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Visual and athletic skills training enhance sport performance

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ABSTRACT

The aim of this study was to investigate the effect of 8 weeks visual and skills training on visual skills and athletic skills among novice table tennis and basketball players. Sixty novice male were randomly divided into 6 groups (1- visual training and basketball lay-up, 2- visual training and table tennis forehand derive, 3- basketball lay-up, 4- table tennis forehand derive, 5- visual training and 6- control). Based on their training, Revien and Gabor (1981) visual training and athletic skill drills were used. Before and after 8 weeks training, we used from 6 visual skill tests and athletic training tests. The results have shown that all of the experimental groups had enhancement in their visual skills and athletic skills based on their training. Visual and table tennis group had better performance in comparison with visual and basketball group. It seems that the combination of visual and athletic skills training is better than exclusive athletic and visual training. Also the nature of sport skills and their visual demands can affect the visual training programming.

Keywords: Visual training, Basketball lay-up, Table Tennis forehand drive.

INTRODUCTION

Visual system is one of the most important sensory systems in performing sport skills. Despite such important role, such function is rarely taken into consideration when designing training program by coaches and athletes as well [1]. Probably the lack of time for inclusion of this factor in the training program or insufficient research findings showing the significance of the visual system in the success of athletes are the reasons for not paying due attention to it [2]. Despite the fact that eye trainig program is not a new subject in sport, howevr, the prgram has been carried out in laboratories and clinical settings with heavy expense for the athlets [3]. In additions, the findings of such programs have had clinical application and limited usage in sport environmemts [4]. The majority of coaches think that having a 20/20 vision ability is sufficient vision for successful performance in sport context and no extra effort is needed to devote to visual training. Such belief is also very common among the trainer and athletes as well [4]. Theodore and David (1991) showed that some of the elite olympic athletes have no experience in visual training and very few athletes have had the opportunity to participate in specific training to improve their performance.

There are some evidences that show visual system like any other body system performance can show improvement as a result of training [3]. The visual system like musco-skeletal system responds to overload principle. Even the components of the perceptual system functions can be improved through exercise [5]. In addition, it seems like overloading or even putting extra demands on perceptual-visual, visual-motor and kinesthetic sense during the training sessions can lead to the improvement in readiness for competition [6, 7].

The results of studies indicate that visual training can lead to the development of brain regions related to the visual

system including visual memory, figure-ground perception, and orientation [6, 8 & 9]. Such involvement can help the athletes to acquire these skills and use them well in their sport. Visual system is directly related to the proprioception center in the brain. These centers are in charge of controlling the body position in space- such control is very important during the execution of sport skills and physical activities [10]. The development of interaction between the visual perception and peroprioception can improve the ability of the athletes to concentrate better on a given task and easily alleviate the irrelevant cues within the environment such as the players around, fans, or unrelated color within the environment [11].

Despite the fact that visual training is effective in sport performance [3, 5], however, conflicting findings show the opposite. For instance, Wood & Abernethy (1997) examined the effects of 4 weeks of visual training on the execution of sport skills and reported that the efficiency of these programs are not more beneficiary that the training of physical practice alone. In addition, Abernethy & Wood (2001) studied the effect of one course training on the performance of two groups of athletes in rocket sports for a period of 4 weeks. They conducted their research by assigning the athletes into four groups including a visual training, aerobic exercise, sport training and a control group. At the completion of their study, they concluded that there was no significant positive effect for the visual training group on the sport performance.

In the other hand, Balasaheb et al. (2008) examined the effects of visual training in a study where there were three groups of college students assigned into cricket training, visual training and a control condition for six weeks. The results of this study showed that the visual training group performed the visual skills (depth perception, saccadic movements, and visual reaction time) and sport performance significantly better than the pretest condition as well as better than the control group. They concluded that visual training program resulted in improvement in sport performance of the cricket players.

