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MOTOR LEARNING

Does Varying Attentional Focus Affect Skill Acquisition in Children? A Comparison of Internal and External Focus Instructions and Feedback

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Abstract

Recently, researchers have concluded that motor skill performance is enhanced when learners adopt an external attentional focus, compared to adopting an internal focus. We extended the line of inquiry to children and examined if skill learning in children was differentially affected by providing instructions and feedback that direct attentional focus internally versus externally and if the effect of attentional focus varied between younger and older children. Forty-eight children in two age groups (5–8 years old and 9–12 years old) were randomly assigned to either an internal attentional focus group or an external attentional focus group. Participants completed three 10-trial acquisition blocks of a shuffleboard accuracy task, followed by retention and transfer tests. There was no significant difference between internal and external focus groups, though older children performed significantly better than

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younger ones did, and all groups improved with practice. These results suggest that skill learning in children improves with task-based instruction and practice, regardless of the direction of attentional focus. More research is needed on children and attentional focus to determine whether they, and possibly other beginners, learn better with an internal or external focus of attention.

Since the 1990s, researchers have completed a great deal of basic and applied skill acquisition research on the effects of specific types of attentional focus instructions. Many of these researchers have directed attentional focus using instructions and feedback and have compared the effects of directing learners to adopt an internal versus an external focus. Led by the work of Wulf and colleagues (e.g., Wulf, 1998, 2013; Wulf, Granados, & Dufek, 2007; Wulf, Höb, & Prinz, 1998; Wulf & Jiang, 2007; Wulf, Lauterbach, & Toole, 1999; Wulf, McConnel, Gartner, & Schwarz, 2002; Wulf, Waechter, & Wortmann, 2003), the majority of studies suggest that a learner's attention should be directed toward the item being manipulated by his or her body (external attentional focus) instead of toward bodily movements (internal attentional focus). For example, Wulf et al. (1999) found that college students learning a golf shot improved more if they focused their attention more on the path of the golf club (external) than on the movement of their arms (internal). A recent meta-analysis of this research (Tan, Lai, & Huang, 2012) supported the conclusion. The meta-analysis covered 57 published and unpublished studies. Of these, 74.6% found that skill acquisition was enhanced by an external compared to an internal attentional focus, with an average effect size of 0.617.

However, not all researchers have found the external focus advantage. Some found that performance was better with internal focus, particularly for new or novel tasks or for beginners or low-skilled learners. For example, less experienced participants benefited from internal attentional focus in skills such as golf (Black, 2004; Perkins-Ceccato, Passmore, & Lee, 2003) and soccer skills (Beilock, Carr, MacMahon, & Starkes, 2002; Perkins-Ceccato et al., 2003), dart throwing (Emanuel, Jarus, & Bart, 2008; Williams, 2009), and batting (Castaneda & Gray, 2007; Gray, 2004). Therefore, it is possible that during the early stages of skill acquisition, when learners are getting a basic understanding of an effective movement pattern, that

directing their attention to the correct movement pattern (internal focus) is more beneficial. Then, once an effective movement pattern has been developed, the benefits of an external focus of attention can be realized.

Attentional Focus and Children

Skill acquisition researchers who have examined the internal versus external attentional focus question have almost exclusively used adults as participants. Whether the external attentional focus advantage applies to children has yet to be explored conclusively. There are two reasons not to assume that research findings generated from adult learners apply to children. First, children deal with information differently, causing them to learn differently from adults and adolescents (Yan, Thomas, Stelmach, & Thomas, 2000). In addition, children are novices at most skills.

We were able to locate only two published studies (Emanuel et al., 2008; Saemi, Porter, Wulf, Ghotbi-Varzaneh, & Bakhtiari, 2013) comparing the effects of internal versus external focus on skill learning in children and one abstract (Thorpe, Daniel, & Hunter, 2001). Thorpe et al. and Emanuel et al. found trends suggesting skill learning was better when using an internal focus, and Saemi et al. found better performance with external focus. Three studies on children cannot be considered definitive, but they do suggest a line of inquiry.

Emanuel et al. (2008) studied dart throwing with children (8–9 years old) and adults (22–36 years old), having them practice with either internal or external focus instructions. During acquisition and retention, adults performed the task better than the children, with no overall advantage for external or internal focus. However, performance was slightly higher in the adults who adopted an external focus, but the data were in the opposite direction for children; children performed somewhat better, though not significantly, when given internal focus instructions.

