Comparing the Effects of Internal, External and Prefer Focus of Attention on the Elite Shooters’ Performance

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INTRODUCTION

Shooting needs lots of coordination and accuracy [1]. A shooter must have high levels of focus and attention on the target, at the same time he/she should be able to provide an appropriate postural position while raising hands for shooting [2]. Thus it is required that the shooter focus directly on the target and standing still [3]. Focus means thinking about one subject among a few possible subjects which exist simultaneously [4]. Attentional focus improves the execution by directing the focus to specific execution points which are at the attentional capacity zone [5]. From the point of width focus could be narrow or extended and from the point of focus could be concentrated on the inside of the individual (internal focus) or on the external stimuli (external focus) [6]. However, attentional focus on the body movements and the method of skill execution is defined as internal focus and focusing on the signs, tools, result and outcome of the movement in the surrounding environment is called external focus [7].

Kettle & Bernstein believe that the focus should be concentrated on a part which the awareness is available there [8]. Richard Masters believes that you should not think about the way you execute during the skill execution, because thinking about the way you execute disturbs the attentional capacity. Also Robert Singer (1985, 1988) showed that the elite performers do not think about their details of performance while executing skills [7]. Based on the James’s idea of motor principle focusing on the outcome of movement comparing to the way of executing a movement, creates a stable representation for learning skills and it results in stimulating the motor system for producing movement, Wulf, McNevin and Shea (2001) showed that the internal focus leads to decrease of attentional needs, but the external focus increases the role of information processing in execution [9].

The Wulf's constrained action hypothesis states a complementing view; Wulf believes that when individuals focus on movements and methods of execution (internal focus) they interfere the coordinating controlling processes of movement. In fact, the effort of conscious controlling of the movement unexpectedly damages the automatic process which could well control the movements. In contrast, the focus of attention on...
the outcome of movement results in the enhancement of automatic and reflexive control movements. Thus it results in more desirable outcomes. In other words, the choice of external focus leads to decrease of conscious interference in control movements, and it improves the learning and execution [7, 10, 11].

Most of the researchers believe that in designing the training instructions it is better to prohibit the performers to focus on the body and way of skill execution, and they should focus on the outcome of the movement [12]. One of the first empirical studies about the effect of internal and external attentional focus in golf showed that the training instruction with emphasis on concentrating on the outcome of movement (external focus) had a better learning compared to the concentrating on the body movements (internal focus) [13]. Also, Wulf’s review on 15 years researches showed that in most of the motor skills, obtaining the external focus of attention is more useful than the internal focus. Focus on the body movements (internal focus) during executing a skill is relatively ineffective. In contrast the focus on the outcome of movement in the environment (external focus) results in a more efficient performance and better learning [11, 14–16].

It is interesting to note that some of the researchers believe that the internal focus in beginners is more useful than the external focus [17, 18]. But due to some defects in the method of study by Perkins et al (2003), Wulf believes that the pattern of external focus of attention has more positive effects on the performance of golfers [11], because the beginners did not manage to create a connection between the motor commands and the outcome of movement during the external focus [7]. Also, positive effects of external focus have not been observed by Porter et al (2010). They showed that 84.6% of the elite runners used the verbal instructions based on the method of body movement in order to reach the optimum skill execution and no report of offering verbal instructions of external focus by the trainers to the students was observed [18].

It seems that one of the sports which is highly depended on the attentional focus is shooting, because the number of shots in this sport is high and at the same time the shooters’ results are close to each other and the competition is tough, thus missing just one shot could affect the shooter’s rank and performance. The features of shooting skill such as maintaining the posture for all of the shots, controlling stability and body fluctuations, creating the appropriate muscular power in a way that it does not intensify the fluctuations, concentrating for preserving the elements of targeting in the shooting zone, having time limits for detecting the time of shooting and number of several shots during the competition will be the reasons to explain the necessity of conducting researches about shooting as a motor skill with the choice of high decision making and low motor requirements.

This study tries to investigate the role of attentional focus in executing shooting skill in elite individuals and to detect that what kind of effects do different types of focus of attention instructions (internal, external and prefer) on the shooters’ performance. Also, it tries to study that which of the types of focus of attention will be better in improving the elite shooters’ performance. Moreover, it tries to find out that determining the type of focus by the shooter itself has what sorts of effects.

**MATERIALS AND METHODS**

Ten elite shooters in the field of Air Pistol 10 m, 4 females and 6 males in the age range of 20-40 (M: 28.00, SD: 6.60) with 5.05 years of experience of sport participated in this study. One of the participants was left-handed and the other 9 participants were right-handed. All of the shooters who were the members of national team or the national champions in 2013 could have taken part in this study. Selecting the examinees was conducted from the individuals who have filled the application for participating in the study. The Participants had all of the shooting equipments and used their own pistol which they used to use in their practices. Before the shooting test phase, ethical approval was achieved in accordance with the Science and Research Branch of the Islamic Azad University (SRBIAU) Principles for the Research involving Human Participants. Every participant provided informed consent which was kept confidential (participants were numbered). Participants were able to withdraw their data at any time and given a full debriefing including contact details at the end of the experiment.

