The Effect of Task Difficulty and Instructions for Focus of Attention on Performing a Balance Task

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Abstract: The present research is undertaken to investigate the effect of relative difficulty of the task and the attention focus instruction type (base, internal and external) on the performance of a balance task. The results of recent research indicate that the performer's focus of attention, especially when practice is new and challenging, has an important impact on performance and learning of a motor skill. 48 Mashhad Azad University students participated in this research and were randomly divided into two groups of easy/difficult balance task. The participants stood on the digital balance-meter surface in three 15-second trials in three conditions: Without Instruction, Internal Focus of Attention and External Focus of Attention. The results indicated that in the condition of the external focus of attention, the performance of the difficult balance task was significantly better comparing to the two other groups while the focus of attention instruction type made no meaningful difference on the performance of the balance task in the easy group. Therefore, we concluded that the effectiveness of the focus of attention as a movement variable depends on the difficulty of the task.

Key words: Training instructions % Internal and external focus of attention % Difficulty of practice % Balance

INTRODUCTION

The results of most researches indicate that the performer's focus of attention has an important role in the performance and learning of the motor skills. It is especially indicated that concentration on the body movement (adopting an internal focus) while performing movement skill is relatively in vain. But the instructions and reflexes that take the performer's attention to the effects of his/her movements on the environment (adopting an external focus) leads to a more effective performance and learning [1-8]. For example, it is indicated that giving instructions in a way that takes the person's attention to the effect of the movement rather than body movements leads to the golf performance [9-10], tennis performance [11-12], volleyball service hits [13], football kicks [13-16] and basketball free throws accuracy increment. There are other researches that consider the external focus of attention effective in better balance and height control [1, 6, 7, 17-20]. It is interesting that in another research investigating control conditions, also, the external focus of attention instruction comparing to both conditions of internal focus of attention and control manner without attentional instructions leads to more effective performance and learning [1, 8, 17]. These results indicate that the external focus of attention increase the performance and learning of motor skills.

Wulf et al. [4, 7, 21] referred to the Constrained Action Hypothesis in effort to explain why the external focus of attention is more effective than the internal. Therefore, when the training instruction takes the attention of the performer to the body members involved in the movement, the automatic control processes will be eased and also lead to the better auto-organization of different systems and will not be restricted and limited by the intelligibly control processes.

As a result, the person's need for the involvement of the higher nervous centers for controlling the body parts will be decreased. Consequently, the movement performance increases. In other words, the focus requirements decrease in the external focus while more processing will be engaged in the internal focus and the focus requirements will increase.

Masters and Maxwell [22], based on their explicit and implicit motor learning dichotomy, suggested...
another interpretation of the effectiveness of the external focus of attention. According to the Explicit Processing Hypothesis, they deduced that in the external focus, the performer processes only one information source- what is external to the performer, while in the internal focus, not only the attention is taken to internal information, undoubtedly the outstanding external information will also be processed. As a result, the internal focus instruction puts more loads on the focus sources or working memory. More pressure or load on the working memory in the condition of the internal focus of attention is accompanied with weaker performance [23-27]. While the external focus instruction decreases the mechanical information that is processed by the performer and puts fewer loads on the working memory during performing the practice. Therefore, based on the Explicit Processing Hypothesis, the load of the working memory is the source of the performance differences in the external and internal focuses.

The idea that taking the external focus increases the automatic control process is confirmed in several researches. For example, Wulf et al. [28], during the investigation of the focus desires of keeping balance on the balance-meter in the condition of the internal focus of attention (feet) and the external one (the signs on the balance-meter) observed that the external focus participants indicated shorter Probe Reaction Times comparing to the internal focus. Also, this group indicated more appropriate frequency characteristics which are the indicator of the more homogenous movement.

The results of Shia and Wulf [29] research, also confirm this hypothesis. They found out when the people are not aware of the repetition of a part of the pattern, they let the "automatic control process" take charge (external focus). But, when they know that a part of pattern is repeating, concentrate their attention more on the conscious endeavor to remember that part and searching for its happening rather than performing the correct "pattern"; consequently, their performance will be weakened.

Also, according to James' Ideo-Motor Hypothesis, paying attention to the motor effects rather than the way of its performance leads to a more permanent image for learning skills and also provokes the motor system for the movements. It is also indicated in the James' Ideo-Motor Hypothesis [5] that external focus controls the movement different degrees of freedom until reaching the desired result.

