

Do Children Benefit External Focus of Attention as Much as Adults? A Motor Learning Study

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Abstract

Recent evidence supports advantages of an external focus of attention on learning motor skills, however, there is a need to retest these findings for children and comparing them with adults. Thus, the purpose of current study was to determine the effect of different attentional focus on learning a motor skill in children and adults. Thirty children (8-12 year) and thirty adults (25-42 years) were randomly assigned to one of four groups: (1) Children external focus of attention (EFA), (2) Children- internal focus of attention (IFA), (3) Adults- External focus of attention (EFA), (4) Adults- internal focus of attention (IFA). Following initial instructions and task demonstration, participants performed 60 darts throwing in six blocks and 24 hours later performed 10 additional throws for retention test. Results revealed that children benefited from EFA and IFA instruction in the same manner, however, adults benefited from EFA more than IFA instruction. Future studies should continue to examine effects of different attentional focus on other skills.

Keywords: attention, dart throwing, instruction, motor learning

1. Introduction

Some level of attention is needed to learn and perform complex motor skills. Determining the types of attentional foci is interest area for researchers because of its influential effect on learning motor skills. Previous studies revealed that providing instruction about skill execution to the participants were less effective during practice (Wulf & Weigelt, 1997) and transfer test (Hodges & Lee, 1999) than control conditions that didn't receive any instruction. Furthermore, "just do it" strategies (Singer, 1988) and implicit learning (Masters, 1992) have shown problematic. To resolve these problems Wulf (Wulf, 2007) offered an alternative method, that an external focus of attention (EFA) is more beneficial for the learner than an internal focus of attention (IFA). The advantage of EFA has been shown for learning balance task (Wulf, McNevin, & Shea, 2001), learning a golf pitch (Wulf, 2007; Wulf, Lauterbach, & Toole, 1999), free throw (Al-Abood, Bennett, Hernandez, Ashford, & Davids, 2002; Zachry, Wulf, Mercer, & Bezodis, 2005), dart throws (Marchant, Clough, & Crawshaw, 2007), volleyball serves and soccer passes (Wulf, McConnel, Gärtner, & Schwarz, 2002).

The advantages of EFA compared to an IFA has since been replicated across a wide range of tasks and samples (Lohse, 2012; Wulf, 2013). Most of studies support benefits of EFA than IFA in athletic skills such as dart, golf, tennis, volleyball and soccer (Bell & Hardy, 2009; Maddox, Wulf, & Wright, 1999; Marchant et al., 2007; Wulf, 2007, 2013; Wulf et al., 2002). Perkins-Ceccato, Passmore, and Lee (Perkins-Ceccato, Passmore, & Lee, 2003) studied the effect of focus of attention on the performer's skill level. Two groups of highly and less skilled golfers were assigned into two different instructional focus of attention groups: internal and external. Their results revealed a significant interaction between instruction type and skill level during acquisition, retention and transfer tests. The highly skilled group performed better with EFA instruction, whereas less skilled group performed better with IFA instruction.

The Constrain Action Hypothesis (CAH) is main theoretical framework used to explain the effect of focus of attention on motor skill learning and performance (McNevin, Shea, & Wulf, 2003; Wulf et al., 2001). The CAH hypothesis was developed as an alternative for common coding theory (Prinz, 1997). Wulf and Prinz (Wulf &

Prinz, 2001) argued that common coding theory was too abstract and did not make specific predictions related to the effects of different attentional focus instruction on learning. An external focus of attention (Focusing on the effects of one's movements) allows the person to perform the action unconsciously and govern in a reflexive control. However, an internal focus of attention (Focusing on one's movement) disrupt automatization of motor system by constraining them.

Despite the extant literature on the superiority of EFA (Wulf, 2013) there are few number of studies have investigated focus of attention with children that their findings have been mixed (Chiviakowsky, Wulf, & Wally, 2010; Emanuel, Jarus, & Bart, 2008; Thorn, 2006). Information processing of children is different than adults that have a potential influence on motor performance and learning. These differences could be including age-related improvements in processing speed (J. Gallagher & Thomas, 1980), movement labeling (Winther & Thomas, 1981), using rehearsal strategy (J. D. Gallagher & Thomas, 1984), memory organization (J. Gallagher & Thomas, 1986) and selective attention (Ross, 1976).

It might suppose children as novice players in their lack of experience and unfamiliarity with tasks (Emanuel et al., 2008). In the other hand, most adults have more experience and a greater diversity of motor skills. In addition, children have difficulties in focusing their attention while performing motor tasks (Lidor & Singer, 2003).

Some studies suggest that children differentially affected by attentional focus instructions than adults (Emanuel et al., 2008) but there is a clearly need to further examine effects of attentional focus in children and adults. Therefore, the aim of current study was to examine the effects of attentional focus on the motor skill learning of dart throwing in children and adults.