The position that all the athletes have similar perceptual-visual and visual-motor skills is not a valid assumption [12]. Many of the abilities required for successful performance in sports are amenable to specific training programs for that particular sport. In addition, visual training can be employed to improve the visual-perceptual and visual-kinetic ability of the athletes [11]. Visual training is defined as a collection of techniques employed for the purpose of developing visual functions of athletes, a process by which their sport performance is enhanced [13]. Thus, this process needs to apply visual skills and have to be thought depending on the type of sport skill [14]. Such is particularly true for the ball and rocket sports like table tennis [15] and basketball where the speed of ball movement is relatively high and athlete is faced with limited time to react. In these sports the information from the visual system has to be processed accurately in and responded to a fraction of second [10].

What reveals from the review of literature is that no definite agreement exists among the experts and researchers in regard to the effectiveness of visual training. In addition, the researches that have been conducted in examining the visual training factor are very limited in their scope [8, 13] and also have been conducted on a exclusive skills such as baseball batting [5, 16, 17].

Therefore, this research was designed to examine the effectiveness of visual training, sport training in addition to sport-visual training program of basketball and tables tennis hopping to determine whether visual training plus sport training can lead to superior sport performance caused by enhanced visual function in sports. Also we selected two different skills to hypothesis that maybe the nature of skills and their environmental and task needs can constraint the visual training efficiency.

MATERIALS AND METHODS

Research methodology

Following the call from the male undergraduate students registered in university, 100 volunteers registered to participate in the research project. The volunteers had no prior history of basketball or table tennis training. The participants were examined for visual ability tests and eye examination for eye disorders such as refractory error, color vision, and posterior or anterior eye disease by an optometrist. All the subjects showing any of these disorders were exclude from the study.

Finally, 90 subjects between the age 19 to 25 (mean= 21.39yr.) were randomly assigned into 6 groups of equal size (n=15). Five groups participated as the experimental group and the sixth group served as the control group.

The experimental group was assigned to: 1- the visual training-basketball layup training, 2-visual training- table tennis forehand drive training, 3- basketball layup training, 4- table tennis forehand drive, 5- visual training group

and 6- the control group. The visual training program included the sport visual training designed for athletes [18]. These training are standstandardized and used by many researchers [4, 5, 13, 19].

The sport training programs included table tennis forehand drive executed by ball thrower model Butterfly Amicus 3000 under the supervision of officially certified International Table Tennis Federation (ITTF) trainer and triple step basketball training was carried under the supervision of officially certified trainer by the Fédération Internationale de Basketball (FIBA). The visual training sessions lasted for 30 minutes, three times per week. During the training periods, the subjects were free to use their trainer's feedback. In order to eliminate variations of coaching interaction with the subjects, all the instructions and guidance were provided by the same basketball and table tennis trainers. The visual training and sport training program session were divided into two equal times of 15 minutes each to limit the training period to 30 minutes for all the experimental groups.

Pretest and post training scores were recorded before and after the completions of 8 training weeks. The 4 experimental groups participated in sport training program (basketball or table tennis). In addition, the group 1 and 2 used visual training in order to determine the visual training effect if any. The fifth group exclusively performed the visual training for the purpose of comparing with the other 4 groups.

Revien & Gabor (1981) manual for visual training procedure was used as follow:

1. Light simulation exercise: in this procedure, a hand torch is turned on and off alternatively in order to improve visual acuity through the stimulation the central cells of retina.
2. Spiral rotation exercise: in this exercise, the trainee looks at a spiral rotating path for a prolonged period. This exercise results in illusion of size during the seeing of objects. Through this procedure, the athlete perceptual system becomes familiar with this illusion and in sport movements that head rotation is required, such temporary illusion is eliminated.
3. Chord ball training: in this training trials, the athlete has to shift his look from one ball hanging from a string to another ball located within around 3 meters away from that ball as quick as possible and vice versa. The execution of these movements enhances the facility of accommodation and convergence.
4. The swinging ball exercise: in this exercise sessions, the athletes are supposed to track a swinging ball while keeping their head stable. This exercise improves the saccadic action of eyes.
5. Swinging ball with pointed finger: in this exercise, the athlete has to track a swinging ball. This exercise improves the eye-hand coordination ability of the athlete.
6. Colored rotor exercise: in this training trials, a circular plate with varied black spots (size and shape) rotating at various speed is used. The athlete task is to track the targeted spot on the rotating plate. This exercise improves peripheral awareness.
7. Marbles in carton exercise: in this exercise, a card box that contains 6 to 16 colored balls is used. At the center of the card box a block spot is located. The subject task is to keep his eye fixed on the spot while the balls within the box are moved in a specific path with his fingers.
8. Flip –card practice: this practice is employed to improve the visual memory. In this practice, 50 to 100 cards are used. At the middle of every card, there is one block hole and at the sides of the circle, there are two equidistant several digit numbers. But these digits move progressively from center of cards. While the cards are moved rapidly at the trainer’s hand, the athlete is supposed to read the numbers. Revien & Gabor (1981) suggested that this exercise results in the speed of recognition and peripheral vision.
9. String pull exercise: an 8 meter-long string is tied from the middle to a wall in 4 meter distance in such a way that two heads of the string are placed at the hand of the athlete. The aim of using this exercise is to place colored balls from each side of the string in such a way that they stay in equal distance from each other. This exercise can improve the depth perception in athletes. Before the start and at the end of Revien & Gabor (1981) visual training program according to the instruction manual, the participants perform the warm up and cool down exercise.

