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**Original Article**

# Effects of 10 weeks of imagery and concentration training on visual focus and free-throw performance in basketball players.

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**Abstract**:
Problem Statement: Free throw shooting is one of the unique techniques applied in the game of basketball. It is a technique that needs special attention to develop due to the fact that it is a unique shot. As much as physiological characteristics prepare the body for the shot, it is important to acknowledge that psychological state of the player affects it, too. Free throw shots can be vital for winning games. Purpose: The purpose of the study was to examine the effects of 10 weeks of imagery and concentration training on visual focus and free-throw performance in basketball players. The participants consisted of 29 basketball players (11 female, 18 male) from different teams in Izmir that compete at the youth level (age 15.62 ±,09). Approach: The participants were divided equally into homogenous groups pre-test and were evaluated based on their success rate. While the study was not done with the control group, the implementation was done with the imagery and concentration group for 10 weeks, three times a week for 15 minutes a day. Concentration studies were done with yantra. In the imagery studies, the athlete was asked to watch the recording of the best shot they made, and to recreate it. Before the participants recreate it, they were advised to read the imagery script and then use the information provided to mentally recreate this material from their desired viewpoint and from an alternative perspective. At the end of 10 weeks, the athletes were tested again. The study investigated whether the mental training affected visual focus or performance or not.Results: The results of this study revealed that there was a significant difference between the pre-test and post-testing protocols of the concentration group, while the control and imagery groups revealed no significant difference ($p<0.028$). Conclusions: Present findings show that concentration trainings with yantra have an improving effect on visual focus. In order to better understand the effect of imagery and concentration training on performance, different tests can be done. Also, before investigating the effects of imagery trainings on performance, imagery skills of the athletes can be measured.
**Key Words***:* **free-throw, imagery, concentration, visual focus, eye tracking**

## Introduction

The percentage of successful shots in basketball is critical to winning a game (Mülazımlıoğlu et al., 2009; Savucu et al., 2004). The free throw is particularly important because it provides points that can be taken without being tackled by an opponent, and also plays an important role in determining who will be the winner when the game stops (Wright et al., 2014). In some cases, the team that is behind as a result of tactically committed fouls can get ahead and win the match by throwing a free throw to the opponent's worst player. On the other hand, different types of fouls, such as deliberate fouls, technical fouls, can be called by the referee as a penalty for players, coaches or club managers who commit illegal interventions. In such cases, the importance of free throws increases considerably in order to take the lead in the competition (Wright et al., 2014). Between 20 and 25% of all points scored in a basketball game are from free throws (Cedra & Sério, 2008; Krause et al., 2008). It plays an important role in winning a game and establishing superiority (McArdle et al., 1971).

Performing a certain skills in sports requires not only physical but also mental work. There are many psychological methods to successfully achieve the desired skill (Driskell et al., 1994; Gross et al., 2018; Thelwell et al., 2006). The methods commonly used in these studies are imagery and concentration studies (Cumming & Eaves, 2018; Feltz & Landers, 1983; Fortes et al., 2020; Gonzalez Campos et al., 2017; Mendes at al.,2015; Simonsmeier & Buecker, 2017; Watt et al.,2018).

Imagery is defined as a concept that imitates real experiences and involves the use of a combination of sensory methods in the absence of real perception (Vine et al., 2011). While White and Hardy (1998) stated that "we can reach the awareness of the existence of an image without experiencing the image itself, by 'seeing', sensing the movements as images or by experiencing the smell, taste or sound of the image," Moran (2004) defines imagery as "perception without feeling" (Weinberg & Gould, 2003; Moran, 2004). Vealey and Walter (1993) and Vealey and Greenleaf (2001) define imagery as "using all senses to envision or recreate an experience in the mind" (Vealey, 2007; Vealey & Greenleaf, 2001).


