



The Effects of Attentional Strategies (Augmented feedback, Instructional Self-talk, and Instruction) on Motor Learning in Ten-Year-Old Children

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Abstract

Background: The external focus of attention is one of the most important and effective variables of performance and motor learning.

Objectives: The current study aimed at comparing the effects of external focus of attention with instructions, instructional self-talk, and augmented feedback strategies on motor learning in 10-year-old male students.

Methods: Sixty students (with the mean age of 10.10 ± 0.20 years) participated in the current study voluntarily as the study samples and were randomly divided into four groups of 15 students (three experimental groups and one control group). Participants practiced overarm throwing using their non-dominant arm. In the training phase, the subjects were trained for 300 throws in five sessions (60 attempts per session) and then, they performed a retention test. One-way analysis of variance (ANOVA) was used to determine the difference between the groups. In order to investigate the intervening effects in the four groups within the pre-test, post-test, retention stages, repeated measures ANOVA and in order to determine the differences between the groups, Bonferroni post-hoc test was applied.

Results: The results showed that all groups except the control group progressed in post-test and retention tests. On both tests (post-test and retention), the augmented feedback group showed the greatest throwing accuracy ($P < 0.001$). Also, the accuracy scores of the instructional self-talk and instruction groups were better than those of the control group ($P < 0.001$).

Conclusions: The findings of the current study showed that the external focus of attention with the augmented feedback method was the best strategy to take advantage of the external focus of attention on motor learning in 10-year-old male students.

Keywords: Feedback, Attention, Students

1. Background

Recent studies showed that in every task, level of skills, age group, adoption of external focus of attention rather than internal focus of attention, always lead to higher accuracy and balance in the exercise (movement effectiveness) and muscular activities, oxygen consumption, and heart rate (efficiency) (1, 2). External focus of attention leads to increased rate of automatic control of movements (3) and as a result causes accelerated speed of the learning process (2). Thus, by adopting external focus of attention, the learner is able to attain higher levels of skills in a shorter period of time (3). One of the theories that support the effectiveness of external focus of attention is the theory of "Constrained Action Hypothesis" (4). In this hypothesis, the superiority of external focus over internal focus of attention is attributed to the increased level of control

over the automaticity of the actions. But what methods can be applied in order to benefit from external focus of attention? In recent years, it is observed that methods such as instruction, feedback, and instructional self-talk are used to make the focus of external attention.

Instructional instructions are one of the methods to transfer information and implement strategies to perform motor tasks (1, 2). Several studies showed that instructions for the adoption of external attention (goal of the move) improve and facilitate the learning process compared with those of the instructions for internal focus (organs of the body) and control group (1, 2, 5).

Instructional self-talk is often used in a widespread manner by athletes both during the learning stages of a skill and within competitions (6). Instructional self-talk enhances the level of performance through the focus of at-

tention, provision of technical information, and introduction of appropriate executive solutions (7, 8). Studies by Chang et al. Kolovelonis et al. and Zourbanos et al. respectively in basketball skills, handball, and softball throwing used instructional self-talk techniques to benefit from external attention (9-11). But, there are also studies that contradict with the results of these studies (12, 13).

Another method to employ the focus of attention is augmented feedback. Augmented feedback comes from an external source such as a coach and teacher, and informs the learner on how to do it (14). Studies that used the feedback technique to benefit from external attention are two studies by Wulf et al., on volleyball and soccer skills (14, 15).

Among the studies comparing focus of attention methods, those of Shea and Wulf and Cutton and Landin, are noteworthy (16, 17). Shia and Wolf in their study on the impact of the external and internal focus of attention through feedback and instruction on learning to maintain dynamic balance, concluded that external focus of attention feedback group and external focus of attention instructions group had a better performance than internal attention feedback and internal attention instructions groups in retention test, and external attention feedback group had better performance than the other groups in the transfer test. Couton and London in their study on the effect of self-talk and augmented feedback on learning the skills of table tennis forehand compared the two methods, which showed that the self-talk group had better results than augmented feedback group.

Generally, by affirming effectiveness of the external focus on the performance and learning of motor skills (1, 2), also considering that one of the major purposes of sports teachers and sports psychologists is training experts from an early age, in the shortest time and with the most desirable methods of training and provide training methods that lead to the most learning in the skill training and also enable athletes to reach peak performance during the competition. Therefore, the challenges facing the researchers are those of the instruction, feedback, and instructional self-talk methods in the effectiveness of the external focus of attention, which are more profitable and more advantageous than other methods.

2. Objectives

The current study aimed at comparing the effect of external focus of attention with instruction, augmented feedback, and instructional self-talk techniques on motor learning of 10-year-old male students.

