

EXTERNAL FOCUS OF ATTENTION ENHANCES DISCUS THROWING PERFORMANCE

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Abstract:

A performer's focus of attention has been shown to influence motor performance and learning in a variety of motor skills. The purpose of the current study was to examine the effects of an external and internal focus of attention on discus throwing. Participants (N=20; mean age: 22 years, SD: 1.58) were recruited from an undergraduate male student population that had limited experience with the task. Using a within-participants design, all participants completed five maximum effort trials under each attentional focus condition (external and internal). The results of a repeated-measures ANCOVA revealed that participants had a significantly more effective performance in external focus of attention condition compared with the internal attentional focus. These findings are in line with the previous studies showing enhanced motor performance as a result of using external versus internal focus of attention. Therefore, it is suggested that coaches and practitioners give instructions that promote an external focus of attention.

Key words: *external attentional focus, internal attentional focus, constrained action hypothesis, motor performance*

Introduction

Focus of attention instructions, such as those inducing an external or internal focus of attention, are among the major influencing factors in the process of motor skill learning (for a review see, Wulf, 2007). Therefore, it is not surprising that motor learning researchers have examined effects of different types of focus of attention instructions on the enhancement of motor learning in a variety of sport skills. When a performer directs his/her attention towards the effects or outcome that his/her movements have on the environment, he/she is using an external focus of attention. In contrast, when a performer directs his/her attention towards his/her specific body parts or movements, he/she is using an internal focus of attention (Wulf, Höß, & Prinz, 1998).

In the motor learning literature, the majority of studies have revealed that inducing an external focus of attention would be more beneficial to motor skills performance and learning than inducing an internal focus of attention. Among the sports and sport skills that have been shown to benefit from external attentional focus are those which require participants to manipulate objects such as soccer kicks and volleyball serves (Wulf, McConnel, Gärtner, & Schwarz, 2002), golf shots (Wulf & Su, 2007), tennis strokes (Wulf, McNevin, Fuchs, Ritter, & Toole, 2000), basketball free throws (Al-Abood, Bennett, Hernandez, Ashford, & Davids, 2002), dart throw-

ing (Lohse, Sherwood, & Healy, 2010; Marchant, Clough, & Crawshaw, 2007). Tasks that require maximum force production such as vertical jumps (Wulf, Zachry, Granados, & Dufek, 2007), agility performance (Porter, Nolan, Ostrowski, & Wulf, 2010), and standing long jumps (Porter, Ostrowski, Nolan, & Wu, 2010) have also been demonstrated to be enhanced under external attentional conditions. Another sport skill for which an external focus has been shown to be beneficial is swimming (Freudenheim, Wulf, Madureira, Pasetto, & Corrêa, 2010; Stoate & Wulf, 2011). Porter, Nolan and colleagues (2010) have recently examined the effects of focus of attention on agility performance. In the study, participants (N=20) performed five agility task trials in each of the focus of attention conditions, totaling 15 trials. The results of the research demonstrated that participants in external focus condition demonstrated a significantly better agility performance than when in other (internal and control conditions) attentional focus conditions. In another study, Porter, Ostrowski and his colleagues (2010) assessed the effects of an external and internal focus of attention on standing long jump performance and found that focusing on the effects of the movement rather than focusing on body movements enhanced performance.

The constrained action hypothesis explains the benefits of an external over internal focus of attention for motor performance and learning (Wulf, Shea and Park, 2001). According to this hypothesis,

when performers use an external focus of attention, they allow their movements to be controlled more automatically or unconsciously. In contrast, when performers adopt an internal focus of attention, they interfere with the automatic control processes, and this interference degrades the motor performance and learning (for a review, see Wulf, 2007). In support of this view, some studies that used balance tasks and analyzed the movement frequency characteristics, such as mean power frequency, demonstrated higher frequency adjustments for participants who utilized an external focus compared with participants with an internal focus of attention (McNevin, Shea, & Wulf, 2003; Wulf, McNevin, & Shea, 2001; Wulf, et al., 2001) – indicating the use of more reflex-based movement adjustments and thus greater automaticity. Other studies using electromyography (EMG) showed that inducing an external attentional focus produced more efficient muscular contraction and, consequently, more efficient performance, compared to inducing an internal attentional focus (Vance, Wulf, Töllner, McNevin, & Mercer, 2004; Marchant, Greig, & Scott, 2009).

