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The Effects of Cognitive and Motivational Imagery on Acquisition, Retention and Transfer of the Basketball Free Throw

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Abstract: The present study was designed to compare the effects of physical practice, cognitive imagery accompanied with physical practice and motivational imagery accompanied with physical practice on acquisition, retention and transfer of the Basketball free throw. Seventy-eight female students with no prior experience in the task participated in the study in partial fulfillment of the requirements for their P.E. course. They were assigned in three groups according to the results of Motor Imagery Ability questionnaire, Sport Imagery Questionnaire and pretest scores. All groups participated in eighteen sessions of practices and acquisition, retention and transfer tests. The results of one way ANOVA indicated that physical practice group was better in acquisition phase, but cognitive imagery group produced better results in retention and transfer tests. These results pointed out that the cognitive functions of the mental imagery, not the motivational functions, may improve the processes of learning a new motor skill.

Key words: Motivational Imagery, Cognitive Imagery, Basketball Free Throw, Retention, Transfer, Performance

INTRODUCTION

Basketball is an exciting game and has many fans all around the world. Free throw is one of the important basketball skills and most coaches believe that it is one of the main factors for a team to succeed. To successfully perform this skill, not only physical abilities but also mental skills are important.

Mental imagery is defined by Richardson (1963) as a Para-perceptual experience or a Para-sensory awareness while lacking of factual stimulus causing these. It is a mental skill which plays an important role in learning motor skills, rehearsing special skills, improving self-confidence, controlling stress, excitement ... [1]. Schmidt (2005) stated that mental imagery is an effective method to rehearse skills. It can be always performed and need no assets [2]. Magil (2002) confirmed the advantages of mental imagery in learning skills, healing injuries and preparing to perform efficiently [3]. McMorris (2004) asserted that mental imagery, similar to physical practice, creates a skill model in the central nervous system; therefore, when we imagine performing a skill, the central nervous system learns as much as when we really perform that skill [4].

Wulf *et al.* (1995) considered the reduction of the relative frequency of the feedback during physical practice as useful. They believed that mental imagery, due to lack of feedback, operates similar to physical practice without feedback; therefore, they stressed the physical practice accompanied by imagery [5]. In his theoretical framework, Paivio (1985) emphasized the role cognitive imagery and motivational imagery play in performing and learning motor skills [17]. In their conceptual model, Martin *et al.* (1998) divided the cognitive and motivational functions of the imagery into several categories.

Motivational specific imagery is used to imagine special goals and goals-oriented behaviors such as the victory in a competition or the joy after a successful performance. Motivational general imagery is used to psych-up generally and to improve self-confidence. Cognitive specific imagery is used to improve the skill level. Finally, cognitive general imagery is used to imagine training and competition strategies. Compared to cognitive imagery, it seems that limited researches investigated the effects of motivational imagery on novice and elite players' performance and learning; mainly these researches were not conclusive [6-10].

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Murphy (1992) asserted that novices rarely use mental imagery [11]. Feltz and Landers (1983) and Rayn and Simon (1983) stated that mental imagery more affects delicate skills with more cognitive aspects [12, 13]. Hall (1998) stated that mental imagery significantly affected novice and professional players' performance although it more affected professional players' performance [14]. In contrast, researchers such as Mulder (2004) and Overdorf (2004) did not believe in the effect of mental imagery on novices' performance [15, 16]. Different theories of mental imagery attempted to explain the effectiveness of mental imagery. In his psycho- neuro-muscular theory, Carpenter (1993) stated that as mental imagery activates neural-muscular patterns, it facilitates learning motor skills. In his symbolic learning theory, Saket (1934) indicated that mental imagery provides an opportunity for the performer to practice motor sequences as the symbolic aspects of a skill. This speculation suggests the learning resulted from mental imagery and the cognitive learning as related and points to the perception of motor patterns. In fact, mental imagery codifies the movements necessary to perform the skill and creates the motor program in the central nervous system. The codification of the movements in the brain facilitates the performance of motor skills [1]. Magil (1976) believes that mental imagery is more effective in the early stages of learning a skill as cognitive processes are dominant; therefore, mental imagery is more effective for those learning a new or reviving an old skill. Mental imagery can help the individuals to perform more ideally in the absence of physical pressure [3]. Schmidt (1975) suggested mental imagery as effective in the early stages of learning a skill as well. This suggestion is contrary to Richardson (1979) as he suggests the effectiveness of mental imagery and familiarity with the skill as directly related [2]. Feltz and Posner (1976) believed that mental imagery in the early stages of learning leads to learning a motor skill more ideally [3]. As there are controversies over the effectiveness of imagery in the early stages of learning a skill, it seems that more researches on mental imagery and its functions should be carried out to reach more subtle grounds.