Visual tests

For the purpose of restrictively matching the visual tests with the visual training programs, standard optometric assessments applied in previous researches [20, 21, 22].

The visual tests employed in this research included:

1- Accommodation facility was used measured by Rock lenses [22]. In this test, spherical lenses ±2/00 was employed. A close table within 40 centimeter was placed in front of the athletes' eye. The athlete was asked to keep his look fixed at a row of letters $\frac{20}{25}$ (in a room or appropriate light). The subjects were required to call the letter loud. In this time, the examiner changed the lens and asked the subject to repeat the letter. The number of replacement of the lens power per minute and the clarity of vision by the subject was recorded.

2- The peripheral vision was measured by tangent screen [22]. In this test, the response of visio-motor to peripheral vision was measured in 8 directions. The subjects were sitting in front of tangent screen one meter away and fixed their look on the central point. The examiner moved the color pointers from the outside of the screen and gradually moved it toward the center. As soon as the subject could name the color of the pointer, it was held and the distance of it to the center of the screen was recorded. The mean distance of the 8 presented colors from the 8 sides were recorded.
3- Speed of recognition was measured by the Optosys software [20]. The subjects were sitting in front of a computer monitor and a light point was randomly appearing and disappearing at a high speed (fraction of a second). The subjects were required to put a mark by a marker on the light point before it disappeared. After one minute, the numbers of marks recorded on the monitor were recorded as the score for the subject.
4- Saccadic eye movements (SEM) from a 40 centimeter distance were measured [22]. The examiner held the saccadic board 40 centimeters away in front of the subject and asked him to move his look from one location to another location and vice versa on the board as quickly as he could for one minute. The examiner recorded those correct eye movements.
5- Visual memory was measured by Lendolt broken circles test [22]. The examiner presented 15 Lendolt broken circles to the subject randomly in one minute. Then, the subject was required to recall the number of cards and their directions. The number of errors and the open side of the circles were recorded.
6- The vergence was measured by prism test [22]. A prism was placed in front of one of the eyes of subjects and asked him to look at another target place 4 meters away in front of the other eye. Then, the examiner gradually moved the prism till the thicker part of it was approached. Then, the subject was asked to report as soon as the vision became blurred or experience double vision. Then, the other eye was examined by the same procedure. The mean score for both eyes were recorded as the vergence score
7- Eye-hand coordination was measured by Optosys software [20]. The subject seat in front of a computer monitor and various forms of geometrical shapes (star, square, triangle, and pentagon) appeared in a random order interspaced by 5 seconds. The subject was required to draw the shape with a marker on the monitor. Then, the correct shape drawn in one minute was recorded as the score.

Forehand test for table tennis
In this researcher designed test, 3 officially approved trainers by international federation of table tennis were invited to rate forehand execution based on the speed and accuracy of the strike from 1 to 5. In order to avoid differences in the way of throwing the ball to toward the subjects to perform the forehand task, a set of ball thrower robot model Butterfly Amicus 3000 was employed. The robot was set in such a way to that could throw the ball with 35 degree angle change every three second. Overall, 20 ball was thrown toward the subject in one minute. The range of score considering the scoring range varied between 20 to 100 points.