**Fig. 1**: Air Pistol, Scatt and equipments which used in the study.

All of the shooting tests procedures were conducted in the shooting halls which were based on the standards of International shooting sport Federation (ISSF). Score recording and analyzing the shooters’ performance were conducted by the shooting analyzer system (Scatt). This device has the capability of recording the
shooters’ functional features and it has been used in different studies such as the studies of [19,20]. This device has an optical sensor which is installed under the pistol. The infrared light of optical sensor is sent and it is received by the built-in receivers in the target. Then the information related to the way of shooting is transferred to a computer by the use of a processor and then it is shown in the computer in the form of table and diagram.

The plan of taking test was given to all of the shooters. The examinees gathered in the shooting hall 30 minutes before the test started. They were able to warm up for 15 minutes based on their own personal program. Then the Scatt was connected to their pistol and the calibration with the center of the target was done. According to the rules of ISSF, 10 minutes was considered for preparation exercises, 15 minutes for detecting the deviation of the pistol, and 55 minutes for 40 shots. Examinees were allowed to take a break during the test and they were allowed to use the equipments and pistol which they used to use in their personal trainings. Since the number of shots in international competitions is 40 shots for women and 60 shots for men, it was possible that the increase of shots for women up to 60 be effective on their performance, thus the test for all of the participants (men and women) in each level was 40 shots.

As it can be seen in figure 2, in the first test session no attentional instruction has been offered, and the examinees took 40 shots based on their own method and technique. In the second session after one day and based on the situations of external focus of attention and by the aim of attentional focus to the movement outcome the test was conducted. At this level shooters must concentrate on the front sight and observe its movements toward the target, control the pistol movements in the fine aiming area and perform their shots. Before starting each of the tests the attentional instruction and what the shooter must observe were explained by the examiner. The third session was conducted by emphasizing on the internal focus and focusing on the movement itself. Shooters must make attentional focus on the appropriate muscle contraction in shoulder create adequate power for controlling the front sight in the final shooting area and take shots. At the fourth level they choose on the focus situations (external or internal) and they take shots based on that.

Due to the normal distribution of the samples and existence of homogeneity of variance, the one-way ANOVA test was used for studying the difference between the examinees’ performance and LSD post-hoc test was used for determining the points of difference.

Fig. 2: Different levels of conducting 4 attentional instructions.

Results:
ANOVA test results showed that a significant difference exists between the mean of scores of shooters during 4 attentional instructions (F(3,36)=5.229; P=0.0004). Also the results of one-way ANOVA test and LSD post-hoc test for determining the points of difference between the mean of scores of shooters in different attentional instructions showed that the difference between mean of scores of shooters in different situations is significant. As such, the difference in mean of scores of shooters in no attentional situation was 370.0, and in external attentional situation it was 375.6 and they were significant (P=0.023; P<0.05). Thus the external attentional instruction had an effect on the shooters’ performance and it improved their performance. The score difference of shooters in no attentional situation is 370.0 and in internal attentional situation is 366.3 and they were not significant (P=0.127; P>0.05). Thus although the internal attentional instruction compared to the no attentional situation resulted in decrease of their performance this difference was not significant. Also the difference in scores of shooters in external attentional situation was 375.6 and in internal attentional situation it was 366.3 and they were significant (P=0.0001; P<0.05). Thus the shooters’ performance under the external attentional situation compared to the internal attentional situation is significantly at higher levels. Findings showed that no significant difference exists between the shooters’ scores in prefer focus 370.9 and no attentional focus 370.0 (P=0.706; P>0.05). As the figure (3) shows, the external focus in elite shooters is along with improvement of performance and internal focus results in execution disorder and performance drop. Also the elite shooters’ scores in prefer focus situation are equal to the ones in no attentional situation.
Discussion:

The aim of this study was to investigate the effects of different focus of attention instructions on the elite shooters’ performance. While literature has consistently demonstrated that prompting an external rather than an internal focus of attention leads to superior motor skill learning and performance [10, 18]. Based on the Wulf’s constrained action hypothesis there are significant reasons for the matter that external attentional focus has more benefits than the internal focus.