Researchers studied the effectiveness of cognitive functions as well as motivational functions of imagery. Burhans *et al.* (1988) used the cognitive functions of imagery and increased their subjects' speed after four weeks [18]. Lee *et al.* (1990) and Murphy *et al.* (1998) stated that both cognitive and motivational imageries promote the performance of skills [14, 23]. Blair, Hall and Leyshon (1993) found a 6-week regular physical practice accompanied with cognitive imagery as advantageous to perform fundamental football movements [19]. Hall *et al.* (1998) and Cumming *et al.* (2001) asserted that novice players use the cognitive functions of imagery more [20, 21]. Short *et al.* (2002) suggested the cognitive and motivational functions of imagery as effective to perform golf putting task [22].

On the other hand, the evidence for motivational imagery does not present consistant results. Burhans *et al.* (1988) suggested the motivational imagery as advantageous at the end of a series of practices [18]. Feltz and Riessinger (1990) indicated that motivational imagery group performed a muscular endurance task more ideally than the control group [13]. Lee *et al.* (1990) reported that motivational imagery group enjoyed more self-confidence and performed more ideally than the control group [7]. Hall, Toews and Rodgers (1990) reported that motivational imagery encouraged the subjects to practice and participate more in the training [21]. Murphy *et al.* (1998) indicated that motivational imagery alone was not better than concurrent cognitive and motivational imageries in improving a strength skill [11]. Callow and Hardy (2001) stated that motivational imagery increases incentive and lead to reach the goal [23]. On the contrary, Jones *et al.* (2002) concluded that novice mountain climbers who used motivational imagery did not perform differently from the control group [6].

Above mentioned researches generally show that the elites use motivational imagery for efficient performance, more ideal arousal level and better goal setting; but it is still unknown how novices qualitatively and quantitatively use motivational functions.

It is also vague how beginners in basketball use imagery to improve their free throw skills, since most researches were carried out on elite subjects. For example, Clooney (1977), Lane (1980), Wrisberg and Anshel (1989) stated that mental imagery improved basketball penalty throw [24, 8, 25]. Ross (1985) observed that basketball free throw improved when mental imagery and physical practice were used together [26]. However, Kearnes and Crossman (1992), Lerner *et al.* (1996) and Meyers and Schleser (1980) stated that mental imagery weakened university basketball players' free throw [27, 28].

Briefly, the existing results lack universality because: first, the advantages of cognitive and motivational imagery are not separated as several researches suggested cognitive imagery as useful [18-21, 29] and some other researches motivational imagery [13, 21, 23]. Second, the effectiveness of these two kinds of imagery is not clear in novices learning motor skills as most

researchers confined the effectiveness of mental imagery to elites [13, 30, 6, 23, 21, 7, 31]. Third, the effectiveness of cognitive and motivational imagery when learning basketball free throw is vague. On the one hand, researches focus on the promotion of elite basketball players' performance [20, 32, 33, 27, 26, 25, 8, 24]. On the other hand, some researchers rejected the effectiveness of mental imagery on this skill [15, 16]; therefore, conducting an investigation to meet the vague points seems necessary. The present study tends to investigate the effectiveness of cognitive and motivational imagery plus physical practice on the performance and learning of basketball free throw. We hypothesized that both cognitive and motivational imagery increase the novice learners' scores in acquisition, retention and transfer phases compared to the control group. We also hypothesized that novices will benefit more from cognitive imagery, as they perform in the early stage of learning.

MATERIALS AN METHODS

Subjects: 78 female university students at Shiraz Medical Sciences University, with no prior experience in participating in basketball training and competitions, participated in this study. We used stratified blocking randomization, based on the results from Hall and Martin's MIQ-R (Movement Imagery Questionnaire), Hall and Martin's (1998) SIQ (Sport Imagery Questionnaire) and pretest scores, to divide the subjects into three levels: high, medium and low (each group=26 members) and three groups: physical practice, cognitive imagery+physical practice and motivational imagery+physical practice.

Instruments: The Following Instruments Were Used to Gather Data:

- Hall and Martin's (1997) Movement Imagery Questionnaire: 8 questions in two subscales (visual and sensory-motor)
- Hall and Martin's (1998) Sport Imagery Questionnaire: 30 questions in five subscales of cognitive (general and specific) and motivational (general and specific at expertise and motivation levels)
- Free throw test: throws were scored based on AAPEHRD's[1] basketball test: 3 point to hit the ball into the basket without hitting the hoop or the board, 2 scores to hit the ball into the basket while hitting the board or the hoop, 1 score to hit the ball to the board or the hoop, 0 score to not to hit the ball to the board or the hoop.
- A registration form to keep the subjects' scores in practices and phases.