Basketball triple step test
This test that was also designed by the researcher, three international level trainers certified by the international basketball federation were asked to score the performance of the subject from 1 to 7 depending on the technique of triple step skill and the accuracy of the execution (in regard to the ball entering the basket and the quality of the skill performed). The score in this skill was determined following 5 times of triple step skill. The range of score for every subject varied between 5 to 35.

For the purpose of examining the effects of 8 weeks of visual and sport training on the visual skills of 6 groups, paired sample t-test was employed. Further analysis was performed by employing factorial analysis of variance (2 by 4 ANOVA) by including the pretest and post test scores as a time factor and 4 experimental groups as the second factor. This analysis was performed to examine whether there was any interaction between the time and condition of practice.

RESULTS

For the purpose of examining the effects of 8 weeks of visual and sport training on the visual skills of 6 groups, paired sample t-test was employed. A visual inspection of the table 1 reveals that group 1 and 2 showed significant improvement in accommodation facility, saccadic movements, eye-hand coordination and speed of recognition. These findings indicate that performing eye training programs accompanied by specific sport training exercise resulted in improvement in visual skills. The interesting point is that the group 5 (visual training only) also showed improvement in these skills and only did not benefited in two skills of vergence and visual memory.

Table 1: Pre test and post test result of 6 groups in visual skills

Groups	1 Visual training & Basketball		2 Visual training & Table Tennis		3 Basketball		4 Table tennis		5 Visual training		6 Control	
Skills	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Accommodation facility	7,64 (1,95)	10,36* (2,11)	8,11 (3,51)	11,10** (2,92)	8,67 (3,28)	8,52 (3,68)	7,90 (1,92)	10,27* (2,64)	8,26 (3,11)	11,64** (4,22)	8,50 (2,10)	9,22 (2,86)
Eye saccadic movement	66,24 (8,56)	93,82** (15,22)	69,85 (20,12)	100,76** (22,58)	70,22 (14,48)	72,66 (10,54)	72,62 (8,52)	90,58* (6,18)	69,28 (11,91)	106,11** (8,22)	70,54 (14,41)	73,32 (14,62)
Vergence	6,52 (1,82)	7,28* (2,11)	7,09 (2,28)	8,08 (3,26)	6,16 (1,58)	6,58 (2,12)	7,61 (2,48)	8,22* (3,16)	6,80 (2,20)	8,12** (3,88)	7,24 (3,07)	7,98 (3,26)
Eye-hand coordination	7,28 (3,12)	10,54** (3,62)	6,98 (2,24)	11,08** (3,06)	7,22 (2,54)	8,11 (3,16)	7,28 (2,08)	10,54* (2,86)	6,54 (1,78)	11.36** (2,12)	7,28 (2,63)	8,06 (2,74)
Speed of recognition	48,29 (7,53)	54,12* (8,12)	49,69 (9,04)	57,26* (7,16)	50,11 (8,42)	51,53 (9,63)	48,24 (4,16)	56,12* (7,32)	47,12 (5,23)	55,25* (7,24)	50,93 (11,24)	52,11 (12,26)
Visual memory	-3,16 (-0,7)	-2,58 (-0,36)	-3,52 (1,26)	-2,11 (0,81)	-2,91 (0,61)	-2,81 (0,81)	-3,61 (1,01)	-3,08 (0,72)	-3,26 (1,08)	3,18 (0,52)	-2,86 (1,12)	-2,54 (1,36)

**p ≤ .01. **p ≤ .001.*

In the other hand, group 3 whose subjects exclusively performed the basketball training showed no significant improvement in visual skills, while the 4th group (table tennis) showed significant increase in their visual skill in accommodation facility, saccadic movement, eye-hand coordination and speed of recognition. This may indicate that there are different demands on performers when training for basketball compared to training table tennis. Thus, the type of sport may have different effect on the visual ability of the athletes

As it can be observed in that table, the group 5 who performed the visual training showed significant difference in all visual skills except the visual memory ability. This finding may indicate that visual training in this research could improve the level of targeted visual skills.

The results of paired t-test for performing specific forehand tennis drive and basketball layup and effect of visual training on these skills are presented in table 2.