3. Methods

3.1. Participants

Sixty male and right-handed students with the mean age of 10.10 ± 0.20 years studying in Bonab city, Iran in the academic year 2017 - 2018 with no previous training and experience in throwing exercises with their non-dominant arm were recruited. It was noted that participation in the current study was voluntary. All participants had physical health and were also right-handed. All of them were informed about the study objectives and a consent form was signed by their parents. The current study was conducted under the supervision of office of education in Bonab and the study protocol was approved by the ethics committee of University of Tehran. The Gpower-software was employed to calculate the research sample size (statistical power of 0.80, with a large effect size, $f^2 = 0.80$, a moderate correlation $R = 0.50$, and an overall level of significance of 0.05).

3.2. Apparatus and Task

To achieve the goals of the current study, a shooting target was fixed on the ground within 3 meters of the participants consisting of 10 concentric circles with dimensions of 2×2 meters used to measure the precision of overhand throwing (18) (Figure 1). A non-dominant hand was determined through asking the participants; for example, which hand do you use to write; right hand or left hand (19) ?

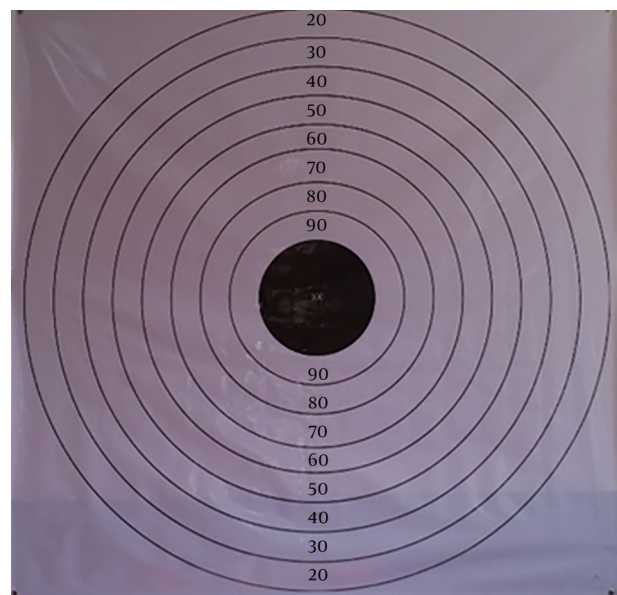


Figure 1. Study task

3.3. Self-Talk Scale

To find out if the participants used self-talk phrases or not, and the type of self-talk phrase and its number, the self-talk scoring scale including three questions was used. The questions were “Did you use self-talk phrases while practicing?”, “If the answer was yes, what self-talk phrases did you use?” and then “how many times did you use the self-talk phrases” (9)?

3.4. Methods

First, the participants received basic instructions regarding how to throw overhand using a non-dominant arm including standing behind a line and throwing with the left hand. Furthermore, the correct manner of throwing was shown by the examiner to the participants. Next, the participants were randomly divided into four groups (using the numbers assigned when participating in the study), each including 15 students. The groups included instruction (I), instructional self-talk (IST), augmented feedback (AF), and the control group. Then, the participants performed 10 throws as the pre-test. Then the subjects of each group practiced their own rules. The external attention instruction group received instructions on external attention (in the current study focusing on the target center), the instructional self-talk group replicated the word “Target Center” before each throw (9), the augmented feedback group with augmented feedback (attention to the center of target with 33% of the frequencies) and the control group continued to practice throwing with a non-dominant arm without any attention instructions, instructional self-talk, and augmented feedback. Acquisition stage consisted of five sessions. The number of throws per session was six blocks, and each block was 10 attempts that the subjects received two minutes of rest between the blocks and at the end of each block received feedback about the mean scores. The retention test was performed after 24 hours by performing 10 throws without any feedbacks or instructions. Also, before performing the retention test, self-talk scale was completed.

3.5. Data Analysis

For the statistical data analysis, the Shapiro-Wilk test was applied to determine the normality of the distribution and the Levene test was applied to determine the homogeneity. After these two tests, Multivariate analysis of variance (MANOVA) (four groups x six stages) in the acquisition stage was applied. In order to make a within-group comparison in the pre-test, post-test, and retention test, one-way ANOVA was applied. To study the intervening effects in the four groups within the pre-test, post-test, and retention stages, repeated measures ANOVA and in order

to determine the differences between the groups, Bonferroni post-hoc test were applied. All the analyses were conducted with SPSS version 16. The level of significance for all the tests was ≤ 0.05 .