Procedures: After filling out their general data form and consent form, the subjects' height and weight were measured. Then, they filled out the MIQ-R and SIQ questionnaires. Next, the subjects were instructed with basketball free throw and participated in the pretest. Based on the pretest scores and questionnaire results, the three groups practiced basketball free throw for 18 sessions. The practice was carried out by a special protocol designed by Paivio (1985), Martin *et al.* (1998) and Munroe *et al.* (2000).

Cognitive imagery group imagined the details of the skill performance plus performing physical practice. They performed 640 physical throws and 270 mental throws. Motivational imagery group performed physical practice and they imagined the motivation and excitement during the successful performance of the movement. They performed 640 physical throws and 270 mental throws. The audio tape of imagery groups consisted of mental warm-up (Hickman) as well as the instructions on cognitive or motivational imagery. The warm-up took 10 minutes and when subjects improved their imagery to clear, controllable and real movement imagination, 10 minutes was reduced to 7 minutes. Physical practice group performed only 640 physical practices.

The subjects' performances in the acquisition phase were registered. Of course, they were not aware of the registration. The acquisition test was held 24 hours after the last acquisition session, the retention test was held 24 hours after the acquisition test and the transfer test 24 hours after the retention test from an angle 45 minutes to the side of the hoop. The degree of difficulty to reach the goal was determined considering the highest score gained in practice sessions so that the required score was 10% higher than the ideal performance. If the subjects gained the required scores in retention and transfer tests, they were awarded the complete score in physical education course.

Data Analysis: Descriptive statistics were used to achieve median, mean and standard deviation. One-way ANOVA and multiple comparisons Tukey test were used to compare the results among the groups.

[1]American Association for Physical Education, Health, Recreation and Dance

RESULTS

Table 1 indicates the subjects' general data in the three groups.

One-way ANOVA results showed no significant difference in height (p=0.636 and $F_{(2 \text{ and } 75)}$=1.39), weight (p=0.63 and $F_{(2 \text{ and } 75)}$=0.46) and age (p=0.86 and $F_{(2 \text{ and } 75)}$=0.14) among the three groups.

A)the Comparison of Pretest Scores: The means of randomly divided subjects scores in the pretest were compared (Table 2).

One-way ANOVA results showed no significant difference in the means of the scores among the three groups. This finding supports the subjects' random division.

B)Acquisition Test: One-way ANOVA in the acquisition test showed a significant difference in the means of the scores among the three groups (Table 3).

As you can see in the above table, one-way ANOVA results showed the superiority of physical practice group over the other groups in the acquisition test. Next, cognitive imagery+physical practice group performance better than motivational imagery+physical practice group.

C)Retention Test: One-way ANOVA in the retention test showed a significant difference among the three groups (Table 4).

As it can be seen in the above table, one-way ANOVA results in the retention test showed the superiority of cognitive imagery+physical practice group over the other groups. Next, the mean score of physical practice group was higher than that of motivational imagery+physical practice group.

Table 1: The mean and standard deviation of the subjects' general characteristics

	Cognitive imagery +physical practice	Physical practice	Motivational imagery +physical practice
Mean Age	20.92	21.34	21.03
SD	2.46	3.21	3.03
Mean Weight	56.07	55.15	56.80
SD	5.05	7.88	5.29
Mean Height	162.46	161.58	164.15
SD	4.54	6.17	6.11

Table 2: One-way ANOVA findings to compare the means of the scores in the pretest

Index Group	Mean	SD	F	P
Cognitive imagery+physical practice	24.46	10.67		
Physical practice	23.15	9.63	0.24	0.781
Motivational imagery+physical practice	25.19	11.34		

Table 3: one-way ANOVA findings in the acquisition test

Index Group	Mean	SD	F	P
Cognitive imagery+physical practice	35.3	10.15		
Physical practice	42.15	10.91	4.02	0.022
Motivational imagery+physical practice	35.15	9.72		

Table 4: one-way ANOVA findings in the retention test

Index Group	Mean	SD	F	P
Cognitive imagery+physical practice	53.12	10.28		
Physical practice	46.85	9.55	15.11	0
Motivational imagery+physical practice	39.85	5.49		

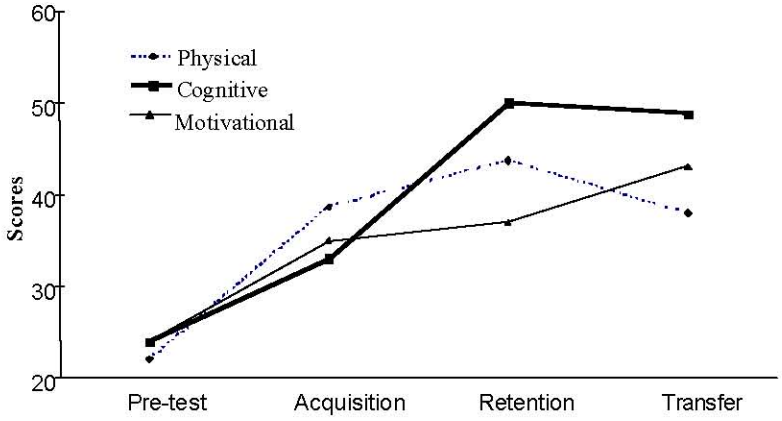

Fig. 1: Improvements of the three groups

Table 5: one-way ANOVA findings in the transfer test

Index Group	Mean	SD	F	P
Cognitive imagery+physical practice	52.62	7.57		
Physical practice	40.15	7.68	15.27	0
Motivational imagery+physical practice	46.69	9.05		