Table 2: Pre test and post test result of 6 groups in sport skills

Groups / Skills	group1 (Basketball and visual training)		group2 (Table tennis and visual training)		Group3 (Basketball training)		Group4 (Table tennis training)		Group5 (Visual training)		Group6 (Control)	
Table tennis Forehand drive	pre	Post	pre	Post	Pre	Post	pre	Post	Pre	Post	pre	Post
			38,42 (8,12)	76,12** (10,26)			34,27 (9,16)	64,24** (11,04)	40,12 (7,85)	43,19 (8,12)	38,18 (6,58)	42,32 (6,09)
Basketball Layup	14,48 (3,84)	26,16** (5,17)			18,52 (4,12)	28,32** (6,11)			17,23 (6,12)	21,16 (7,82)	16,61 (5,08)	20,52 (8,16)

**p ≤ .01. **p ≤ .001.*

As it can be seen in this table, both sport training programs showed significant improvement in sport specific skills, that is, performing specific tennis drive and basketball layup resulted in significant improvement in these skills. Also, the groups that practiced the sport skills in addition to the visual skills showed significant improvement.

Further analysis was performed by employing factorial analysis of variance (2 by 4 ANOVA) by including the pretest and post test scores as a time factor and 4 experimental groups as the second factor. This analysis was performed to examine whether there was any interaction between the time and condition of practice.

The results of two-way ANOVA in regard to the table tennis drive revealed that there was a significant interaction between the condition and time factor (p=0/001 & $F_{1,36}$=240). The main effect of both time (p=0/001 و $F_{1,36}$=1/078) and condition (P=0/001 & $F_{3,36}$=2/407)were also significant, respectively. The results of LSD post hoc test showed that the visual-sport training group performed the task significantly better that the sport training group alone (P=0/001) and sport training group performed the task significantly better than the visual alone training group (P=0/001). These results indicate that visual training combined with specific table tennis drive training has greater effect than sport training alone on performance.

The results of two-way ANOVA in regard to the basketball layup also showed that there was a significant interaction between the condition (P<0/001و $F_{3,36}$=4,312) and time ($F_{1,36}$=123,481 و P<0/001) factor. However, the main effect of both time and condition were not significant, respectively ($F_{3,36}$=0/82 ,P=0/187) .The results of LSD post hoc test showed that there isn't significant difference between visual-sport training group and sport training

group alone (P=0/201) These results indicate that visual training accompanied by specific basketball training has no greater effect than sport training.

DISCUSSION AND CONCLUSION

During the last few years there has been debate over the effectiveness of visual training programs on the sport performance of athletes. While some researchers have claimed that visual training has no significant effect on the improvement of athletes' performances [13]. On the contrary, some other researchers claim that visual training programs are effective means of improving sport performances [3, 5, 15]. A careful review of the literature reveals that both pro and against the programs have had weakness and strength in their approaches in examining the factor.
One of the main objectives of this research was to clearly examine the effectiveness of visual training programs on sport performance. The results of this research as was presented in table 1 showed that 8 weeks of visual training had significant effect on visual skills such as accommodation facility, saccadic movements, eye-hand coordination and speed of recognition in groups with combination conditions and visual training group alone. These findings are in agreement with results reported by Abernathy and Wood (1987) and Kluka et al. (1996). It seems like participating in eye training programs facilitates the visual skills in laboratory environment and the researchers particularly those in optometric field unanimously agree with it [4, 22]. In contrast, despite the fact that both skills of vergence and visual memory improve by visual training programs, the change is not statistically significant. Such improvement may be attributed to the familiarity of the subject with the testing procedure and are not related to the training programs. It is also possible that the tests did not have sufficient sensitivity to show the effectiveness of the programs. For instance, visual memory test of broken circles conducted by Landolt is a simple test that is designed to diagnose visual disorders and lacks sufficient sensitivity to measure athletes' visual ability. Another explanation may be attributed to the nature of sport tasks. Ludeke & Ferreira(2003) claim that visual skills may be classified into two category including software skills that are more or less acquired and are amenable to improvement by exercise and training plus the skills that are assumed to be hardware in nature and are determined genetically and do not change by exercise [23]. These skills are even different among the expert and novices athletes. Some of these skills have changed through sport training [21] and some of them are the same in the athletes and elite athletes [22]. In this regard, it is possible to assume that selecting the type of visual training and trainability of them is a factor that has to be taken into consideration in future researches.