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Experimental evidence has shown that imagery aids performance significantly for both novices and experienced athletes, and there are some powerful effects for experienced players (Weinberg & Gould, 2015). Elite athletes state that they often use imagery (Orlick & Partington, 1988). Elite coaches and sports psychology consultants also state that they use imagery training extensively (Grushko & Leonov, 2014; Hall & Rodgers, 1989).

In addition to imagery, it has been found that studies on concentration in sports literature also affect visual focus or performance positively (Çolakoğlu et al., 1993; Miller et al., 2008). According to Wilson et al. (2006), concentration is how long an individual can sustain without distraction or interruption while performing any skill (Williams et al., 1999). Weinberg and Gould (2015) define concentration as the ability to focus on relevant environmental cues (Weinberg, 2008). Assessment of concentration includes different factors such as external distractors, ability to focus, and duration of focus. When the environment changes rapidly, the focus of attention must also change rapidly (Weinberg, 2008). These qualities are related to the attention skills of athletes. If an athlete maintain his/her concentration longer and more uninterruptedly, she/he will be more successful in his/her skill (Çolakoğlu et al., 1993).

The better your concentration is, the better the athlete you can be. However, the most important point of this process is what you concentrate on. What do you pay attention to? What are you focusing on? If you pay attention to your negative thoughts; you take the wrong direction, lose focus and can have a poor performance. If you focus on technique, breathing, your body, the ball or your opponent, you get a chance to showcase your best game. When you master your physical technique and training, it is your mental strength that will bring you to peak performance (Porter & Foster, 1990). It is known that talented basketball players direct their gaze to the basket earlier and maintain their view in the area where the target is located longer than less skilled athletes (Ripoll et al., 1986). In order to improve their performance, athletes resort to the principles of mindful control and attention style (being broad or narrow, and being internal or external). There are studies in the literature showing that there is a relationship between performance and attention style (White & Hardy, 1998; Wu et al., 2012).

Today, the effects of imagery and concentration on performance and visual focus in sports psychology have begun to be measured by eye tracking method. Most studies in eye tracking research focus on fixations, twitches, and smooth follow-ups (Bojko, 2013; Gould et al., 1989; Patla & Vickers, 1997; Whitney, 1988). Fixations mean no movement in the eye, that is, the eye remains relatively still (Holmqvist et al., 2011). Fixations last for a very short time, and measuring fixation means measuring attention (Bojko, 2013; Discombe & Cotterill, 2015; Duchowski, 2007; Vickers, 2007). The majority of eye tracking systems use a video-based pupil and corneal reflection (CR) system (Holmqvist et al., 2011). Its purpose is to illuminate the eye to provide a highly visible reflection known as a corneal reflection. The eye tracker module tracks these reflections and in this way calculates the position of the eye and the position of the participant's gaze (Majaranta & Bulling, 2014; Veraksa & Gorovaya, 2012). There are three main types of CR eye trackers available: table/table-mounted, head-mounted, and remote-controlled systems (Discombe & Cotterill, 2015; Panchuk et al., 2015). The head-mounted system was used in this analysis, despite the fact that each of these systems has its own set of benefits and drawbacks. These head-mounted systems provide the participant with maximum mobility and allow data to be collected in more ecologically viable environments such as golf, tennis service, darts, aiming at a target while shooting, or a long-distance bike ride. Head-mounted systems often use small mobile recording devices worn by the participant to collect data. They require the use of special glasses or a head-worn camera to collect data, so it usually does not interfere with athletic performance. While head-mounted systems allow participants to move freely throughout the natural environment, valid data must be collected by keeping the participants' heads reasonably stable during the study (Holmqvist et al., 2011). Because of the high degree of stability needed for these systems during data collection, studies have mostly focused on indoor sports skills like golf shots, basketball free throws, and pistol shooting, while cricket, table tennis, and tennis have also been successfully examined in live sports (Croft et al., 2010; Land & McLeod, 2000; Rodrigues et al., 2002). Quiet eye approach is generally used in these studies. Quiet eye refers to the last fixation or tracking gaze found in a particular place or object (Vickers, 2007). Studies done with the eye tracker module show that skills requiring narrow focus of attention in various sports branches have developed (Vickers, 2007; Vickers, 2009; Wilson et al., 2006).

