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ORIGINAL ARTICLE

THE EFFECT OF ATTENTIONAL-FOCUS INSTRUCTION ON PERIPHERAL TRANSFER FROM DOMINANT HAND TO NON-DOMINANT HAND AND VICE VERSA IN BASKETBALL DRIBBLING

Abstract

The aim of the present study was to investigate the effect of focus of attention (external, internal) on peripheral transfer of basketball dribbling.. In this study, 60 elementary school students with age(11.7±4) were randomly divided into four groups. Considering the attentional-focus instruction, they performed basketball dribbling with their dominant and non-dominant hands (with regard to their group) for eight weeks (31 sessions). The results showed that the instruction of interlimb transfer was carried out in both external and internal focus of attention by both dominant and non-dominant hands. Also, external focus of attention significantly facilitated interlimb transfer more than internal focus of attention (P≥0.05).

Key words: Attentional-focus instruction, peripheral transfer, dominant limb, elementary school students

INTRODUCTION

Modern sports such as basketball and football need complex skills. Athletes should not perform these skills only through their dominant limbs (dominant arm or leg), but they should have the ability to perform them through their non-dominant limbs as well; especially, in competitive sports, when athletes are under pressure by their opponents or when they have to perform a skill during a limited period of time, it seems essential to use dominant and non-dominant limbs for a successful performance. For example, in order to maintain the ball, a basketball player should be able to dribble by his dominant as well non-dominant hand (Tino, Matthias& Krug;2011). Research shows that trainingmotor skills by one arm (or leg) enhances the performance of the opposite limb (Criscimagna, Donchin, Gazzaniga &Shadmehr,2003; Sainburg & Wang ,2002; Teixeira,2000). Some researchers have investigated the transfer amount of simple skills (e.g. tapping skill by Laszlo, 1970;inverted-reversed printing task by Parlow and Kinsbourne, 1977;key-pressing skill by Taylor, 1980;rotary pursuit tracking taskby Byrd, 1986. However, there are some researches on complex tasks (e.g.soccer foot-tapping and dribbling by Haaland and Hoff, 2003;Teixeira et al., 2003; basketball throw by Stöckel et al., 2007; dance movement patterns by Puretz, 1983; basketball dribbling by Tino, 2011. Also, some researchers have investigated the transfer from dominant to non-dominant hand (Kamer, Samer and Mendal, 2005; Mariorama, Tani et al., 2001) or the transfer from non-dominant to dominant hand (Puretz, 1983; Archibald, 1980; Ghaderi, 1999). It is interesting to know that all these researches have reported thetransfer between two similar limbs. Scientific findings show that heredity is the reason for dominating one brain hemisphere and one limb. One of the effective factors of bilateral transfer is the connections between the two brain hemispheres which are mostly located in corpus callosum and transfer the acquisition to the other hemisphere (Bagherzadeh, Sheikh, Tahmasby, Shahbazi, 2005). However, some researchers believe that bilateral transfer is of a cognitive nature. They believe that what is transferred is important cognitive information which is related to reaching the skill aim. Other researchers have provided a control explanation for bilateral transfer which connects generalized motor programming to the transfer of motor output features along the nervous system; they believe that through allocating the spatial and temporal aspects of movement, generalized motor programming acts as a control mechanism. Regarding the importance of transfer and inter-limb transfer, research shows the effect of attentional focus on motor and cognitive aspects of motor skill learining (Wulf, McNevin &shea, 2001A). Also, other researches show that focusing attention influences all process

