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Research Paper: Effects of Attentional Focus on Learning a Balance Task among Children with DCD

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Abstract

Motor learning studies on adults have shown that directing the learners' attention to external cues is more effectual than internal cues. In this study, we investigated if this could be applied to children with developmental coordination disorder (DCD). 45 boys with developmental coordination disorder were selected using motor observation questionnaire for teachers. The task was static balance test that was measured in two experimental conditions including internal (focus on body limb) and external (focus on rex marker) focus of attention. For data analysis, ANOVA and Tukey's post hoc were used at the significant level of $P < 0.05$. Results showed that external focus could improve motor learning. However, there was no significant difference between internal focus and control groups. Thus children with DCD benefit from the external focus of attention to learning a static balance skill. According to the results of this study, therapists and coaches should adjust their rehabilitation methods and instructions based on external focus of attention.

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1. Introduction

About 5 to 6 percent of school-aged children suffer from developmental coordination disorder (DCD). This disorder is a type of neuro-motor disability and most of the affected people have problems in performing and learning fine or gross motor skills, which can affect their daily activities and academic performance and lead to isolation, depression and a decrease in their quality of life (Abdollahipour et al. 2019; Saeedpour-Parizi et al. 2020, 2021). (Most of these children have problems with balance skills and have weaker postural control compared to their healthy peers, and therefore, are more exposed to falling and getting hurt. However, through exercise and therapeutic interventions, it is possible to improve movement and the balance of these children (Abdollahipour et al. 2015, 2017; Mohammadi et al. 2022; Hazrati et al. 2022; Hashemi Motlagh et al. 2022; Ghorbani & Bund, 2014, 2016; Ghorbani, Ghanati, Dana, & Salehian, 2020). Therefore, knowing more effective methods can be beneficial in the rehabilitation of these children.

Attention of focus is the act of directing a person's attention to specific sources of information or topics of interest during movement performance. The focus of external attention is directing a person's attention to external sources of information (such as the path of an object or the result of movement on the environment) and the focus of internal attention is directing a person's attention to his own body movements (Chiviacowsky et al. 2010; Dana et al. 2019, 2021; Ghorbani, & Bund, 2020; Ghorbani, Dana, & Christodoulides, 2020; Ghorbani, Dana, & Fallah, 2019). They direct the attention of learners to body movements or environmental signs. Researches have shown that when learning movement skills, it is better to direct the attention of adults to external signs than to internal signs (Flores et al. 2015; Ghorbani & Bund, 2017). These findings have been observed in balance tasks (Ghorbani et al. 2019, 2020), endurance (Baniasadi, Ranjbari, Khajehaflaton, Neshati & Dana, 2022; Chaharbaghi et al. 2022; Saemi et al. 2013) and various sports skills (Salehian, 2012a, 2012b, 2021). To justify this issue, Wulf et al. (2010) presented the action constrained hypothesis. According to this hypothesis, by adopting an internal focus and focusing on body movements, learners try to consciously control their movements and thus, the automatic control process is damaged, but by adopting an external focus, the possibility of controlling movement with automatic processes and the unconscious is provided and the result is more effective learning and performance (Wulf & Lewthwaite, 2016). On the other hand, according to the results of some researches, the skill level of the performers is also influential in this issue; So that in skilled players, the focus of external attention and in beginner players, the focus of internal attention leads to better performance and learning (Wulf & Su, 2007).

It can be considered that children, like beginner players, have little movement experience and are unfamiliar with movement tasks and have problems in focusing their attention during the execution of movement skills (Baniasadi, Ranjbari, Khajeaflaton Mofrad & Dana, 2022;

Chaharbaghi, Baniasadi & Ghorbani, 2022). According to the studies, only a few studies with contradictory results have investigated this have addressed the issue in children. Some researches (Baniasadi, Ranjbari, Abedini, Dana & Ghorbani, 2022; Seyedi Asl et al. 2016; Taghva et al. 2020) have suggested adopting an external focus of attention and others (Eskandarnejad, Mobayen, & Dana, 2015; Khosravi et al. 2023; Seyedi Asl et al. 2021) have also suggested adopting an internal focus of attention in children. In the case of children with DCD, although their motor learning processes have been studied in different ways has been placed, but more research is needed to eliminate the existing gap in the field of the focus of attention suitable for their performance and motor learning. With the investigations that were done, only one study (Chaharbaghi et al. 2022) on the subject of the effect of the focus of attention on the motor learning of children with DCD was found to indicate a difference in the use of the focus of attention in these children compared to normal children. Developmental differences may cause different motor learning (Saeedpour-Parizi et al. 2020, 2021) and the more effective focus of attention is different for adults, normal children and children with DCD. Therefore, investigating this issue will be useful for a better understanding of educational and therapeutic methods and instructions during performance and movement learning of these children. The purpose of this study was, therefore, to investigate the effect of the focus of attention on the motor performance of children with DCD. The performance of the participants in the balance task was examined and it was assumed that the effect of adopting an external focus of attention is better than an internal focus of attention.

