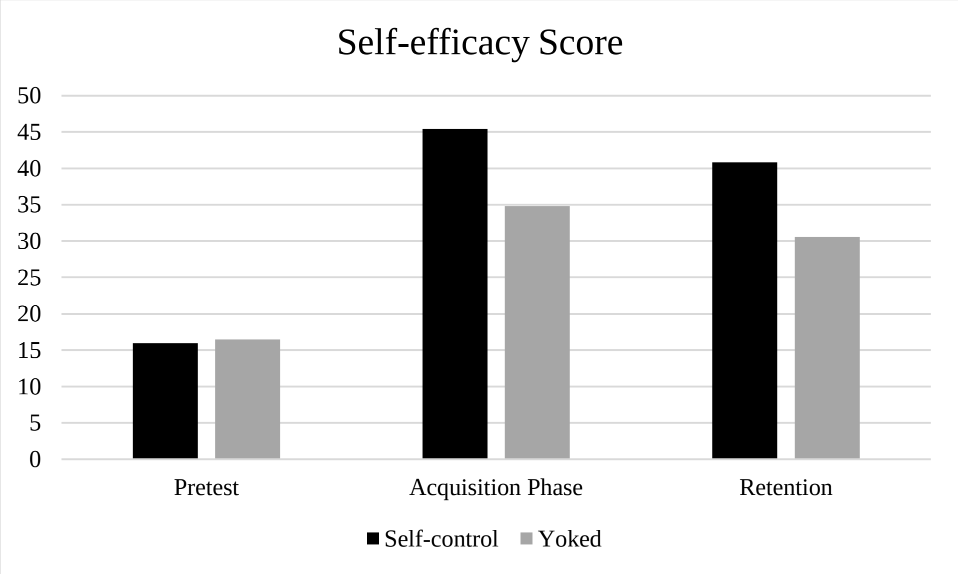


Figure 1. Accuracy scores across the pretest, acquisition phase, and the retention test.

The analysis of the pretest showed no significant differences between groups, t = 0.48, p = 0.56. This shows that both groups had identical condition before engaging in the protocol. During the acquisition phase, the performances of both groups improved significantly, F = 5.11, p = 0.000, η^2 = 0.12. Moreover, self-controlled group performed significantly better than yoked group, F = 6.73, p = 0.000, η^2 = 0.19. Finally, the data from the retention test indicated that self-controlled group performed significantly better than yoked group, t = 4.61, p = 0.000. Figure 2 presents the Self-efficacy scores across the pretest, acquisition phase and the retention test.



The analysis of the pretest showed no significant differences between groups, t = 0.24, p = 0.71. This shows that both groups had identical condition before engaging in the protocol. During the acquisition phase, the self-efficacy scores of both groups improved significantly, F = 6.41, p = 0.000, η^2 = 0.15. Moreover, self-controlled group reported significantly higher scores than yoked group, F = 8.69, p = 0.000, η^2 = 0.26. Finally, the data from the retention test indicated that self-controlled group reported significantly higher scores than yoked group, t = 8.83, p = 0.000.

4. Discussion

Due to the lack of research data on the use of autonomy support in improving the performance and motor learning of people with ADHD, the aim of this study was to investigate the effect of autonomy support (i.e., in the form of self-controlled feedback) on learning and self-efficacy in a throwing skill in adolescents with ADHD. We hypothesized that exposing to self-controlled feedback would result in greater motor performance and learning as well as higher self-efficacy among adolescents with ADHD. As expected, the results demonstrated that self-control practice led to significantly higher accuracy scores in both acquisition phase and the retention test than the yoked condition. That is, giving individuals with ADHD a choice to control practice condition resulted in higher motor performance and learning in comparison to yoked group. The results of the present experiment are in accordance with those of previous studies on healthy individuals (Chiviacowsky, 2014; Chiviacowsky & Wulf 2002, 2007; Chiviacowsky et al. 2008, 2009; Ghorbani & Bund, 2020; Wulf et al. 2014, 2017) indicating that autonomy support was clearly beneficial for motor learning in individuals with ADHD.

Interestingly, the self-control condition had beneficial effects on self-efficacy. Such results demonstrated that the self-control group reported significantly higher self-efficacy scores in the acquisition phase, and retention test than the yoked group. The findings generalize prediction of the OPTIMAL theory that autonomy would affect motivational states such as self-efficacy in individuals with ADHD (Wulf

& Lewthwaite, 2016). The results also are in accordance with the results of previous studies (Chiviacowsky, 2014; Chiviacowsky & Wulf 2002, Chiviacowsky et al., 2008; Ghorbani & Bund, 2020; Wulf et al., 2014). Present findings indicate that autonomy support has clearly increased motivation during practice and it remained at a high level in no-KR retention condition, while that was not the case for yoked group. To interprets these finding, it can be stated that in the OPTIMAL theory, it is assumed that autonomy support facilitates motor learning by making dopamine available for memory consolidation and neural pathway development and contribute to efficient goal-action coupling by preparing the motor system for task execution (Wulf & Lewthwaite, 2016). There is some evidence that feedback frequency may effect on motor learning in children with special needs (Kordi et al., 2017). So this issue should be considered in findings justification.

5. Conclusion

These results are important for practical settings, too. According to the benefits of self-control practice for enhancing self-efficacy and motor learning, it can be used as an effective method for teaching new motor skills to novices with ADHD. According to the OPTIMAL theory, enhanced intrinsic motivation and motor learning can be expected for individuals who were given a choice to control the training conditions.

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Conflict of interest

The Authors declare that there is no conflict of interest with any organization.

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