Saemi et al. (2013) had children throw tennis balls using their dominant arm at a target; their results showed a significant performance advantage for the external focus group. It may be important that Saemi et al. used a presumably familiar task (throwing) and Emanuel et al. (2008) used a novel task. This could suggest that beginning learners and/or novel tasks are exceptions to the external-is-better conclusion.

Numerous studies have shown that an external attentional focus enhances skill learning more than internal attentional focus does. However, adult participants have been used in most of this research, and there is some evidence that an internal focus may be advantageous for children or beginners. Therefore, we sought to extend this research by comparing the effects of internal and external focus instructions and feedback on children learning a novel, but realistic, motor skill and by comparing the effects in younger and older children.

Method

Participants

Forty-eight 5- to 12-year-olds with no known physical or intellectual deficits were recruited from a public elementary school's after-school program. Younger (5–8 years old) and older (9–12 years old) children were randomly assigned to an internal attentional focus group (IAF) or an external attentional focus group (EAF). All participants were unfamiliar with the task (shuffleboard). University institutional review board (IRB) approval was obtained before the study, the children's parents provided informed consent, and the children gave written assent.

Apparatus and Task

The task was using a shuffleboard stick to shoot pucks along a 5-ft-wide lane toward a target placed 10 ft from the starting line (Figure 1). Pilot testing indicated that this distance was far enough to challenge 5- to 12-year-olds, but not so far that they were likely to shoot recklessly or struggle to generate enough force. The target was a 1-ft × 5-ft rectangle, with additional lines placed 1 ft and 2 ft in front of and behind it. A shot stopping in the target area scored 3 points, 2 points if the puck was within 1 ft of the target, 1 point if the puck was within 2 ft of the target, and 0 points if it went wide or stopped more than 2 ft from the target.

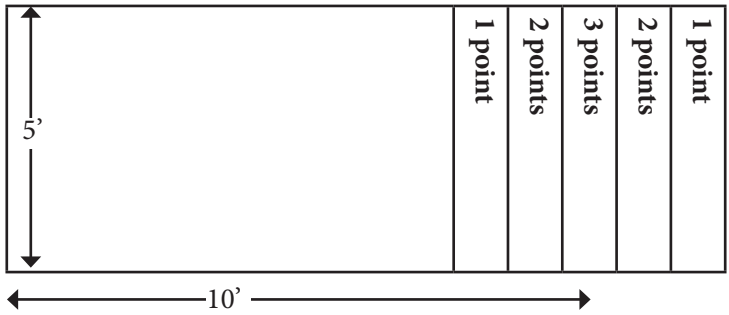

Figure 1. Diagram of shuffle target.

Procedure

The study was performed in a large, quiet room. On the first day, each participant was given a demonstration and explanation of the task and then performed three blocks of 10 acquisition trials (30 shots total), with feedback after each trial. The children returned in 1–2 days to perform 11 retention and 10 transfer shots. The first of the 11 retention trials served as a warm-up and was not counted in analysis. Following the retention phase, the children performed one block (10 shots) using their opposite hand as a transfer task. No instructions on how to do the task or feedback were given on the second day.

Explanation and Demonstration

Before acquisition trials, the researcher demonstrated the task to each participant, and provided this brief explanation: "The goal is to make the puck stop in the center of the target to score as many points as possible. The closer to the center of the target, the more points you get. Remember to keep your body behind the line. In order to score, the puck must stop on the target." Subsequent instructions and feedback directed subjects' attention to internal or external aspects of the task.

EAF group. Instructions, cues, and feedback provided to the children assigned to the EAF group were directed at the target, puck, shuffleboard stick, and the puck's course. For example, the learner's attention was directed to using the stick to propel the puck in the

desired direction or with appropriate force. Typical feedback examples included "The stick needs to push the puck faster" or "The stick needs to push the puck slower."

IAF group. Instructions, cues, and feedback given to participants in the internal condition were directed toward the bodily actions used to perform the task. Instructions were focused on body position, movements of the shoulder, stepping of the foot, pushing of the arm, and position of fingers (grip). Feedback was consistent with internal attentional focus, such as "Step harder," "Swing your arm faster," or "Step and push your arm toward the center" [if shot was wide].

Data Analyses

The dependent measure was the accuracy score. Scores were divided into blocks of 10 trials, creating three acquisition blocks, one retention block, and one transfer block. Scores were also divided into two age groups, younger children and older children, for analysis. A $2 \times 2 \times 3$ (Age × Condition × Blocks) ANOVA, with repeated measures on blocks, was used to examine acquisition scores. A 2×2 (Age × Condition) ANOVA was used to analyze retention and transfer.