2. Method

2.1 Participants

Thirty children (8-12 year) and thirty adults (25-42 years) with no known delays or developmental concern randomly selected from elementary school and university and randomly assigned to four groups (1) Children-IFA (2) Children-EFA (3) Adult-EFA (4) Adult -IFA (Table 1). All participants were unfamiliar with the task and signed informed consent (for children their parent signed). This research approved by ethical committee of Ferdowsi University of Mashhad.

Table 1. Demographic information of participants

	Least (Years)	Highest (Years)	Age (Mean±Sd)
Adults-EFA	25	42	32 ± 4.6
Adults-IFA	25	42	32 ± 8.7
Children-EFA	8	12	10.53
Children-IFA	8	12	10.11

2.2 Apparatus and Task

The task was a dart throwing (Emanuel et al., 2008). A commercially available bristle dart board was adjusted to height and distance for each participant (fig 1). The participants had to throw regulation steel tip darts that weighted 22g. The linear distance from the center of the dart board was measured as the radial error. To eliminate the previous experience of participants we asked them to throw with their non-dominant hand.

2.3 Procedure

All participants were asked to throw two darts at the beginning of the experiment, one under each condition. Participants in the IFA group were instructed to focus on the movements that they carrying out during each throw and use the following instructions: 1) feel the weight of the dart in their hand; 2) think about bending the elbow 3) feel the dart while left finger tips. The participants in the EFA were instructed to focus on the outcome of the task and use following instruction: 1) focus on the center of the dart board 2) slowly begin to expand upon the perspective of the dart board 3) throw the dart to the target. Participants in the control group instructed to throw the dart as they can.

After administration of their instructions, each participant performed 10 throws using their particular strategy as practice. The practice was 60 throws in 6 blocks. After one day participants entered to retention-test.

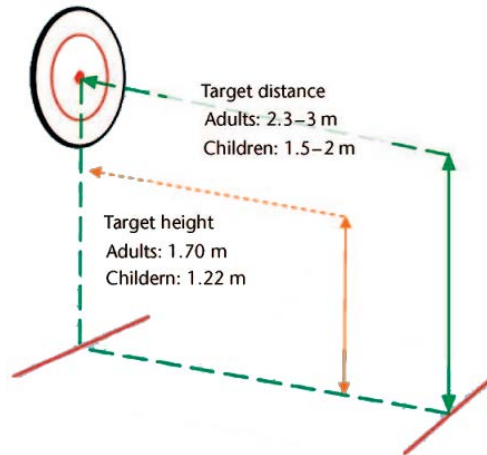


Figure 1. Throwing setting Emanuel et al.(Emanuel et al., 2008)

2.4 Data and Statistical Analysis

The mean score of each block of 10 throws was used as a measure of accuracy for the task, resulting in 6 consecutive scores. A Group (3) × Blocks (6) repeated measure ANOVA has carried out to analysis the acquisition phase. A one-way ANCOVA was used to compare between groups in the retention-test.

3. Results

3.1 Acquisition

As fig 2. depicts, all groups improved their performance across training blocks. Results of repeated measure analysis of variance revealed that there was a significant effect of Blocks ($F(3.38, 189.70)=36, p<0.001, \eta^2=0.39$), however, the effect of Groups and interaction effect of Group×Block were not significant ($p>0.05$).

3.2 Retention

Results of one-way ANCOVA revealed that there was a significant difference between groups in retention test ($F(3,55)=7.43, p<0.001, \eta^2=0.289$). Pairwise comparison using Bonferroni test revealed that Adult-IFA group performed less efficiently than Children-EFA ($p=0.002$) and Adult-EFA ($p<0.001$). Interestingly our results revealed that there were not any significant differences between EFA and IFA instructions in children and just adult participants benefited in a different way from attentional focus instructions.