Generally, the conclusion of all the hypothesis and theories supporting the preference of the external focus of attention to the internal focus of attention in performing motor skills is that by taking the attention of the person to the effect of the movement through training instruction or reference, the need to focus on the performance and consequently focus requirements will decrease and less conscious processing procedures to control the movement will be needed.

Up to now, the result of previous researches about the effects of the external focus of attention comparing to internal focus of attention, mostly supported the external type [5, 17-19]. However, some researches were not able to indicate the differences [25, 27]. For example, the preference of the external focus of attention to the ski simulation practice performance was indicated at the end of the first day (first test) in the Wulf et al. research. While, in the balance-meter task the preference was not indicated until the end of the third day (Remembrance Day). Also, in the research by Wulf et al. [15], the relative difficulty of the task in the transfer (moving ball) task comparing to the remembrance (fixed ball) task indicated the difference and more effectiveness of the external focus of attention. Wulf et al. [28] observed no difference among healthy young adults (first test) in the condition of the external and internal focus of attention. While among Parkinson patients (second test) whom the task was so challenging, the preference of the external focus of attention was observed. Therefore, it seems that a relatively definite level of task difficulty is one of the pre-conditions that lead to the different effects of the focus of attention [29], because previous researches showed that external focus of attention will be more effective in the new and challenging conditions [17, 19, 25, 28]. Therefore, the present research is to investigate the effect of the relative difficulty of the task on the effectiveness of the external focus of attention. The question is: Can the relative difficulty of task affect the performance differences between the conditions of external and internal focuses of attention? The answer to this question provides more direct proofs for Constrained Action Hypothesis and Explicit Processing Hypothesis as well as a deeper insight to the ways the type of the focus of attention affects motor performance.

**MATERIALS AND METHODS**

The present research with regard to the presence of the human being subjects and the way of measuring and
Fig. 1: The balance-meter device and the standing condition of the testees in different conditions of easy and difficult balance task

exerting dependant variable and lack of the necessary conditions for the experimental researches, uses quasi-experimental methods.

Participants consisted of 48 volunteer students (24 male and 24 female) from Mashhad Islamic Azad University. After investigating the biography questionnaire with regard to the purpose of the research, they were randomly divided into two groups of easy balance task and difficult balance task. All the participants were healthy and had no previous experience in performing the determined task.

To measure the balance, a digital balance-meter system or the body stability-meter device including software and hardware was used. The device measures the posture sway in to different directions. The general indicator of the body posture sway to all directions (standard deviation from the balance point) was used as the sway indicator in this research. The participants' duty was to stand on the balance-meter board on three conditions: without especial attention instruction (basic condition), internal focus of attention instruction and external focus of attention instruction. Participants stood on the balance-meter board in the easy balance task and in the difficult balance task they stood on a windy cushion on the balance-meter board (Fig. 1).

The participants in each group performed a 15-second try in each condition of the focus of attention (Base, External and Internal). That is, in whole, each participant performed nine 15-second tries. No especial focus instruction was given to the participants in the base condition. In the internal focus of attention, the participants were trained to try to stand fixed on the balance-meter board (or the windy cushion in the difficult task group) as much as possible and pay attention to the amount of the equal pressure they exert from their feet and in the condition of the external focus of attention, the participants were trained to try to stand fixed as much as possible and pay attention to the board (or the windy cushion in the difficult task group) under their feet.

One way ANOVA was used to compare sway indicator (%) in groups. Factor analysis test (a 2*3 design indicating relative difficulty of the task* conditions of focus of attention) was also used to analyze the effect of the task type and conditions of the focus of attention with repeated measures. SPSS software was used to process and analyze the data. The level of significance was established at p<.05.

RESULTS

Before testing the research hypothesis, it was necessary to show that the presentation order of attention focus type does not have any meaningful effect on the balance task. Therefore, the factor analysis test results indicated that the presentation order of the Attention Focus type had no meaningful effect (F(1.46) = 0.173 & P= 0.680) on the balance performance of the participants. The results of the test are shown in Table 1.