Imagery and concentration are highly involved in the field of sports psychology. In this study, we aimed to examine the effects of 10 weeks of imagery and concentration training on visual focus and free-throw performance in basketball players using an eye tracking method. Our other aim, apart from looking at the spatial orientation and shooting technique, is to prove that the athlete's visual focus (the center where s/he concentrates) will be considered successful if s/he is within the radius of the circle, the more s/he looks outside the circle radius and the more s/he deviates to those areas, the more s/he will be unsuccessful.

## Material & methods

*Participants*

We chose to test high-level young players because they already have a well-developed free-shooting technique, and it is unlikely that any potential performance gains are due to changes in this technique alone. A total of 29 players from four different squads that compete at the highest level in the Turkey Youth League

volunteered to take part. The study group consisted of 13 female and 16 male basketball players with an average age of 15.62 ± 09. A written informed consent document was signed by all participants. The study was carried out with three groups: concentration (n: 10), imagery (n: 10) and control (n: 9) groups. All data in this study were collected in accordance with the ethical standards of the Helsinki Declaration. The study was approved by local ethics board in Turkey (Decision number:13-11/15).

*Procedure/Test protocol/Skill test trial/Measure/Instruments*

*Measures*

1. Socio-demographic data collection form: In this form, which participants filled in themselves, there were questions related to four different variables (age, gender, team, sport age).

2.ASL Eye Tracking Module: This device that shows the focus of the individual in the field of vision at 25Hz in a linear line. The device works together with the (modified DVCR) waist recorder and laptop with Eyevision recording software outside the test area. This recording system allows for offline analysis. After the glasses part of the device was properly placed for the athlete, the participant was asked to shoot. After all the shots were tried, an analysis was made for each shot as to how close it was to the focal point and how by how much it missed.

3. Free-throw shooting: Free throws were carried out within the framework of TBF (Turkey Basketball Federation) competition rules. In an indoor gymnasium, participants shot from a 4.60-meter free-throw line to a standard basketball target set at 3.05 meters (Kangalgil et al., 2014). Free-throw performance was scored based on a two-point scale. A score of 1 was given for a make and 0 for a complete miss.

*Procedure*

Ethics committee approval was obtained for the study, and the informed consent form was given to the volunteers and signed before starting the study. First, a pre-test was done for the study. For this test, after the athletes warmed up, free-throws were shot, and then 10 shots were requested from each athlete. After the shots were recorded, the athletes shot again using the eye-tracking module. After getting used to the glasses, the athletes were asked to shoot 10 shots again. As a result of the tests, the groups were determined homogeneously. Free-throws were ranked according to their success level and the groups were based on this success level (control group 1-6-7-12-13-18-19-24-25; concentration group 3-4-9-10-15-16-21-22- 27-28; imagery group 2-5-8-11-14-17-20-23-26-29) were detected. All groups carried out their regular training. While the study was not done with the control group, the implementation was done with the imagery and concentration group for 10 weeks, three times a week for 15 minutes a day. Concentration studies were done with yantra. In the imagery studies, the athlete was asked to watch the recording of the best shot they made, and to recreate it. At the command of the investigator, 10 imaginary shots were tried by the athlete and the feelings of the athlete during these shots were recorded in line with the information provided by them. At the end of 10 weeks, the athletes were tested again, investigating whether the mental training affected visual focus or performance or not.

*Imagery training program*

After the pre-test of free throws with eye tracker, study and control groups were formed. Each participant in the imagery group watched the video that included their best shot and then received an individualized imagery script. Participants were asked to read the imagery script and then use the information provided to mentally recreate this material from their desired viewpoint and an alternative perspective. Participants were also advised to perform their imagery at the same pace and in the same setting as they would usually perform the movement (Holmes & Collins, 2001). They were also instructed to dress in the same manner, adopt the same stance, and carry the same ball as they would while performing the movements mentioned in the imagery script. Participants were advised to read the script and then practice the imagery for 15 minutes three times a week for a 10-week period, based on the recommendations of several researchers (Schuster et al., 2011; Wakefield & Smith, 2009; Wood & Wilson, 2011).