2. Methods

This research was semi-experimental and applied in terms of its purpose. The statistical sample was selected in a targeted and accessible way from undergraduate students and elementary school students in Tehran in the academic year 2022. Children with DCD included 45 boys aged 9 to 11 (the presence of DCD disorder in these children was confirmed with the help of the teachers' movement observation questionnaire). The participants were randomly assigned into three groups including external focus of attention, internal focus of attention and control. Each group consisted of 15 participants. In order to cooperate in conducting the study, parents and children are not familiar with the task and the absence of obvious musculoskeletal, neurological or intellectual problems, and the exclusion criteria also include addiction, any type of illness or the use of any medication during the test period, and the presence of pathology or limitations. The entry and exit criteria were made through a researcher-made questionnaire and the medical and psychological records of the children in the school were examined. Meanwhile, in case of dissatisfaction or withdrawal of the participants in any of the stages test, there was no limit for not continuing their cooperation. Children with DCD were selected through the teachers' movement observation questionnaire. According to this questionnaire, children below the 15th

percentile were identified as children with DCD.

In this study, static balance performance was assessed. Static balance performance was measured using Warrior III Pose task. Children were asked to balance on the right foot while lifting the left foot off the ground and holding the hands above the head. The purpose of this test was to maintain static balance as much as possible. The time each child was at balance was measured by a digital stopwatch. The stopwatch started in a balanced position and stopped when an error occurred, such as when the left hand or foot hit the ground.

Protocol of this study was as following. First, a demographic information sheet was completed for each child by referring to the child record at school. The children were tested separately in a room set up for the study in the respective schools. As soon as they entered the particular room, demographic information such as age, height, and weight were obtained. Then, the details of the method and motor skill were provided to the child. To familiarize children with the protocol implementation environment and motor task, they were asked to perform static balance skill in a designated area once. Then, in the pretest, the children performed the static balance skill once without any feedback or instructions. Then, they participated in the acquisition phase in five training blocks, each of which consisted of three minutes of static balance task. Participants were given a two-minute break between each exercise block. One day after the acquisition test, the children took a retention test that performed static balance skill. In the pretest and retention test, children were asked to continue performing static balance skills as much as possible. Here, the length of time that children could perform the skill without error was calculated as their score in performing the static balance skill.

Regarding the external focus of attention, the children in the external focus group were instructed to "focus on the red marker" two meters ahead of them on the floor while performing the static balance skill. The children in the internal focus of attention group were instructed to "focus on their feet" while performing the static balance skill. There was no focus of attention instructions in the pretest and retention test and no red markers on the ground. To ensure that children follow the concentration instructions, we reminded the children how to concentrate at 10-second intervals during the exercise blocks. In order to measure the type and intensity of participants' focus, we asked all children to take the manipulation test after the acquisition phase. In the manipulation test, we asked the children "What are you focusing on?" to determine the type, and "How much did you focus on it?" on a Likert scale from 1 (not at all) to 7 (very much) to measure the focus intensity. The children in the control group did not receive any instructions on the focus of attention during the training period.

In the present study, the dependent variable included the balance time (in minutes) in the pretest and retention test. One-way analysis of variance was used to analyze the balance time in the pretest and

retention test. Tukey's post hoc test was used as a post hoc test. The level of statistical significance was used at P <0.05.

3. Results

The demographic characteristics are given in Table 1. Demographic results include age, height, weight, and BMI of children in different groups.

Table 1

Subjects' demographic characteristics

Group	Age	Height	Weight	BMI
External focus of attention	35.1 ± 01.14	79.13 ± 47.162	08.17 ± 52.54	22.2 ± 49.20
Internal focus of attention	48.1 ± 22.14	48.14 ± 17.160	93.20 ± 70.55	79.1 ± 01.21
Control	40.1 ± 96.13	44.15 ± 47.159	06.18 ± 07.56	94.1 ± 08.20

Table 2 and Figure 1 show the performance time of groups in the pretest and retention test. The results of the analysis of variance in pretest and retention test are given in Table 3. The analysis of variance showed no significant difference in performance time between groups in the pretest (F = 0.82, p = 0.54). These results indicate that all children in different groups had the same conditions at the beginning of the exercise. However, in the retention test, the analysis of variance showed a significant difference between the groups in performance time (F = 12.01, p <0.001). Tukey post hoc test results showed that children in the external focus of attention group performed better than the internal focus of attention and control groups (p <0.001). However, no significant difference was observed between the internal focus of attention and control groups (p> 0.05).

