



The Relationship between Hand - Eye Dominance on the Performance in Target Sports: A Systematic Review

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Abstract

Any individual that exhibits physiologic superiority and priority, or preference behaviors in any bilateral structure is referred to as dominant. When thinking about the target sport in sports, hand and eye dominance might be a crucial performance factor. In this study, the association between performance in target sports and dominant eye and hand dominance is examined in order to determine whether visual dominance will be added as a new criterion for performance. Utilizing the terms archery, biathlon, shooting, dart and air-shooting as well as the keywords dominant eye, ocular dominance, dominant eye dominant hand laterality. The search was conducted in the databases "PubMed, Google Scholar, Elsevier ScienceDirect and Web of Science" on the online library pages of Yeditepe University.

The words or for status of domination and between targeted sports categories were entered in the search keywords. By using keywords to search the databases, 604 articles were found. Since they have scoped various themes and assessment criteria, the found publications were discarded and reduced to seven studies with duplicates removed. The results of the gathered research allow it to be established that there is no correlation among hand laterality and achieving ocular domination in the targeted sports, to reach consensus on the effect of dominance on outcomes in the chosen sports, more research is necessary.

Keywords: Dominant of eye; Hand laterality; Target sports; Dominance

Introduction

The amount and caliber of information about the world that the human visual system gives is amazing. One look is all it takes to determine an object's location, size, shape, color, texture, and, if it's moving, its direction and speed [1]. Sight is the most dominant sense, with 70% of all sensory receptors in the eye. With components such as visual skills, vision contributes up to 80% of the information obtained. The participation of sight is significant in any sport [2]. Familiar sports phrases such as "eyes guide the body" "stay your eye on the ball" and "you cannot hit what you cannot see" highlight the critical role visual input plays in sports [3]. Ocular dominance can be defined as either an individual's preference to use one eye for a specific visual task (motor or targeting dominance) or reflects each eye's proportional contribution to the perception of a combined binocular image (sensory dominance) [4]. Ocular dominance was described by Aristotle around 330 BC, but he did not realize its significance. It is accepted that Porta (1593) then defined the first visual dominance test (aiming test). It was also claimed that the right eye was preferred by describing the competition between the eyes and the dominance that develops with its binocular gaze. Borelli claimed in 1673 that the left eye is stronger than the right eye. Individual variations in eye dominance were studied gradually in the nineteenth century, but individual differences in ocular acuity were confirmed in the eighteenth. In the twentieth century, it developed in popularity [5].

Ocular dominance is a popular topic studied in many fields, such as visual skills in sports, education, manufacturing, and the military. Although there is no consensus on the benefits of ocular dominance in these areas, many studies have been conducted targeting this issue [3]. As an example of the relationships shown, some studies have found that specific dominance patterns (cross or same) can benefit sports performance, while most studies give different results. Different results have been obtained in the studies of dominance patterns and performance relationships in baseball and cricket players, and it has been concluded that dominance patterns do not provide an advantage in these sports [6]. Another area where ocular dominance can be significant is target sports. To support this hypothesis with an example, when shooting a rifle, one of the eyes is prepared by being aligned with the target. This task is completed monocularly. In previous studies in this area, it has

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been documented that the relationship between ocular dominance and hand dominance may be meaningful in target sports that require aiming and that ipsilateral eye-hand dominance is seen above the average in elite-level athletes with rifle and pistol shooting [7].

By gathering research on the connection between performance in target sports and the dominant hand and eye, this research sought to determine if eye superiority is going to become a new factor in how well a player performs in the targeted sports. The aim of this review is to examine the results of studies examining the effect of eye and hand bias on performance in individual sports, especially in shooting sports, and to reach a consensus.

Methods

In this review study, studies that looked at the connection between ocular dominance and performance in the target sports that were published in English between 1998 and 2021 were analyzed.