The factor analysis indicated that considering the factors of "condition of focus of attention" (F(1.46) = 9.303, P<0.001) and "task type" (F(1.46) =113.48, P<0.001), each of
Table 1: The result of the factor analysis test for comparing the averages based on the type presentation of the focus of attention

<table>
<thead>
<tr>
<th>Source of changes</th>
<th>Sum of squares</th>
<th>DF</th>
<th>Average squares</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presentation order of Focus of Attention</td>
<td>4.947</td>
<td>1</td>
<td>4.947</td>
<td>0.173</td>
<td>0.680</td>
</tr>
<tr>
<td>Error</td>
<td>1318.70</td>
<td>94</td>
<td>28.667</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 2: The average balance mark (sway indicator) in different conditions of the Focus of Attention in two groups of easy and difficult task

<table>
<thead>
<tr>
<th></th>
<th>Easy balance task group</th>
<th>Difficult balance task group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base condition</td>
<td>3.07 (0.7621)</td>
<td>9.14 (1.6660)</td>
</tr>
<tr>
<td>Internal Focus of Attention</td>
<td>3.06 (0.8134)</td>
<td>8.65 (1.8096)</td>
</tr>
<tr>
<td>External Focus of Attention</td>
<td>2.94 (0.7496)</td>
<td>8.14 (1.7570)</td>
</tr>
</tbody>
</table>

The amount in the parenthesis is the standard deviation

Fig. 2: Comparing the participants’ performance in the different conditions of the focus of attention in two groups of easy and difficult task

<table>
<thead>
<tr>
<th>Practice type</th>
<th>Simple</th>
<th>Difficult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of focus of attention</td>
<td>BASIC INTERNAL EXTERNAL</td>
<td>BASIC INTERNAL EXTERNAL</td>
</tr>
</tbody>
</table>

The general purpose of the present research is to investigate the effect of the relative difficulty of task and the instruction type of the focus of attention on the performance balance task. On the other words, only when the balance task was challenging and difficult (standing on the windy cushions), the advantages of the external focus of attention comparing to the internal focus of attention and the base conditions, was observed. The results of the present research indicated that the difficult task group in the condition of the external focus instruction i.e. when they were trained to concentrate on the cushion under their feet performed a better balance task comparing to the condition of the internal focus instruction and the base condition. While, the balance performance of the easy group had no meaningful difference in the different conditions of the focus instructions (Base, External and Internal). These results confirm the research hypothesis that in difficult conditions, balance will increase through external focus of attention rather than internal focus of attention. The results of the present research on the base of the better performance of the external focus of attention in the difficult conditions is in line with the results of Wulf et al. [21], Wulf and McNein [20], Passmore [30], Landers et al. [17] and Poolton et al. [31]. But it does not support the results of Masters and Maxwell [22] and Landers et al. [17] researches.

The results of this study are in line with the current views on focus of attention in motor control. For example, according to the Constrained Action Hypothesis [4, 7, 21] when people are asked to take an internal focus of attention and also when no definite attention instruction is presented, they try consciously to control their movements. On the other hand, concentration on the movement effect or taking the external focus of attention lets the automatic and unconscious processes control the movements. As a result, this leads to a more effective performance. The possible explanation for the results of the present research is that standing on the fixed and tough surface of the balance-meter board (in the easy balance task group) was not enough difficult and challenging for the participants. Therefore, in such conditions, the balance will be automatically controlled and the person lets the motor system perform what ever it wants to reach the desired result [10], because balanced performance of the participants in the different conditions of the focus of attention in both groups of easy and difficult task.

DISCUSSION AND CONCLUSION

The general purpose of the present research is to investigate the effect of the relative difficulty of task and the instruction type of the focus of attention on the performance balance task. On the other words, only when the balance task was challenging and difficult (standing on the windy cushions), the advantages of the external focus of attention comparing to the internal focus of attention and the base conditions, was observed. The results of the present research indicated that the difficult task group in the condition of the external focus instruction i.e. when they were trained to concentrate on the cushion under their feet performed a better balance task comparing to the condition of the internal focus instruction and the base condition. While, the balance performance of the easy group had no meaningful difference in the different conditions of the focus instructions (Base, External and Internal). These results confirm the research hypothesis that in difficult conditions, balance will increase through external focus of attention rather than internal focus of attention. The results of the present research on the base of the better performance of the external focus of attention in the difficult conditions is in line with the results of Wulf et al. [21], Wulf and McNein [20], Passmore [30], Landers et al. [17] and Poolton et al. [31]. But it does not support the results of Masters and Maxwell [22] and Landers et al. [17] researches.