intervening in motor learning (Neumann, Brown, Justine,2013;Wolf,2007). Wolf et al. (2007) provided constrained action hypothesis to support external focus of attention. According to this hypothesis, focusing attention on the movement effect promotes an automatic mode of movement control. Adopting an external focus allows unconscious, fast and reflexive processes to control the movement, with the result that the desired outcome is achieved almost as a by-product. Consequently, individual's demands for intervention of higher nerve centers to control body parts will decrease and as a result motor performance will increase. In other words, in external attention, attentional demands will decrease while in internal attention, more processing processes will be intervened and attentional demands will increase (McNevin &Wulf, 2003; Wulf, McNevin &shea, 2001A, Wulf, Shea & Park, 2001B). It is interesting to know that research evidences report that when a skill is performed by a limb, motor instructions will be automatically and unconsciously dispatched to other limbs. Based on their implicit and explicit motor learning concepts, Masters and Maxwell (2004) suggested another interpretation of the effectiveness of external focus of attention. Based on explicit processing phenomenon, they argued that in external attention, performer processes only one source of information – what is external to the performer while in internal attention, not only attention is paid to internal information but also apparent external information will be processed. Consequently, an internal focus instruction places a larger load on working memory which will accompany poorer performance (Maxwell, Masters, &Evea, 2003; Whitehouse, 2012; Gabriele Wulf, 2013; Maxwell & Masters, 2002) whereas an external focus instruction reduces mechanical information which the performer processes and place little load on working memory during task performance. Based on this phenomenon, load on working memory is the reason for the differences in performance of external and internal focus. Many researches have proved that external focus increases automatic control processing. For example, Wulf et al. (2007) in their investigation of attention demands of balancing on a stabilometer in internal (feet) and externalfocus of attention (signs on the stabilometer) reported that external focus participants showed shorter probe reaction times than internal focus participants.Also, this group indicated a higher frequency of movement adjustment which is an indicator of more finely tuned integrated movement (Ford, Hodges& Williams, 2005).The results of a research by Shea and Wulf (2001) confirmed this hypothesis as well, they suggested that when participants were not aware of the repetition of a segment, "automatic control processing" (external attention) happened while when they were aware of the repetition of a segment, they more focused their attention on conscious attempt to remember that segment and to search for its incidence which leads to their poor performance.

Ide motor principle of human actions by James (1890) showed that providing instructions and feedback that direct the performer's attention to the effects of his or her movements generally seems to be more beneficial than directing the learners' attention to their own movements. The effect-action hypothesis by Hommer showed that external attention more naturally controlled those degrees of freedom involved in movement so that it could achieve the desired outcome (Wulf &Prinz, 2001). Also, research showed that external focus of attention increased the precision of golf strokes (Perkins et al. 2003), tennis strokes (Maddox et al., 1999), volleyball service (Wulf et al., 2002), soccer dribbling (Beilock et al., 2002; Ford et al., 2005) and basketball free throw (Zachry et al., 2005). In most studies, it is proved that external focus of attention improved performance and skill learning compared to internal focus of attention (Shea et al., 2001; Tutsika et al., 2003; McNevin et al., 2003; Wulf et al., 2006; O'Hara et al., 2008; Wulf et al., 2009; Beilock, 2010; Klov et al., 2010; Doko et al., 2011; Shafizadeh et al., 2005 and 2007; Maghdo et al., 2008; Borna et al., 2009) . while other studies could not show a difference between internal and external foci of attention (Tolneret al., 2004; Wulf et al., 2004). Regarding those mechanisms involved in bilateral transfer, the role nervous system plays in improving transfer process and skill learning, the role of attentional mechanisms and the effect of attentinal focus on nervous processes and information processing system, the present research tries to answer this question: is bilateral transfer influenced by focus of attention and does the amount of transfer change along with a change in focus of attention?