*Yantra training program*

Yantra is a 5 x 5 cm white square placed in the middle of a black background of 30 x 30 cm square. The yantra is placed in the middle of a white wall at eye level. The participant sits comfortably about one meter away from the yantra. After only looking at the black background for a short time, s/he closes his/her eyes and imagines a black screen in his/her mind. Then, the person opens his/her eyes slowly and tries to look at the white square in the middle. When s/he sees a color formation around the white square (gray) s/he slowly shifts his/her eyes to the white wall. Here, the person will see the exact opposite image of the Yantra. In other words, a black square in the middle of a white background. Even if the person loses the image, s/he can recreate it. Participants were advised to read the script and then practice the yantra for 15 minutes three times a week for a 10-week period, based on the recommendations of several researchers (Biçer & Aysan, 2008; Çolakoğlu et al., 1993).

*Data collection and analysis / Statistical analysis*

The data during the fixation and movement phases were recorded scene by scene with eye tracker software. After the study, the xx.csv file exported by the eye tracker software was scanned and the desired points (shot start and end frame interval) were recorded. The distance of these points to the center was calculated using the "Pythagoras c2 = a2 + b2" theorem. The numerical points coming from the software are visually shaped as points on the Cartesian plane with software. Here, monitoring the proximity to the center and the radius of the circle in which the points formed during the firing process were determined, with the farthest point calculated.

Later, the data were transferred to the SPSS 21. Program. The data showed a non-parametric distribution after the Kolmogorov-Smirnov normality test. The distribution between groups was analyzed using the Kruskal-Wallis non-parametric test. Intragroup growth was measured using the Wilcoxon-related two-sample test. For statistical analysis, the level of significance was accepted as $p \leq 0.05$.

**Results**

No significant difference was found as a result of the Kruskal-Wallis non-parametric test performed to determine whether there was a difference between the means of the pre-test and post-test visual focusing measurement values obtained for the control, imagery and concentration groups (Table I). While the focusing time of the concentration group decreased, that of the imagery group increased, and there was almost no change in the control group.

Table I: Kruskal-Wallis non-parametric test of pre-test and post-test visual focus measurement values between groups

| | **Group** | **N** | **Mean** | **ss** | **$X^2$** | **p** |
|---|---|---|---|---|---|---|
| **Pre-Test Visual** | Control | 9 | 13,30 | | | |
| **Focusing Sum** | Imagery | 10 | 12,20 | 2 | 3,977 | ,137 |
| | Concentration | 10 | 19,30 | | | |
| | Total | 29 | | | | |
| | ***Group*** | ***N*** | ***Mean*** | ***ss*** | ***$X^2$*** | ***p*** |
| **Post-Test** | Control | 9 | 13,22 | | | |
| **Visual Focusing** | Imagery | 10 | 15,10 | 2 | ,704 | ,703 |
| **Sum** | Concentration | 10 | 16,50 | | | |
| | Total | 29 | | | | |

No significant difference was found as a result of the Kruskal-Wallis non-parametric test performed to determine whether there was a difference between the means of the pre-test and post-test performance measurement values obtained for the control, imagery and concentration groups (Table II). While the performance of the concentration group increased, the performance of the imagery group decreased, and there was almost no change in the control group.