D)Transfer Test: One-way ANOVA in the transfer test showed a significant difference among the three groups (Table 5).

As you can see in the above table, one-way ANOVA results in the transfer test showed the superiority of cognitive imagery+physical practice group over the other groups. Next, the mean score of motivational imagery+physical practice group was higher than that of physical practice group.

Figure 1 shows the improvement of the three groups during the pretest, acquisition test, retention test and transfer test.

While all groups seem equivalent in pre-test, they started to differ in the acquisition test in which physical practice group showed more improvement. This improvement did not last to the retention test in which the cognitive group performed better. Cognitive group also performed better in transfer test.

The above figure indicates that cognitive imagery group performed better than the other groups in retention and transfer tests. It means that these subjects learned free throw skill better than the other subjects did.

DISCUSSION AND CONCLUSION

The results of the present study showed the superiority of physical practice group in the acquisition test. It means that physical practice group acquired the skill better than the other groups, but they did not performed well in the retention and transfer phases. This finding supports previous findings which attributed the profitability of contextual interference to the test phase, not to the acquisition phase; for example, Hird *et al.* (1991)in the pegging board task, Kohl *et al.* (1992) in the pursuit rotor skill and Wright and Smith (2007) in a computer game [14, 34, 35]. However, it should be considered that the cognitive and motivational groups participated in mental practice as well as physical practice. As all groups performed 640 physical throws, lower scores of the two mental imagery groups in the acquisition test may be attributed to the temporary and negative effects of contextual interference.

The present findings also indicated the superiority of cognitive imagery group over other groups in retention and transfer tests. These findings support Kolonay (1977), Lane *et al.* (1980), Ross (1985), Burhans *et al.* (1988), Weisberg and Anshel (1989), Lee *et al.* (1990), Hall (1990, 1998), Cumming *et al.* (2001) and Short *et al.* (2002) [25, 24, 26, 18, 8, 36, 7, 21, 20, 15]. Therefore the following results should be confirmed: cognitive imagery group improved more than motivational imagery group. If the profitability of imagery to learn a motor skill can be attributed to psychological readiness aspects such as motivation, goal-orientation and self-confidence, as Hall, Toews and Rodgers (1990), Munroe *et al.* (2000) and Callow, Hardy and Hall (2001) confirmed [21, 10, 37], it is expected that motivational imagery group will perform better. However, it was observed that cognitive imagery group learned best of all; therefore, it seems that cognitive aspects are more effective in learning basketball free throw than motivational ones. It seems that conceptual / cognitive characteristics of basketball free throw support the above suggestion. This finding partially supports Burhans *et al.* (1998) who found that cognitive imagery group performed their best on the fourth week while motivational imagery group on the twelfth week [18]. Cognitive researchers state that mental imagery help the individual to respond to the problems on performing a movement in early perplexing stages of motor skill learning. In this stage, the individual tries to respond to the questions such as “what should I do?”, “how should I perform the skill?” and “what should I do next?”; therefore, mental imagery helps to review of symbolic aspects, to the perception of motor pattern, to the codification of movements necessary to perform the skill in the brain and the creation of a motor program in central nervous system [13, 3, 1]. Cognitive imagery can involve the individual more effectively in practice strategies. It seems that as it emphasizes the movement aspects, the cognitive imagery directs the individual’s attention to most superior aspects of the skill and consequently enhances learning.

To support this finding, it seems that we can use McMorris’s (2005) explanation. He believed that the effectiveness of imagery results from creating a model in the central nervous system. Learning when we imagine a skill is the same as learning when we really perform the skill; therefore, when an individual imagines, he will benefit from an extra practice.

Briefly, mental imagery is not effective on the skill acquisition; cognitive imagery is more effective than motivational imagery and physical practice in skill

retention. However, the effectiveness of motivational imagery should not be neglected. Although motivational imagery was not as effective as cognitive imagery when learning a skill, results from previous researches on the profitability of motivational imagery and the effectiveness of motivational imagery in competition indicates that motivational imagery might result in a better performing a skill in emotional situations (for example, a competition). Therefore, the future direction of the present study will compare the effectiveness of the two types of imagery on these types of performance.

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