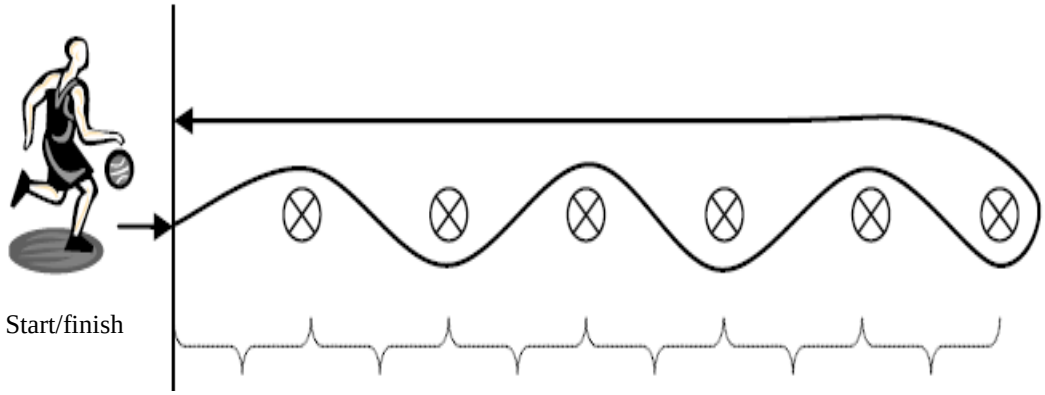
METHODOLOGY

Population and Sample

The statistical population of this study consisted of all primary school students from Qom province. 60 students in grade 5 and 6 from Seyyed-Al-Shohada primary school (district 1) were selected by availability sample method (mean age: 11.9$\pm$5 yr.). All subjects were right-handed and their dominant hands were identified by Edinburgh Handedness Inventory before the protocol. They also had no experience of criterion task and they did not participate in basketball centers in their leisure time. Their parents filled out forms of consent before the protocol and the school head was informed about the research. The protocol was performed during subjects' physical education class.

Criterion task

This task was derived from basketball dribbling task by Tino et al. (2011).The task required participants to dribble around an obstacle course of six javelins, arranged in a straight line and spaced apart by 1.5 m. The total distance from the start/finish line to the last javelin was 9 m. Each trial started with the participants crossing the starting line. They then dribbled around each javelin, circled the last javelin and returned as fast as possible to the finish line. Participants started whenever they felt ready. They had to circle the javelins by their left or right hands (as per their group) with regard to the attentional focus instruction. The time it took participants from start to finish was measured with a stopwatch (made by Q&Q).



150 cm between each javelin

Procedure

After pretest, 60 participants were randomly divided into four groups after primary instructions. The first group performed their trials with their dominant hand and internal focus of attention; the second group performed the trials with their dominant hand and external focus of attention; the third group used their non-dominant hand and external focus of attention and the fourth group used their non-dominant hand and internal focus of attention. As a result, all subjects were instructed through equal time and trial and the only difference existed in their hands (dominant and non-dominant) and focus of attention (internal and external), that is, at the end of the protocol, the observed differences in dribbling speed could be attributed to these two variables. Attentional focus instruction consisted of focusing attention on hand movements during dribbling (i.e. moment of contact, controlling and

guiding the ball in internal focus of attention and focusing attention to the path and the location of obstacles in external focus of attention). The protocol lasted 8 weeks (2 sessions per week). To analyze data, descriptive mean and standard deviation) and inferential (one-way analysis of variance and Tokey post hoc test) statistics were used (P≤0.05). All data were analyzed by SPSS20.

FINDINGS

Table 1 shows biographic features of the students.

Table 1: Biographic features of subjects

Groups	Age (yr)	Height (cm)	Weight (Kg)
Transfer from dominant hand to non-dominant hand + internal focus of attention	11.2±0.62	155±4.32	54±2.2
Transfer from dominant hand to non-dominant hand + external focus of attention	11.5±0.43	152±5.2	52±1.9
Transfer from non-dominant hand to dominant hand + internal focus of attention	11.9±0.30	157±3.2	56±3.3
Transfer from non-dominant hand to dominant hand + external focus of attention	11.6±0.45	153±5.5	54±2.9

Kolmogorov-Smirnov test confirmed the normality of data distribution. The results of one-way analysis of variance in the pretest showed no significant difference among the groups (P≥0.05).

The comparison of pretest and posttest showed that all groups performed better than pretest (P≥0.05). Table 2 shows the outperformance of subjects in posttest.

Table 2: The comparison of pretest and posttest scores of groups

Groups	Tests	Mean	SD	P
Transfer from dominant hand to non-dominant hand + external focus of attention	Pretest	16.52	2.89	0.000
	Posttest	12.2	1.66	
Transfer from dominant hand to non-dominant hand + internal focus of attention	Pretest	16.45	3.29	0.005
	Posttest	13.88	2.06	
Transfer from non-dominant hand to dominant hand + external focus of attention	Pretest	15.79	2.36	0.000
	Posttest	10.64	0.51	
Transfer from non-dominant hand to dominant hand + internal focus of attention	Pretest	15.50	2.20	0.004
	Posttest	12.35	0.85	

One-way analysis of variance showed a significant difference in the scores in the posttest (P≥0.05). The Tokey post hoc test results showed that compared with internal focus of attention, external focus of attention significantly outperformed peripheral transfer from dominant to non-dominant hand and vice versa (i.e. non-dominant to dominant hand) (P≥0.05).