Table 2

The mean and standard deviation of performance scores of research groups in pretest and retention test

		External focus of attention	Internal focus of attention	Control
Pretest	Mean	42.1	40.1	52.1
	Std.	25.1	30.1	48.1
Posttest	Mean	93.3	57.2	69.2
	Std.	04.2	25.2	17.2

Table 3

Results of analysis of variance in pretest and retention test

		Sum of Squares	Df	Mean Square	F	Sig.
Pretest	Between Groups	63.48	2	31.24	82.0	547.0
	Within Groups	86.48	43	42.59		
	Total	135.11	45			
Retention	Between Groups	54.186	2	27.93	01.12	000.0
	Within Groups	386.94	43	183.69		
	Total	573.48	45			

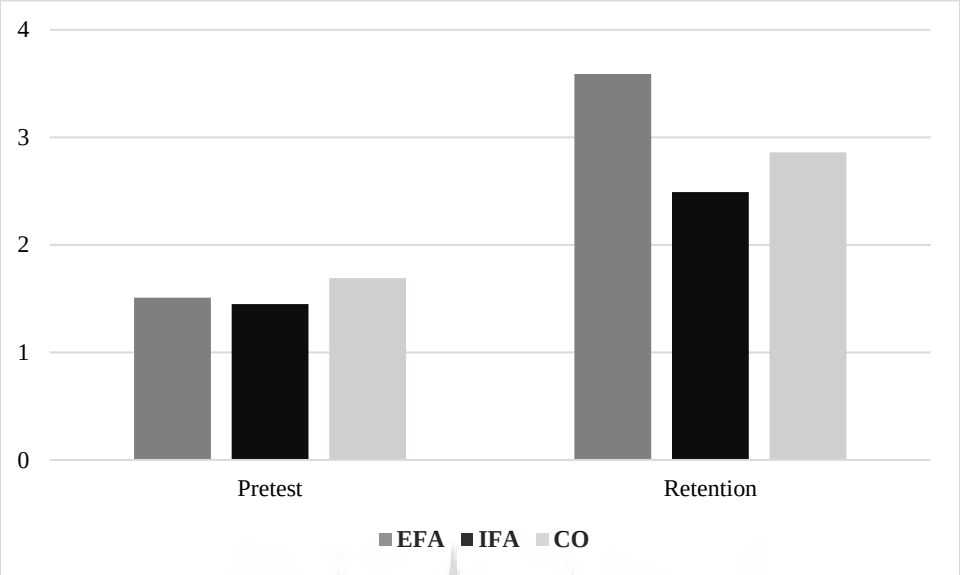

Figure 1. Children's performance in pretest and retention test. EFA: External Focus of attention Group; IFA: Internal Focus of attention Group; CO: Control group.

4. Discussion

This study compared a static balance skill learning by the external and internal focus of attention on children with DCD. Based on the results of previous research on the acquisition of external and internal focus of attention, this study hypothesized that external focus of attention compared to an internal focus of attention leads to better learning of a static balance skill in children with DCD. The results of the research indicate that the research hypothesis is confirmed. The results showed that children with DCD who adopted an external focus of attention were significantly more likely to perform better during the retention test than children in the internal focus of attention or control groups. This finding is consistent with the results of previous research, which shows that taking the external focus of attention on learning new motor skills is more effective than internal focus of attention in both healthy children and specific groups such as ADHD (Baniasadi, Ranjbari, Khajehaflaton, Neshati & Dana, 2022; Chaharbaghi et al. 2022; Saemi et al. 2013). In addition, this finding supports the optimal theory (Baniasadi, Ranjbari, Abedini, Dana & Ghorbani, 2022; Seyedi Asl et al. 2016; Taghva et al. 2020), which suggests the advantage of an external focus of attention when learning new motor skills.

Wulf and Lewthwaite (2016) suggested that adopting an external focus of attention results in promoting focus of the learners on task goal and this directly connects goals and actions, enhancing goal-action coupling. Adopting an external focus of attention facilitates efficient switching from the default mode network to relevant motor networks,

whereas an internal attentional focus impedes this process. In the optimal theory, performing under external attentional focus conditions are presumed to facilitate functional connectivity, that is, task-specific neural connections across distinct brain regions that are seen in skilled performers. Lack of a clear task focus (e.g., internal focus) would impede switching to task related functional networks or goal-action coupling.

One limitation is that we used only boys as participants, thereby limiting the generalization of research results to girls. Similarly, the restricted age group was 9-11 years old, limiting the generalization of results to older children. Also, we examined the effects of focus of attention on balance time, and the motor coordination components were not measured. Future studies should examine the effect of focus of attention on motor coordination in children with DCD, emphasizing kinematic analysis.

5. Conclusion

In summary, the results show that children with DCD benefit from the external focus of attention to learning a static balance skill. This result may indicate that these children have the mechanisms to learn new skills through the external focus of attention (such as goal-action coupling). Based on the optimal theory, adopting an external focus of attention reduces a self-focus, directs attention to the task goals, and connects goals and actions, e.g., goal-action coupling. Generally, the results of this study confirm these propositions. The present findings have some practical implications. These results suggest that coaches, trainers and physical educators could optimize learning new motor skills in children with DCD by adopting an external focus of attention during practice. Future studies might examine the effects of external focus of attention on learning new motor skills in other special populations.

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Conflict of interests

The Author declares that there is no conflict of interest with any organization. Also, this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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