Another interesting point in this research was the improvements observed in some of the visual skills in table tennis. The accommodation facility, saccadic movements, eye-hand coordination and the speed of recognition of the subjects who practiced the forehand drive was significantly improved. Thus, it is possible to conclude that with participating in some of the visual skill trainings, some of these skills can be improved. This subject has been investigated in elite, novice or non-athlete individuals by previous researchers and is a topic of interest for optometrists. Jafarzadehpour et al. (2004) demonstrated that visual skills of elite athletes in table tennis are higher than the non-athletes, but in basketball, exercising the layup had no significant effect on their visual skills. It is likely that in layup skill, the visual skill of the performer is not challenged. However, the results of some other researchers showed that that basketball players have higher visual skills than the non-athletes [24].

It should be mentioned that separation of visual training from the sport training in past researches may make it difficult to make firm conclusion about this type of training. For instance, some researchers insist that separating some of the specific perceptual-visual components of sport skills for the purpose of performing visual training makes the matching of perceptual-action quite difficult, thus the findings may not be applicable [25]. It seems like the reason for such assumptions lie in the fact that the nature of the tasks being studied has not been taken into consideration. These training definitely need to include visual training during the execution of the task in such a way that it benefits the perception-action components of the specific sport task and the visual skill function as an assisting factor and develop the visual needs of the task.

The type of visual training and the magnitude of its influence on sport performance need to be the focus of research [12]. Considering the fact that lack of visual skill battery for the majority of sports exist, many researchers are facing specific direction to focus their research objectives, thus, the selection of the training program depends on the experience and vision of the researches [12]. In addition, some researchers attempt to eliminate many confounding variables by conducting their research in laboratory and by computer [16, 26]. Probably one of the reasons for lack of unanimity in considering the visual training programs as effective treatment is the wide range trainings and tests in addition to the incompatibility of trainings with the tests.

In the present research, both visual and sport training in addition to the combination of both factors were employed in order to compare the performances of the subjects in sport versus training alone and control group as well. The possible differences in the combination group compared to the visual or sport training can be attributed to the

interaction effect of the combination group. In order to control the time factor, the length of time for the training group was held constant. In other words, the combination groups devoted 15 minutes to the visual training.

As was stated earlier, the interaction effect of sport and visual training for the table tennis drive was significantly different than each one of these two conditions, thus it can be concluded that training the sport skill such as table tennis drive combined with eye training has beneficiary effect on sport performance of the athletes as has also been confirmed by other researchers [5, 14, 15].

One of the short comings of the researches conducted before is the fact that they did not take the task requirement into serious consideration and selected visual skills that do not significantly contribute to the successful performance of the task. In addition, thus, in this research, the researcher selected two tasks to address this issue. The findings of the present research confirmed this assumption and showed that performing visual training plus the sport skill simultaneously did improve the performance one sport task (table tennis) while the same condition did not lead to significant improvement of another task (basketball). Probably the visual task requirement for these two skills is different. Table tennis forehand drive task is a complex task and is highly organized that demands very good timing, eye-hand coordination and recognition speed [15, 22]. The negligible surface of ball contact with the table and high speed of moving rocket and ball at the same time are very different from what really occurs during the basketball layup skill. Balasaheb et al (2008) showed that matching the visual training program with the task demands can significantly increase the mean score of hitting the cricket ball.

Another explanation for the discrepancy of findings of this study with others [1, 9] may be attributed to the time difference of trainings. These researchers devoted 4 weeks of training to the task at hand and assumed that this time may not improve the performance of their subjects, whereas, in the present study 8 weeks of training was twice longer and indeed caused significant improvement. Considering the results of this research, it seems like one of the main reasons for the effectiveness of visual training is the length of training program. Therefore, further research seems to shed light in this issue by conducting similar research design for longer period of time.