Table II: Kruskal-Wallis non-parametric test of pre-test and post-test performance measurement values between groups

| | **Group** | **N** | **Mean** | **ss** | **$X^2$** | **p** |
|---|---|---|---|---|---|---|
| **Pre-Test** | Control | 9 | 13,44 | | | |
| **Performance** | Imagery | 10 | 17,80 | 2 | 1,731 | ,421 |
| **Sum** | Concentration | 10 | 13,60 | | | |
| | Total | 29 | | | | |
| | **Group** | ***N*** | ***Mean*** | ***ss*** | ***$X^2$*** | ***p*** |
| **Post-Test** | Control | 9 | 13,17 | | | |
| **Performance** | Imagery | 10 | 13,75 | 2 | 1,860 | ,395 |
| **Sum** | Concentration | 10 | 17,90 | | | |
| | Total | 29 | | | | |

As a result of the non-parametric Wilcoxon-related two-sample tests in Table III regarding the development of visual focus within the control, imagery and concentration groups, significant differences were only found in concentration group (p=0.028).

Table III: Wilcoxon test results of visual focus measurement values in groups

| **Concentration Group** | | **N** | **Mean Ranks** | **Sum of Ranks** | **Z** | **p** |
|---|---|---|---|---|---|---|
| Visual Focus Post- | Negative Rank | 7 | 7,00 | 49,00 | -2,191 | ,028* |
| Test– | Positive Rank | 3 | 2,00 | 6,00 | | |
| Pre-Test | Ties | 0 | | | | |
| **Imagery Group** | | **N** | **Mean Ranks** | **Sum of Ranks** | **Z** | **p** |
| Visual Focus Post- | Negative Rank | 5 | 6,40 | 32,00 | -,459 | ,646 |
| Test– | Positive Rank | 5 | 4,60 | 23,00 | | |
| Pre-Test | Ties | 0 | | | | |
| **Control Group** | | **N** | **Mean Ranks** | **Sum of Ranks** | **Z** | **p** |
| Visual Focus Post- | Negative Rank | 6 | 6,17 | 37,00 | -1,718 | ,086 |
| Test– | Positive Rank | 3 | 2,67 | 8,00 | | |
| Pre-Test | Ties | 0 | | | | |

As a result of the non-parametric Wilcoxon-related two-sample tests in Table IV regarding the development of performance within the control, imagery and concentration groups, no statistically significant difference was observed. While a positive increase was observed only in the control group, there was no significant differences within the groups.

Table IV: Wilcoxon test results of performance measurement values in groups

| **Concentration Group** | | **N** | **Mean Ranks** | **Sum of Ranks** | **Z** | **p** |
|---|---|---|---|---|---|---|
| Performance Post-Test–Pre-Test | Negative Rank | 4 | 3,75 | 15,00 | -,897 | ,370 |
| | Positive Rank | 5 | 6,00 | 30,00 | | |
| | Ties | 1 | | | | |
| **Imagery Group** | | ***N*** | ***Mean Ranks*** | ***Sum of Ranks*** | ***Z*** | ***p*** |
| Performance Post-Test–Pre-Test | Negative Rank | 4 | 3,75 | 15,00 | -,171 | ,864 |
| | Positive Rank | 3 | 4,33 | 13,00 | | |
| | Ties | 3 | | | | |
| **Control Group** | | ***N*** | ***Mean Ranks*** | ***Sum of Ranks*** | ***Z*** | ***p*** |
| Performance Post-Test–Pre-Test | Negative Rank | 3 | 3,33 | 10,00 | -1,513 | ,130 |
| | Positive Rank | 6 | 5,83 | 35,00 | | |
| | Ties | 0 | | | | |

**Discussion**

Most sport coaches agree that psychological training accounts for about half of a win over an opponent with equal physical abilities, and that mental skills facilitate the performance (Gould et al., 2002; Weinberg & Gould, 2015). Mental training promotes good performance and increases athletes' personal well-being, according to sports psychology research (Vealey, 2007). As a result, most athletes augment their physical training with additional mental efforts to improve their results. We examined two mental skills in this study: imagery and concentration.

As a result of the tests conducted to determine whether there is a difference between the averages of the first and last performance and focus measurement values obtained for the control, imagery and concentration groups, it was determined that there is no significant difference between the groups. In other words, it is seen that all three groups got similar results in both pre-test and post-test.

As a result of test of the visual focusing within the control, imagery, and concentration groups, while there were no changes in the imagery group, it was observed that the values of the control group deteriorated, only significant difference was found in the concentration group.