4. Results

There were no significant differences between the groups in terms of height, weight, and age of the participants ($P \geq 0.05$). The mean height of the subjects was 134.78 ± 8.79 cm; ranged 121.0 - 151.0; mean age was 10.10 ± 0.20 years; ranged 10.0 - 11.0; and mean weight was 30.65 ± 5.43 kg; ranged 22 - 45. Descriptive information of throwing average and standard deviation of the scores of different groups are shown in Table 1. Results of the Shapiro-Wilk and Levene tests showed that the data had normal distribution and the variances in all of the stages of the study were homogeneous.

Results of MANOVA showed a significant difference between the four groups under the specified acquisitions ($P < 0.001$), the stage of measurement ($P < 0.001$), and its interaction ($P < 0.001$) in the skill of overhand throwing. Thus, one-way ANOVA was applied in order to make a more accurate investigation on the significance of the differences between the groups. Results of Bonferroni post-hoc test revealed no significant differences in the pre-test ($P = 0.904$).

However, there was a significant difference between the augmented feedback group and the instructional self-talk, external attention instruction, and control group in the post-test ($P = 0.0001$). Also, there was a significant difference between the external attention instruction group and the instructional self-talk group ($P = 0.043$), and both groups had a significant difference with the control group ($P < 0.001$). Also, in the retention test, the augmented feedback group from the instructional self-talk group ($P < 0.001$), the external attention instruction ($P = 0.001$) and the control ($P < 0.001$) groups got better scores on the overhand throw technique. However, there was no significant difference between the scores of the instructional self-talk group and those of the external attention instruction group ($P = 0.102$) and the scores of both groups had a significant difference with those of the control group ($P = 0.006$, $P < 0.001$).

In order to investigate intragroup changes, the results of repeated-measures ANOVA showed significant difference between the four groups under the specified interventions ($P < 0.001$), the stage of measurement ($P < 0.001$), and its interaction ($P < 0.001$) in the overarm throw. Also, augmented feedback group led to the enhancement of the accuracy of the throws ($P < 0.001$). Furthermore, such improvement was observed in the performance of the external attention instruction group ($P < 0.001$). The results of

Table 1. Mean and Standard Deviation of Scores of Throwing Groups in Different Stages of the Study^a

Group	Pre-Test		Acquisition					Retention
		Session 1	Session 2	Session 3	Session 4	Session 5		
IST	24.53 ± 2.06	25.46 ± 1.40	26.33 ± 1.98	26.93 ± 2.31	29.20 ± 3.50	30.46 ± 1.55	27.80 ± 1.08	
AF	24.26 ± 2.12	27.66 ± 2.60	32.53 ± 4.08	39.00 ± 1.85	37.40 ± 4.62	39.80 ± 2.45	33.06 ± 3.08	
I	24.00 ± 2.39	26.00 ± 1.41	26.53 ± 1.24	30.06 ± 5.31	32.73 ± 5.17	33.20 ± 4.34	29.73 ± 1.98	
Control	24.00 ± 2.50	24.53 ± 2.06	24.33 ± 2.25	25.20 ± 1.85	25.06 ± 1.98	24.66 ± 1.23	25.06 ± 1.98	
Total	24.20 ± 2.23	25.91 ± 2.21	27.43 ± 4.00	31.25 ± 5.40	31.10 ± 6.01	32.03 ± 6.07	28.91 ± 3.60	

^aValues are expressed as mean ± SD.

this test showed that the participants' scores had a significant progression from the pre-test to the post-test and retention stages ($P < 0.001$). In addition, an improvement was observed in the performance of the instructional self-talk group ($P < 0.001$) and participants' performance significantly improved from pre-test to post-test ($P < 0.001$) and retention ($P = 0.001$) stages, but no progress was observed in the control group ($P = 0.065$). Also, the outcomes of the self-talk scale indicated that in the instructional self-talk group 98% of the participants used the word "Center-Goal". Other groups did not use self-talk (Table 2 and Figure 2).

Table 2. Results of Repeated Measures ANOVA and Comparison of the Intervention Groups with the Control Group Using Post Hoc Tests

Groups (I)/Groups (J)	Mean Difference (I - J) ± Std. Error	Sig.
IST		
AF	-4.78 ± 0.56	< 0.001
I	-1.38 ± 0.56	0.097
Control	2.73 ± 0.56	< 0.001
AF		
I	3.40 ± 0.56	< 0.001
Control	7.51 ± 0.56	< 0.001
IST	-4.78 ± 0.56	< 0.001
I		
Control	4.11 ± 0.56	< 0.001

5. Discussion

The current study mainly aimed at comparing the effects of external focus of attention with instruction, instructional self-talk, and augmented feedback techniques on performance and learning overhand throws using a non-dominant arm among 10-year-old male students in Tabriz, Iran. The results showed that all three groups had a