DISCUSSION

The aim of this study was to investigate the effect of external and internal focus of attention on interlimb transfer from dominant to non-dominant hand and vice versa. Contrary to previous researches which investigated the effect of focus of attention on acquisition, retention and transfer of motor skills (Wulf, Töllner, and Charles& Shea ,2007; Neumann, Brown,2013; McNevin &Wulf,2003; Wulf, McNevin & shea,2001A; Wulf, , Shea& Park,2001B), this study investigated this effect on another aspect of human performance, that is, the ability of interlimb transfer. As we know, heredity is the reason for dominating one brain hemisphere and one limb. One of the effective factors of bilateral transfer is the connections between the two brain hemispheres which are mostly located in corpus callosum and transfer the acquisition to the other hemisphere. It is observed that those individuals who use both sides of their body are more successful than those who use only one side. The results of the present study which are in line with other research results showed that training of motor skills by one hand (or leg)improved the performance of the opposite limb (Haminger et al., 2003;Sainburg, 2002;Teixeira, 2000). Also, this research is in line with some researches which investigated transfer in simple tasks (such as tapping skill by Laszlo, 1970; inverted-reversed printing task by Parlow and Kinsbourne, 1977; key-pressing skill by Taylor, 1980;rotary pursuit tracking task by Byrd, 1986). It is also in line with researches with more complex tasks (e.g.soccer foot-tapping and dribbling by Haaland and Hoff, 2003; Teixeira et al., 2003; basketball throw by Stöckel et al., 2007; dance movement patterns by Puretz, 1983; basketball dribbling by Tino, 2011). Also, some researchers have investigated the transfer from dominant to non-dominant hand (Kamer, Samer and Mendal, 2005; Mariorama, Tani et al., 2001) or the transfer from non-dominant to dominant hand (Puretz, 1983; Archibald, 1980; Ghaderi, 1999) .in these researches, researchers observed the transfer from dominant to non-dominant hand as well as from non-dominant to dominant hand. The results of the present study showed that external focus of attention could increase the amount of transfer from dominant to non-dominant hand and vice versa. Also, the results of this research are in line with those researches which investigated focus of attention and reported the positive effect of external focus of attention on improvement of motor performance (e.g. Shea et al., 2001; Tutsika et al., 2003; McNevin et al., 2003; Zachry et al., 2005; Wulf et al., 2006; O'Hara et al., 2008; Wulf et al., 2009; Beilock, 2010; Klov et al., 2010; Doko et al., 2011; Shafizadeh et al., 2005 and 2007, Maghaddam et al., 2008; Borna et al., 2009). On the other hand, the findings of this study supported the Constrained Action Hypothesis by Wulf et al.

This hypothesis states that focusing on one's movements constitutes a conscious intervention into control processes. That is, trying to actively control those movements disrupts automatic control processes. However, focusing on the movement effect promotes a more automatic type of control. It takes advantage of unconscious and reflexive processes and allows them to control movements to a greater extent. As a result, performance and learning are enhanced.

CONCLUSION

With regard to the role peripheral transfer plays in rehabilitating and recovering patients and the elderly and on the other hand the championship and professional dimension of sports, it is necessary to recognize those factors which improve and enhance the interlimb transfer so that athletes' performance can be improved and the period of motor recovery can reduce and patients can be recovered in rehabilitation centers. However, focus of attention is one of the psychological strategies to improve athletes' performance and many researchers worldwide are interested in this field of study and everyday attempt to report new effects of attentional focus instruction on human's performance. In this study, researchers reported that external focus of attention can increase interlimb transfer in both dominant and non-dominant limb. It is hoped that the results of this study are useful to coaches, researchers and physicians.

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