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standing on the tough surface has become an automatic practice but standing on an unstable surface like a windy cushion is new. In other words, standing fixed on the surface of the balance-meter may be in the higher range of control for the participants and they had the basic balance skills which makes them to stand on the surface of the balance-meter without double endeavor. On the one side, may be they were satisfied with the present control processes and were not stimulated to consciously interfere in the control process. On the other side, the attention requirements for setting the height sway in the height task that are practiced and used a lot like standing on a fixed surface decreases [32]. Contrary, in the difficult balance task group that needed the participants to stand on the windy cushion, the task likely seemed challenging. Therefore, they showed the differences that were taken in the height sway originating from the type of the focus of attention. So, may be the instructions of the external focus in the condition of the difficult task - where may be the participants tend to be conservative and take a conscious control in the more difficult and challenging conditions - makes the participants to take the available automatic control processes. This leads to the faster reaction time comparing to the height sway and better balance and more stability. These results show that the balance will increase through the instruction of the external focus of attention, especially when the task is difficult and challenging for the performer [25, 28].

In another interpretation of the effectiveness of the instruction of the external focus of attention according to the Explicit Processing Hypothesis [23, 24, 31], we can say that standing fixed on the stable surface of the balance-meter, is a relatively easy task which does not have potential load for the attention focuses. In other words, when the task was in the easy condition, no performance difference was seen. Because, the working memory capacity was suitable and enough but when the windy cushion was added, this capacity decreased and in this condition, the task attention desire increased. Adding the windy cushion in the difficult task group had a harmful effect on the performance in the instruction of the internal focus comparing to the External focus. This harmful effect originated from the extra load of working memory sources desired for manipulating more obvious knowledge in the conditions of the external focus. Therefore, the demolition of the motor skill in the difficult balance task group in the external focus of attention instruction indicates the addition of more obvious knowledge related to the practice to the working memory and the dependence of the motor performance on the availability of the working memory sources. The results of the research support the Explicit Processing Hypothesis that the external focus of attention may bring the attention desires or pressures on the working memory to the least. So, these results finely indicate that using more complicated skills or more difficult conditions with more attention requirements may lead to more complete results in the conditions of the instructions of the external focus of attention. Therefore, the research result indicates that more difficult and complicated motor skills should be used to make the effects of the attention focus more obvious.

Most attention theories indicate that attention focuses can be divided by parallel processing. How they should be divided may depend on the difficulty of task. In fact, up to now, studies conducted on focus of attention tended to relative complicated skills. It was assumed that these tasks are more prone to show the effects of the external focus of attention [29]. In fact, the results of the recent researches indicate that the advantages of the external focus of attention may especially be observed in the relative complicated skills which comparing to the simple skills impose more desires on the performer. While, the advantages of the external focus of attention for the relative simple skills which are more or less controlled automatically is less or even does not exist [23, 25, 28].

Using the windy cushion on the surface of the balance-meter was in order to unstabilize the height and increase the difficult level of the balance task. This is done based on the previous researches and tests that had balance conditions with different difficulty levels such as standing on a tough surface against standing on a spongy foam [33], fixing and vibrating the surface of the balance-meter [17, 34], standing on one foot comparing to two feet [32] and passing a plastic sheet on the surface of the balance-meter [18, 28]. The reason for using the windy cushion was that it will provide a newer and more challenging condition for the participants. In such situations, the recognition effects will reach the highest [35] because attention desires related to the height control is subject to the difficulty of task [33, 34, 36]. On the other hand, there are some factors that can affect the effects of the recognition load of the balance function. Focus of attention is one of them [36, 37]. As it was expected the participants of the difficult task comparing to the easy task group had more errors (sway index) and the increase of the attention desires of the task while getting more difficult, increased the effectiveness of the external focus of attention. As a result, according to previous studies, as it was expected, in the new and difficult conditions, the external focus of attention leads to a better performance.
The present research preferably has investigated the immediate effects of the focus of attention on the performance rather than investigating the relative permanent effects (learning) of its manipulation, because the performance difficulty and complication of the task will change due to the increase of experience and acquiring skills through acquisition process. Also, with the increase of practice (learning), the performance will need less attention desires and the relative difficulty of task will change with practice. Also, retention or transfer tests are used to test the learning. Therefore, if the temporary effects (performance) of the dependant variable are proved, one can somehow is assured that the observed differences originating from learning effect are different [17].

REFERENCES