Results

Overall, the results showed significant differences attributable only to age and practice; there was no significant difference between internal and external focus groups. All groups improved regardless of focus, with the older children performing significantly better than the younger children. Average scores for each group during acquisition, retention, and transfer are presented in Table 1 and Figure 2.

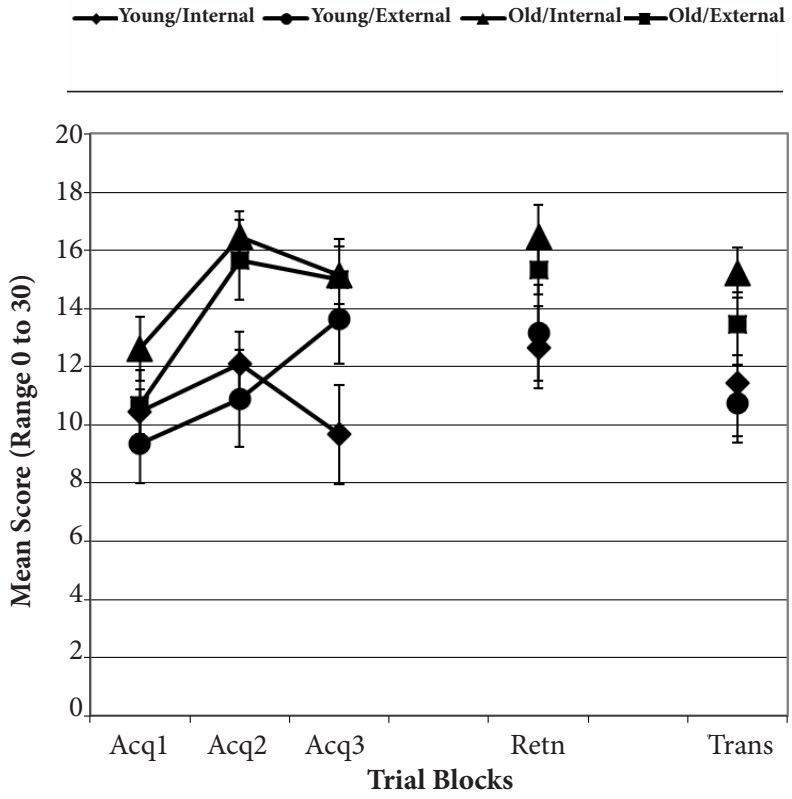

Figure 2. Comparison of means and standard errors for all groups.

Table 1
Shuffleboard Scores of Treatment Groups During Acquisition, Retention, and Transfer Blocks

Trial block	Groups	*M*	*SD*	*SEM*
Acquisition 1	OEAF	10.67	4.776	1.233
	OIAF	12.62	4.194	1.163
	YEAF	9.36	4.523	1.364
	YIAF	10.44	2.297	.766

Table 1 (cont.)

Trial block	Groups	*M*	*SD*	*SEM*
Acquisition 2	OEAF	15.67	5.314	1.372
	OIAF	16.46	3.126	.867
	YEAF	10.91	5.540	1.670
	YIAF	12.11	3.296	1.099
Acquisition 3	OEAF	15.00	5.593	1.444
	OIAF	15.15	3.602	.999
	YEAF	13.64	5.065	1.527
	YIAF	9.67	5.244	1.748
Retention	OEAF	15.33	3.244	.838
	OIAF	16.46	3.971	1.101
	YEAF	13.18	5.474	1.650
	YIAF	12.67	4.213	1.404
Transfer	OEAF	13.47	4.190	1.082
	OIAF	15.23	3.086	.856
	YEAF	10.73	4.474	1.349
	YIAF	11.44	5.503	1.834

Note. OEAF = older participants, external attentional focus; OEAF = older participants, internal attentional focus; YEAF = younger participants, external attentional focus; YEAF = younger participants, internal attentional focus.

Analysis of acquisition data revealed a significant effect for age, $F(1, 44) = 15.88$, $p < 0.001$. The older children (9–12 years old) had significantly higher scores than the younger children (5–8 years old). The blocks effect was also significant, $F(2, 88) = 6.22$, $p < .05$, indicating improvement in scores during acquisition.