Finally, one of the limitations of this study was the lack of employing elite athletes in the project. Some researchers believe that athletes with high skill, their needs depend on the specificity of trainings and visual trainings have no benefit for novice athletes [13, 27]. In this regard, further research is needed to determine the interactive effect of visual and sport training on elite athletes. In addition, the researcher in this study did not examine the stability of the gain obtained by involving in training program. Thus, further research is suggested to examine short and long term retention effects of these training programs.

REFERENCES

[1] Wood JM, Abernethy B. *Optometry & Vision Science*. **1997**;74(8):646.
[2] Coffey B, Reichow A. Visual performance enhancement in sports optometry. Sport vision, DFC Loran and CJ Maceren London: Butterworths-Heineman, Ldt. **1995**.
[3] Cross ES, Stadler W, Parkinson J, Schütz-Bosbach S, Prinz W. The influence of visual training on predicting complex action sequences. Human Brain Mapping. **2011**.
[4] McLeod B. *Canadian Journal of Sports Sciences.* **1989**;14:127-35.
[5] Balasaheb T, Maman P, Sandhu JS. *Serbian journal of sports sciences.* **2008**;2(1-4):17-23.
[6] Kluka D. Visual skills: *ASAPHERED journal*. **1991**;14(1):41-3.
[7] Knudson D, Kluka DA. *Journal of Physical Education Recreation and Dance*. **1997**;68:17-24.
[8] Kluka D, Love P, Kuhlman J, Hammach G, Wesson M. *International Journal of Sports Vision.* **1996**;3(1):23-34.
[9] Abernethy B. *American Journal of sports medicine.* **1996**;24(6):S89-S92.
[10] Williams AM, Davids K. *Coaching Focus*. **1994**;26:6 - 9.
[11] Atkins DL. *Journal of Science and Medicine in Sport.* **1998**;1(1): 3 - 17.
[12] Wilson TA, Falkel LJ. *Sports Vision: Training for Better Performance*. Champaign IL: Human Kinetics; **2004**.
[13] Abernethy B, Wood JM. *Journal of sports sciences.* **2001**;19(3):203-22.
[14] Hopwood MJ, Mann DL, Farrow D, Nielsen T. *International Journal of Sports Science and Coaching.* **2011**;6(4):523-36.
[15] Paul M, Biswas S K, Sandhu J S. *Brazilian Journal of Biomotoricity*. **2011**;5(2):106-16.
[16] Szymanski J, Lowe H, Szymanski D, Cicciarella C, Lowe D, Gilliam S, et al. *The Journal of Strength & Conditioning Research*. **2011**;25:S49.
[17] Kruger P, Campher J, Smit C. *African Journal for Physical, Health Education, Recreation and Dance* (AJPHERD). **2009**;15(4):605.
[18] Revien L, Gabor M. Sportsvision: Dr. Revien's eye exercise program for athletes: Workman Pub.; **1981**.
[19] Abernethy B, Wood JM. *Optometry Vision Sci.* **1977**;74(8):646-65.

[20] Ghasemi A, Momeni M, Rezaee M, Gholami A. *Journal of Human Kinetics*. **2009**;22(-1):15-20.
[21] Ghasemi A, Momeni M, Jafarzadehpur E, Rezaee M, Taheri H. *Perceptual and motor skills.* **2011**;112(1):161-71.
[22] Jafarzadehpur E, Yarigholi MR. *Journal of Sports Science and Medicine.* **2004**;3(1):44-8.
[23] Ludeke A, Ferreira J. *The South African Optometrist.* **2003**;62(4):150-58.
[24] Sillero Quintana M, Refoyo Roman I, Lorenzo Calvo A, Sampedro Molinuevo J. *Perceptual Motor Skills.* **2007**;104(2):547-61.
[25] Turvey MT, Carello C. *Acta Psychologica.* **1986**;63:133-55.
[26] Wimshurst ZL, Sowden PT, Cardinale M. *Perceptual and Motor Skills.* **2012**;114(1):204- 16.
[27] Henry FM. Specificity vs generality in learning motor skill. In Classical Studies in Physical Activity (edited by R.C. Brown and G.S. Kenyon). Englewood, Cliffs NP-H, **editors1961**. 331- 40 p.