The first reason could be proposed in the frequency of movement adjustments and regulations especially toward the focus on the movement controlling. Findings show that when the external focus is chosen in comparison to the internal focus, a wider process of automatic control is used. In contrast, in internal focus situation the effort for conscious control of movements of the motor system is limited and it prevents the automatic motor control processes [11, 21]; [10]. It seems that the external focus instruction with the emphasis on the focus of attention on controlling the movements of front sight (outcome of movement) which is one of the main technical components for performing a desirable shot which causes to provide a kind of automatic process in non-awareness processes and thus it brings about performance improvement compared to the no attentional situation.

The external focus not only results in the decrease of attentional needs but also it typically enhances the automatic control and creation of non-awareness and non-voluntarily movement controlling processes and it provides more desirable result. In fact the external focus helps the individual to prevent the central processing and the skill will be performed in a more self-organizing method. In other words, choosing the external focus decreases the conscious interference in movement control and it increases execution and learning [7, 11, 21].

Moreover, studies show that muscle activities as a function of focus of attention has improved in the external focus and the efficiency of movements has increased. In fact the external focus in comparison to the internal focus or the no attentional situation results in the better coordination of Agonist & Antagonist muscles and it facilitates the execution [7, 10, 11, 21]. As a matter of fact the Electromyography muscle (EMG) activity records in choosing the external focus showed that the created facilitation in the automatic processes results in the decrease of involvement in motor units [22]. For example the external attentional focus in Dart throwing not only results in the throwing accuracy improvement but also decreases the EMG activity in Triceps muscle [23].

It seems that the external attentional focus helps the shooters to focus on the front sight, and non-consciously decrease the pistol movements as the outcome of movement and facilitate the automatic processes and have better shots instead of decreasing their movements consciously. This matter could have been taken place along with improving the muscle functions and creating a better coordination in a way that it provides the decrease of muscle contraction and as a result decrease the movements and vibration of hand and pistol. Thus while obtaining the external attentional focus, the decrease of level of electrical activity of muscles creates some kind of appropriate coordination between the group of Agonist & Antagonist muscles and it brings about the automatic control in execution [11, 24- 26].

But the increase of shooters’ performance in internal attentional situation in comparison to the no attentional situation and external focus shows that by emphasizing on conscious controlling of movements and creating an appropriate muscle contraction for holding hands and the pistol in the final targeting zone the internal focus had a poor performance for the shooters. In the task of maintaining height movements for being stable in one point, Vuillerme & Nafati (2007) found out that when the individuals consciously try to decrease
their body fluctuations have more body movements than the times when they are in normal controlling conditions [27]. This finding states that in well trained skills that the individual control the movements without any conscious interference, the conscious execution of skill increases the attentional needs and leads to interfering with the automatic processes of control of movements and ultimately disturbs the execution.

Wulf believes that when focusing on the movements the individuals tend to consciously interfere with the controlling processes which regulate the movement coordination. Thus by trying to consciously controlling the movements they undesirably damage the automatic processes which could appropriately control the movements [10, 11]. Probably the internal focus in shooters results in formation of some kind of automatic controlling of muscle which disturbs the movement fluidity and thus the adequate coordination for shooting is not formed. Additionally, shooting based on the more muscle contraction instruction (internal focus) results in increase of electrical activity in muscles and the coordination between the agonist and antagonist muscles are not formed for automatic control. In fact when the muscle control is used for reaching a desirable execution the motor hierarchies are put in the lowest level and the execution is disturbed [7].

In summary, findings showed that benefits resulted from the external focus on the elite shooters’ performance are congruent with the findings of [28] in Golf and [26] in dart throwing [29, 30] in balance controlling, [15] in supra postural task, [16] in sprint runners; and emphasize on the performance improvement during adopting external focus. Based on the matter that elite shooters showed different responses toward different types of focus of attention it seems that the task of shooting has the necessary requirements for displaying the effects of focus of attention. Possibly offering instructions of focus of attention to the elite shooters has managed to properly focus their attention on the special technical, functional and environmental points and emphasize on the outcome of movement, because in this study even offering one session of instruction of focus of attention showed its effects.

One of the limitations of the present study was lack of using control group. It is recommended to conduct a study by having three groups (external focus, internal focus and control group) with pre-test, post-test in individuals with different skill levels (elite and beginner). Also it is recommended to use a questionnaire which could determine the type of shooters’ prefer focus in executing the instruction of prefer focus.

Conditions:

In summary the study results support directing focus toward the outcome of movement and adopting external attentional focus in individuals that gained expertise in executing skills. Also the findings showed that internal focus results in disturbance in performance of elite individuals and it causes their drop of performance. Interestingly when choosing the type of focus (external-internal) is on the elite individuals their performance compared to the external focus situation is at lower levels and it is placed near the no attentional situation. Thus it is suggested that in designing the exercise patterns it is better to prevent from offering internal focus instructions and also voluntarily choice of type of attention in elite performers.

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