Analysis of retention and transfer data also yielded a significant effect for age, $F(1, 44) = 6.76$, $p < .05$, with older children outperforming younger children. No other effects were significant. There was a nonsignificant trend in transfer of internal-focus subjects performing better than external-focus subjects (Figure 2).

Discussion

The effect of having learners adopt an internal versus an external focus has been examined frequently, with a general conclusion reached that adopting an external focus enhances motor performance. However, the extent to which this conclusion applies to children has yet to be determined. In this study, we examined the effect of providing children learning a motor skill (shuffleboard) with instructions and feedback that focused their attention externally (on the stick and puck) or internally (on the body actions produced). The results indicated that children learning this task improved, but performance was not differentially affected by the internal versus external focus.

This study had two research questions. First, would children learn new skills (earn more points in a shuffleboard task) more effectively with an external focus (focusing on the shuffleboard stick and puck) or an internal focus (focusing on arm and body movement)? Second, is there a difference in the advantage of one attentional focus over another as a function of age? We found older children consistently performed better than the younger participants, but we found no significant difference between internal and external focus group performance during acquisition, retention, or transfer.

Our review of previous research indicated that most studies support using an external focus regardless of experience or task. However, a few studies have suggested that an internal focus may be better if participants are novices, are using a nondominant body part, or are children.

Most studies comparing internal versus external attentional focus have suggested that using an external focus is more beneficial than using an internal focus, but this study and a few others (Black, 2004; Emanuel et al., 2008) suggest that there may be exceptions. There is evidence that beginners in the early stages of learning may find it advantageous to use an internal focus. Our data indicate that children may significantly improve at a new skill regardless of attentional focus when provided task-related instructions and feedback and given opportunities to practice.

Older children may have performed better than the younger children because of physical growth and biomechanical and physiological factors (Yan et al., 2000). Cognitive development may also

play a role in explaining our finding of no advantage of one attentional focus over another. As children mature, they become better at creating strategies to handle information (Yan et al., 2000). Thus, to benefit from attention-focusing instruction and feedback, learners must attend to, process, and implement information provided and consciously adopt an internal or external attentional focus. It is logical that developmental cognitive differences in children and adults mediate the effects of such attention-focusing direction.

Motivation is always a concern when having children do skill practice. During the third acquisition block, all but the younger external attentional focus group regressed, though not significantly, in performance. The participants likely started to lose interest in the task. Participants rushed through their shots and focused less on their shuffling. When these participants returned 1–2 days later for retention and transfer, their interest in the task was restored and their performance improved.

The results of this study suggest that further examination of the effects of using internal and external attentional focus when designing instruction for children learning motor skills is needed. Researchers might compare novice and skilled children and adults, to examine whether any differences between children and adults stem from developmental abilities or from children's general lack of skills. Additionally, researchers may extend this line of inquiry by including treatment groups who received instructions and feedback that combine internal and external focus.

The findings of this study, as well as those previously conducted, have implications for physical educators. An important aspect of learning and performing motor skills involves effectively directing a person's attention (Magill & Anderson, 2014), and instructors rely on this attentional process when they provide verbal instructions and feedback. A physical education teacher, for example, may say to a learner, "Concentrate on keeping your shoulders back," which provides attention-focusing instructions for practice. Similarly, after observing a student perform a task, he or she provides feedback that directs the learner's attention on one or more aspects of the task to modify. The benefits of providing verbal instructions and feedback have been well established as integral to skill learning, and guidelines for providing effective instructions and feedback are informed

by decades of research (e.g., Magill, 1994; Wulf, Shea, & Lewthwaite, 2010).

Within the context of this study, researchers have examined whether instructions and feedback should direct learners' attention intrinsically or extrinsically and primarily support an external focus. However, the majority supporting this conclusion have examined skill learning in college-aged learners, and some researchers have suggested that an internal focus may be better if learners are beginners (Castaneda & Gray, 2007; Perkins-Ceccato et al., 2003) or are children (Emanuel et al., 2008; Thorpe et al., 2001). It has also been recognized (Wulf & Shea, 2002) that conclusions derived from laboratory-based motor learning research may not always apply to applied contexts. Thus, the guideline of providing instructions and feedback using an external focus may not apply to the elementary or middle school physical education context. The results of this study add to the existent literature guiding effective teaching and suggest that instructions and feedback that focus attention internally or externally are equally effective for young learners. Further research examining whether this holds true for different types of tasks and different stages of learning would be appropriate.

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