According to these results, it is seen that the visual focusing area (location of fixations) of the concentration group narrowed significantly. Castiello and Umilta (1990) state that when the focus of attention area increases, there will be a decrease in processing efficiency. If the main goal with visual focus is an increase in performance, the narrowing of the visual focus area favors the athlete. Although there are studies on the focus of attention in the literature, only two studies were found with yantras as in this study, and it was observed that the examined studies were evaluated with performance.

There was no change in the focusing values of the imagery group. Although there are studies examining the effects of imagery on some mental skills (such as self-confidence, state anxiety, and motivation) in the literature, there are no studies on visual focus (Evans et al., 2004; Hirsch & Holmes, 2007; Vasquez & Buehler, 2007). Besides, some studies have shown that although athletes use imagery, it may not always be effective (Hall, 2001; Hall et al., 1990).

As a result of test of the performance within the control, imagery, and concentration groups, no significant difference was found in groups. However, in the control group, it was observed that more than half of the group performed better, and more than half of the group performed the same or better in the imagery and concentration groups.

The reason for the improvement seen in the control group in our study is the training effect. Previous studies also support our result. In the study of Uzun and Pulur (2011), it was concluded that general basketball training slightly improves the free-throw performance of young basketball players, but free-throw training positively affects the shooting performance, and eight weeks of special free-throw training is sufficient for it to become a habit. In the study of Du Toit et al. (2012) examining the effect of sports-specific exercises on visual skills of rugby players, it was observed that training to improve sports skills improved skills such as attention, following, and hand-eye coordination. In the study of Mujika et al. (1995) examining the effect of training on performance in elite swimmers, it was found that training intensity plays a key role in increasing performance.

There are results of studies on the use of imagery that increases sports performance (Simonsmeier & Buecker, 2017; Weinberg, 2008). In a study conducted by Veraksa and Goroyava (2012) on the effectiveness of imagery training in young soccer players, the results showed that imagery training increased performance. When Seif-Barghill et al. (2012) investigated the effects of the ecological imagery program on football performance in elite players; they found that the successful pass rates of the participants increased after completing the cognitive imagery program. In the study of Mousavi and Meshkini (2011), it was observed that the use of imagery reduces anxiety in sports performance and thus increases performance. In the study conducted by Taylor and Shaw

(2002), it was observed that the group that did a positive imagery study performed more successfully than the group that did not.

There was a significant difference found in the concentration group in visual focus (Taylor & Shaw, 2002). There are many studies in the literature that show that focusing styles have various effects on performance (Ille et al., 2013; Wu et al., 2012). Although there are studies about the focus of attention in the literature, there are very few studies with yantras as in this study. In the study in which Uludağ et al.(2016) examined the effect of imagery and concentration studies on visual focus in novice dart players, they found no statistical differences between control and training groups. In the study in which Biçer and Aysa (2008) examined the effect of mental concentration studies on performance in arm wrestlers, it was observed that the subjects participating in the mental concentration group showed three times greater improvement than the others. In another study in which Çolakoğlu et al. (1993) examined the effect of mental concentration studies on reaction time in athletes, it was observed that the subjects participating in the mental concentration group showed three times greater improvement than the others.

**Conclusions**

When we examined the results of the study, there was no significant difference between the groups in both visual focus and performance. However, when the intragroup developments were examined, we found that the visual focus of the concentration group changed significantly. By looking at these results, we can say that concentration exercises with yantra have an improving effect on visual focus and imagery trainings may have an effect on visual focus. We also know that mental training can affect performance. This study could be repeated by using different concentration training techniques in order to better understand the effects of concentration studies on visual focus and performance. In addition, before investigating the effects of imagery trainings on performance, imagery skills of the athletes can be measured. At the same time, conducting studies on whether visual focus has a direct effect on free throw performance may contribute to the literature.

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**Conflicts of interest**

The authors declare that they have no competing interests.

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