Although numerous studies have investigated the effects of external and internal focus of attention on various sport skills, no studies have yet investigated the effects of focus of attention manipulation on discus throwing performance. Given this situation and the fact that every motor skill is performed in a specific manner the current study set out to examine the effects of external and internal focus of attention on discus throwing performance. Because of individual differences in throwing skill, strength, etc., we used a within-participant design. We hypothesized that participants would show better discus throwing performance when instructed to adopt an external focus of attention than with an internal focus of attention.

Methods

Participants

Participants were 20 healthy undergraduate male university students (mean age: 22 years, SD: 1.58; mean height: 1.74 m, SD: 6.7; mean weight: 68.05 kg, SD: 9.59). All participants had been enrolled in and passed a university discus throwing course and were therefore somewhat familiar with the task. However, they were not aware of the specific purpose of the study. Informed consent was obtained prior to participation in compliance with the University's Institutional Review Board.

Instruments and experimental procedure

Even though all participants had a limited experience with discus throwing, instructions regarding the correct discus throwing technique were given before the start of the trial and data collection. Participants performed the task outdoors, on the uni-

versity campus, using a standard discus (weight: 2 kg). After a brief instruction, all participants first completed five maximum-effort trials as a warm-up and then performed five maximum-effort trials under each focus condition (external and internal), that is, a total of 15 trials, on three consecutive days. Before each trial, participants read instructions related to the respective focus of attention condition. All participants were asked by the researcher to repeat the instructions. If a participant could not accurately repeat the instruction, he was asked to reread it. The external focus instruction was: "Using your maximum strength, throw the discus as far as you can, while concentrating on the discus, particularly on the landing location of the discus". The internal focus instruction was: "Using your maximum strength, throw the discus as far as you can, while concentrating on your hand and wrist that is throwing the discus". The potential order (e.g. practice) effects of attentional focus conditions (external and internal) were counterbalanced across the participants.

Statistical analyses

Descriptive and inferential statistics were used to analyze the raw data. Measures of descriptive statistics such as mean and standard deviation were calculated. As the study used a within-participants design, the data were analyzed with a repeated-measures analysis of covariance (ANCOVA) with the first five practical trials (getting warmed-up) serving as the covariant.

Results

The results indicated that there were significant differences among the two focus conditions, $F(1,37)=8.91$, $p<.005$, $\eta_p^2=.194$ (see Table 1 and Figure 1). The main effect for trials $F(4,148)=2.197$, $p=.09$ and also the interaction of conditions X trials were not significant, $F(4,148)=0.365$, $p=.83$.

Table 1. The means and standard deviations of all trials in the internal and external conditions

| Conditions | Trials | Mean of performance | Standard deviation |
|------------|--------|---------------------|--------------------|
| Internal | 1 | 18.77 | 2.87 |
| | 2 | 19.82 | 2.35 |
| | 3 | 19.91 | 2.09 |
| | 4 | 19.43 | 1.96 |
| | 5 | 18.94 | 1.68 |
| External | 1 | 20.05 | 1.73 |
| | 2 | 20.8 | 2.72 |
| | 3 | 20.75 | 2.59 |
| | 4 | 20.54 | 1.85 |
| | 5 | 20.33 | 2.54 |

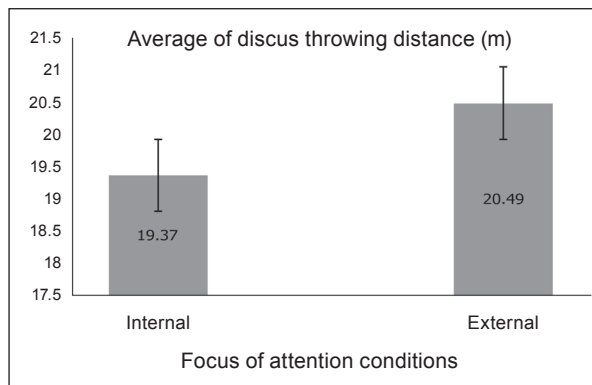


Figure 1. The average of discus throwing distance for external and internal conditions. Error bars show within-subject 95% confidence intervals based on the mean squared error of the main effect of attentional focus (Loftus & Masson, 1994).