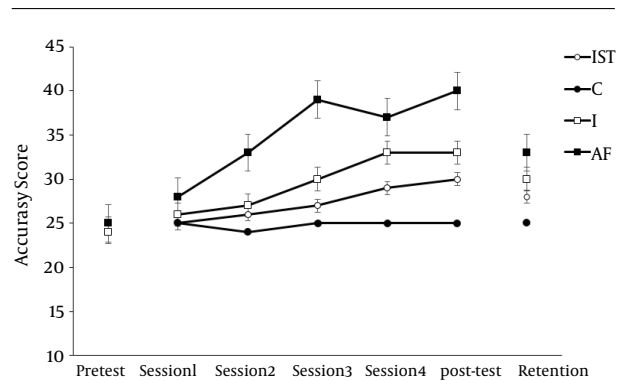


Figure 2. Performance graph for pre-test, acquisition, and retention phases in the two study groups

significant improvement on their performance and learning of the overhand throwing skill compared with the control group. In both post-test and retention tests, the augmented feedback group had the highest scoring accuracy. The effectiveness of the external attention instruction was consistent with those of the previous studies (2, 3). Also, the results of this section of the study were in line with those of the previous studies on the effectiveness of instructional self-talk (9-11). Another result of the current study was the effectiveness of adopting external attention using the augmented feedback method. Results of previous studies were also in line with the results of this part of the current study (14, 15). It should be noted that in all three of these methods of taking external attention, the attention of individuals was drawn to the result of motion and the purpose of movement (the center of the target of marking). External focus of attention leads to increased rate of automatic control of movements (3) and as a result accelerates the speed of learning process (1, 2). Thus, by adopting external focus of control, the learner is able to attain higher levels of skills in a shorter period of time (5).

Also, the results of the current study on the beneficial effects of adopting the external focus of attention can

be justified by the limited operation hypothesis (4). According to this hypothesis, the external focus of attention makes it possible to perform the actions in a more automatic way. Adoption of an external focus of attention leads to the control of actions through fast, and reflexive processes. On the other hand, whenever individuals attempt to control their actions consciously (internal focus of attention), the motor system is constrained due to interferences made on the natural processes that are responsible for the regulation and coordination of movements. Thus, the automatic processes of control cannot be used to create more efficient movements.

But, the current study results were not coincidental with those of Tsiggilis et al. as they did not show a significant difference between the instructional self-talk group and the control group in handball throwing skills in the students of physical education (13). Also, the current study results were not consistent with those of Goudas that did not substantiate the improvement in long jump performance with instructional self-talk use (12). Perhaps the discrepancy between their findings with the results of the current study was due to the differences in age, nature, and level of mastery of subjects. Also, in the case of external attention instructions, the current study results were inconsistent with those of Lawrence et al. (20). The reasons for the inconsistency in the results of the latter two studies can be the type of skill and age of the subjects.

One of the most important outcomes of the current study as the usefulness and effectiveness of external attention through augmented feedback on the performance and learning of the task of the overhand throw technique than the other two methods of instruction and instructional self-talk. The results of this part of the current study were in line with those of Shea and Wulf (16). In order to justify this excellence, it can be pointed to the informational, motivational, and communicative role of augmented feedback (21). Augmented feedback has an important impact on learning with regard to providing information on how to move correctly and the error of the previous move. Also, getting information and augmented feedback has a strong motivational role. The augmented feedback makes the task more interesting, and also makes the learner aware and motivated to pursue his goals. Increasing arousal causes the learner to have a longer, more intense tendency to practice, and ultimately leads to more learning (21).

Also, considering the cognitive developmental capacities of children aged 10, at this age of logical thinking, the child is limited to objective issues (22, 23). Therefore, this may have decreased the effect of instructional self-talk on augmented feedback. On the other hand, findings of the current study were not in line with those of the study con-

ducted by Cutton and Landin (17). The reason of such inconsistency of the results with those of the current study can be attributed to the differences in subjects' age and grade. Also, probably instructional self-talk makes people more focused on their ongoing assignments.

The results of the current study, in agreement with those of Shea and Wulf and Wulf et al. suggested that attentional focus is indeed a significant qualifying variable to benefit from augmented feedback (15, 16).

In general, so far, no study compared the effect of external focus of attention with those of instructions, augmented feedback, and instructional self-talk techniques on performance and learning in 10-year-old male students. Therefore, according to the results of the current study, it is advised that physical education teachers and sports trainers use the augmented feedback method to benefit from the external focus of attention on training motor skills in children aged 10 years. Also, considering that the learners in the current study were beginner and males, it is suggested that further studies be conducted on skilled subjects and females.

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