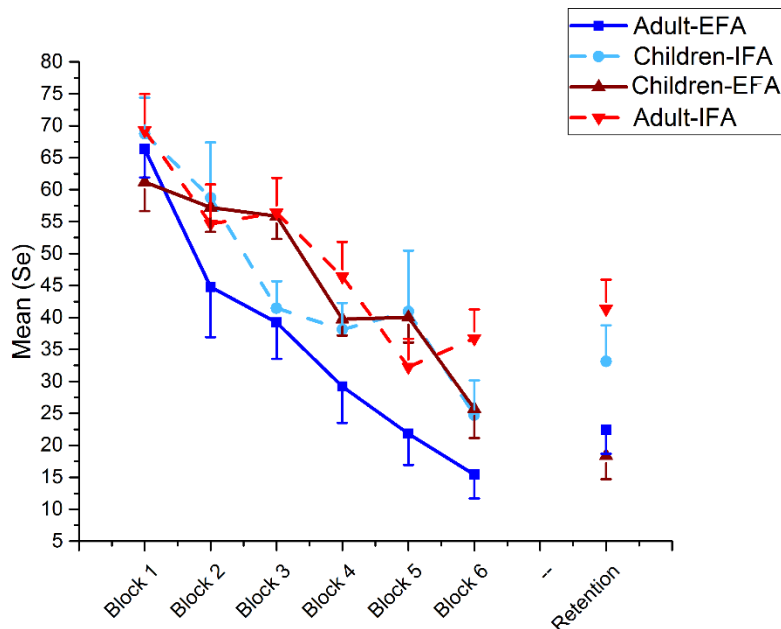


Figure 2. The performance of each group across different blocks

4. Discussion

The effect of different attentional focus instructions has been examined frequently before, with a general conclusion that adopting an EFA enhances motor performance and learning (Wulf, 2013). However, the extent to which this applying this conclusion to children should be determined. In the current study, we examined the effect of EFA and IFA on learning dart throwing in children and adults. The results indicated that all groups improved their performance after training blocks, but the performance of children was not differentially affected by the type of instruction. However, adults should that benefits from EFA instruction more than IFA instruction. Furthermore, children who instructed EFA had better performance than adults who instructed IFA.

Reviewing previous studies indicated that most of them support using an EFA regardless of experience or task. However, few number of researches have suggested that an IFA may be better if participants are novices, using nondominant body part or children.

Most researches comparing EFA and IFA have suggested that using EFA is more beneficial than IFA, but current study and a few others (Agar, Humphries, Naquin, Hebert, & Wood, 2016; Black, 2004; Emanuel et al., 2008) suggest that there may be exceptions. There is some evidence in the literature that beginners in the early stages of learning may advantage from IFA. Our results indicated that children may improve at a new task regardless of attentional focus.

Perkins-Ceccato et al. (Perkins-Ceccato et al., 2003) found that highly skilled athletes performed better with EFA instruction than the IFA. However, low-skilled athletes more benefited from IFA than EFA. Bernstein, Latash, and Turvey (Bernstein, Latash, & Turvey, 1996) believe that EFA might be more beneficial for skilled athletes than less skilled athletes due to the different level of movement automation that they exhibit.

Our results are in agreement with those studies by Perkins-Ceccato et al. (Perkins-Ceccato et al., 2003) and Beilock, Carr, MacMahon, and Starkes (Beilock, Carr, MacMahon, & Starkes, 2002) in which adults benefited from EFA, but in the children, there were not any differences between EFA and IFA groups.

Adults participants may have performed better than children because of physical growth and physiological and biomechanical factors (Yan, Thomas, Stelmach, & Thomas, 2000). Another possible reason is the cognitive development of participants. When children mature, they become better at creating strategies to handle information (Yan et al., 2000). Thus, to benefit children from attentional focus instructions, they must attend to, process, and implement information provided and consciously adopt an external or internal focus of attention. It is rational that differences in developmental cognitive between children and adults mediate the effects of such attentional focus direction. Children may be more similar to low skilled adults who have less experience with such activities, exhibiting a lower level of movement automation, however, our results are inconclusive in this regard.

The results of the current study suggest that further examination is needed to determine effects of using external and internal attentional focus when designing instruction to teach motor skills to children. Future studies might comparison between children and adults in another motor skills, to examine whether any differences between adults and children is related to their general lack of skills or developmental abilities. Also, future studies may extend this line of study by including another group who received feedback and instructions in a combination of external and internal focus of attention.

Children may also not have been able to process the cues to the level of working memory due to some of the cognitive processing differences between adults and children. Previous studies have shown that children do not use encoding (Winther & Thomas, 1981) and rehearsal strategies (J. D. Gallagher & Thomas, 1984) as effectively as adults without some type of training. Consequently, children may not have utilized effective encoding and/or rehearsal strategies for the attentional focus cues making them difficult to retrieve for later use and/or harder to keep available in working memory throughout practice and retention.

According to CAH when person focused internally, the learner evaluates and regulate his/her performance causes the learner to experience a "micro-chocking" episode, which decreases performance outcomes (Wulf, 2013). The ability to evaluate and regulate one's own thoughts, actions, and behaviors may require mature cognitive strategies that young children do not have.

The findings of the current study and some previously conducted, have implication for teachers, physical educators, and coaches. Effectively directing a person's attention to the important aspects of skill is an important part of motor learning and performance (Magill & Anderson, 2014), and instructors rely on them when providing verbal instruction and feedback.

5. Conclusion

In conclusion, the current research adds to the limited research examining the effect of attentional focus cues on motor learning in children and adults. The results of current study add to existent literature guiding effective teaching and suggest that instructions that IFA or EFA are equally effective for children. Further studies examining whether this holds true for different stages of learning and different types of tasks would be appropriate.

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