Discussion and conclusions

Attentional focus is a key factor in enhancing motor learning and performance (Wulf, 2007). Numerous studies have investigated this factor, and the vast majority have found that participants who adopted an external focus of attention showed superior motor skill performance and/or learning, compared to participants who adopted an internal focus or were not given attentional focus instructions (e.g., Al-Abood, et al., 2002; Freudenheim, et al., 2010; Porter, Nolan, et al., 2010; Porter, Ostrowski, et al., 2010; Stoate & Wulf, 2011; Wulf, et al., 2002; Wulf, et al., 2007). The purpose of the present study was to examine whether inducing an external attentional focus would increase discus throwing distance compared to an internal focus of attention. Similar to the majority of previous research findings (e.g. Abood, et al., 2002; Freudenheim, et al., 2010; Marchant, et al., 2007, 2009; Porter, Nolan, et al., 2010; Porter, Ostrowski, et al., 2010; Stoate & Wulf, 2011; Wulf, et al., 2002; Wulf, et al., 2007; Wulf, et al., 2000; Zachry, Wulf, Mercer, & Bezodis, 2005), the results of the present study demonstrated that participants performed significantly more effectively with an external focus than in the internal focus condition.

According to the nature of the discus throwing task, a greater throwing distance requires greater force production and a more effective and efficient inter- and intramuscular coordination. Some studies using electromyography (EMG) have shown that an external focus leads to a more efficient muscular contraction and consequently to better motor performance than an internal focus (e.g. Marchant, et al., 2009; Vance, et al., 2004; for a review see

Marchant, 2011). For example, in a study by Vance and colleagues (2004), participants performed biceps curls while focusing on the movements of the curl bar (external focus) or their arms (internal focus). Their results demonstrated reduced EMG activity, or more efficient muscular contractions, with an external focus. In another study (Zachry, et al., 2005), the effects of external and internal attentional focus on basketball free-throw shooting was investigated, and EMG activity of the arm muscles of each participant's shooting arm was recorded. Their findings showed that free-throw accuracy was higher when participants used an external focus, and EMG activity was lower. Finally, in a study by Wulf, Dufek, Lozano, and Pettigrew (2010), maximum vertical jump height was increased with an external focus, while EMG activity was reduced at the same time. Thus, it is likely that participants' coordination patterns were similarly optimized by the external focus instructions in the present study.

An additional interpretation of the current findings is based on the constrained action hypothesis. According to this viewpoint, making any effort for conscious control of movements, as is the case in internal attentional focus, restricts the automatic process of motor control system and consequently degrades motor performance and learning. On the other hand, focusing attention on the effects of a movement allows the motor behavior system to control movements automatically and consequently enhances motor skill performance and learning. Thus, it is possible that the observed improvement in the discus throwing performance in external focus condition compared to other attentional focus conditions, might be due to the launching of the automatic process of motor control system in controlling the discus throwing movement. Therefore, the findings of the present study support the constrained action hypothesis' predictions.

In summary, the results reported here extend the findings of previous studies by demonstrating that inducing an external focus of attention can increase throwing distance in discus throwing. Our findings have important practical applications for physical education and coaching (see Porter, Wu, & Partridge, 2010). They demonstrate that practitioners and coaches can enhance their athletes' performance by a simple change in the wording of instructions. The participants of the present study were basically novice; future studies should examine the effectiveness of different attentional focus conditions on expert discus throwing performers.

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VANJSKI FOKUS PAŽNJE POBOLJŠAVA IZVEDBU BACANJA DISKA

Dokazano je da usmjerenost pažnje izvođača motoričkog zadatka utječe na motoričku uspješnost i motoričko učenje velikog broja motoričkih vještina. Cilj je ovog istraživanja bio utvrditi učinke vanjskog i unutarnjeg usmjeravanja (fokusa) pažnje na izvedbu bacanja diska. Dvadeset ispitanika, u dobi od 22±1,58 godina, bilo je uzorkovano iz populacije dodiplomskih studenata koji nisu imali velikog iskustva u izvedbi motoričkog zadatka. Svi su ispitanici izveli zadatak po pet puta maksimalnim intenzitetom u svakoj od situacija usmjerenosti pažnje (vanjska i unutarnja usmjerenost pažnje). Rezultati analize ANCOVA pokazali su da je motorička izvedba bila

značajno učinkovitija u uvjetima vanjske usmjerenosti pažnje u usporedbi s izvedbom u uvjetima s unutarnjim fokusom pažnje. Rezultati ovog istraživanja u skladu su s rezultatima ranije provedenih istraživanja koji pokazuju poboljšanu motoričku izvedbu u uvjetima vanjskog fokusa pažnje u odnosu na unutarnji fokus pažnje. Preporuča se, stoga, da treneri i stručnjaci daju instrukcije sportašu u vidu promoviranja vanjskog usmjeravanja pažnje.

Ključne riječi: vanjska usmjerenost pažnje, unutarnja usmjerenost pažnje, hipoteza ograničene akcije, motorička izvedba

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