The following database was accessed and searched: PubMed, Elsevier, ScienceDirect, Google Scholar, Web of Science, and Key search terms included eye dominance (visual superiority) or dominant eye (prevailing eye) or ocular dominance (supremacy of the eyes) or hand laterality and archery, visual superiority (eye dominance) or dominant eye (prevailing eye) or ocular dominance (supremacy of the eyes) or hand laterality and biathlon, eye dominance (visual superiority) or dominant eye (prevailing eye) or ocular dominance (supremacy of the eyes) or hand laterality and aiming sport, eye dominance (visual superiority) or dominant eye (prevailing eye) or ocular dominance (supremacy of the eyes) or hand laterality and shooting, eye dominance (visual superiority) or dominant eye (prevailing eye) or ocular dominance (supremacy of the eyes) or hand laterality and dart, eye dominance (visual superiority) or dominant eye (prevailing eye) or ocular dominance (supremacy of the eyes) or hand laterality and air shooting. The databases were searched using keywords, and 604 articles were found.

Eligibility criteria and study selection

Seven studies were chosen instead of these articles due to repetition and scoping different subjects and sports and evaluation parameters (such as evaluating only hand dominance, not giving place to dominance in visual skills, and not doing the study in target sports). In our study, we excluded studies involving team sports and included only studies involving individual sports. These seven studies are shown in Table 1 and Table 2.

Results

The studies reached within the scope of the research were examined in the target sports branches. The summaries of the studies are given in Table 3.

Studies reviewed include Laborde et al. [8], Mohammadi et al. [9], Gürsoy et al. [10] and Daniel Mon-López et al. [11] stand out in terms of their results. In these three studies, it was concluded that ipsilateral hand-eye dominance would provide an advantage in terms of performance in target sports.

However, Abernathy et al. [7], Razeghi et al. [12], and Nosek et al. [13] did not reach a conclusion proving the relationship between dominance patterns and performance (Figure 1).

Discussion

This review study gathers studies evaluating the relationship

Table 1: Sports branches included in this systematic review.

Archery	Gursoy et al. [10] (2017)
	Laborde et al. [8] (2009)
	Mohammadi et al. [9] (2016)
Clay Target Shooters	Abernathy et al. [7] (1999)
Biathlon	Nosek et al. [12] (2017)
Dart	Razeghi et al. [11] (2012)
Air Shooting	Daniel Mon-López et al. [15] (2021)

Table 2: The measurement areas of studies included in this systematic review.

Eye and Hand Dominance	Nosek et al. [12] (2017)
	Gursoy et al. [10] (2017)
	Razeghi et al. [11] (2012)
	Laborde et al. [8] (2009)
Visual Skills in Sports	Mohammadi et al. [9] (2016)
	Abernathy et al. [7] (1999)
	Daniel Mon-López et al. [15] (2021)

between which of the hand and eye dominance performance in target sports in order to provide an overview of the research on if eye dominance could become the performing requisite in the targeted sports. In the research reviewed, Gürsoy et al. [10] concluded that although right-handedness was higher than left-handedness among female archers participating in the study, left-handed participants scored higher than others. In the light of their findings, they stated that dominance may be an essential criterion in terms of performance. While underlining this issue, the researchers hypothesized that "Left-handed people have right hemispheres dominant. The right hemisphere is superior to the left hemisphere in visual abilities. For this reason, left-handed people have better eyesight". It was also stated in the study that eye dominance was evaluated, but the results were not given openly in the study.

Mapp et al. [14] stated in their study published in 2003 that eye dominance is not associated with hemispheric or hand dominance. Their hypothesis that forms the basis of this idea is that all dominance comes from cerebral dominance. However, this hypothesis is incorrect since the connections of the extremities and eyes with the cerebral hemispheres are different on an anatomical basis. While talking about a dominant hand, we can observe and evaluate the difference between that hand and the non-dominant hand regarding function and strength. However, there is no similar situation for eyes since eyes are working in pairs to function.

Laby et al. [6] in their review published in 2011, mentioned that the definition of ocular dominance is opposed to the phenomenon of ocular fusion. The visual system is designed to integrate the perceptions of the right and left eyes to form a single visual depth assessment, and this is the fundamental cause of the phenomena. According to researchers, the knowledge that one eye dominates the other in binocular gaze is a claim that radically affects and re-questions the knowledge of the working principle of the human visual system. This finding of Laby et al. [6] is supported by the suggestion that "eyes work like two halves of an organ" in Hering's study in 1977 [6,15].

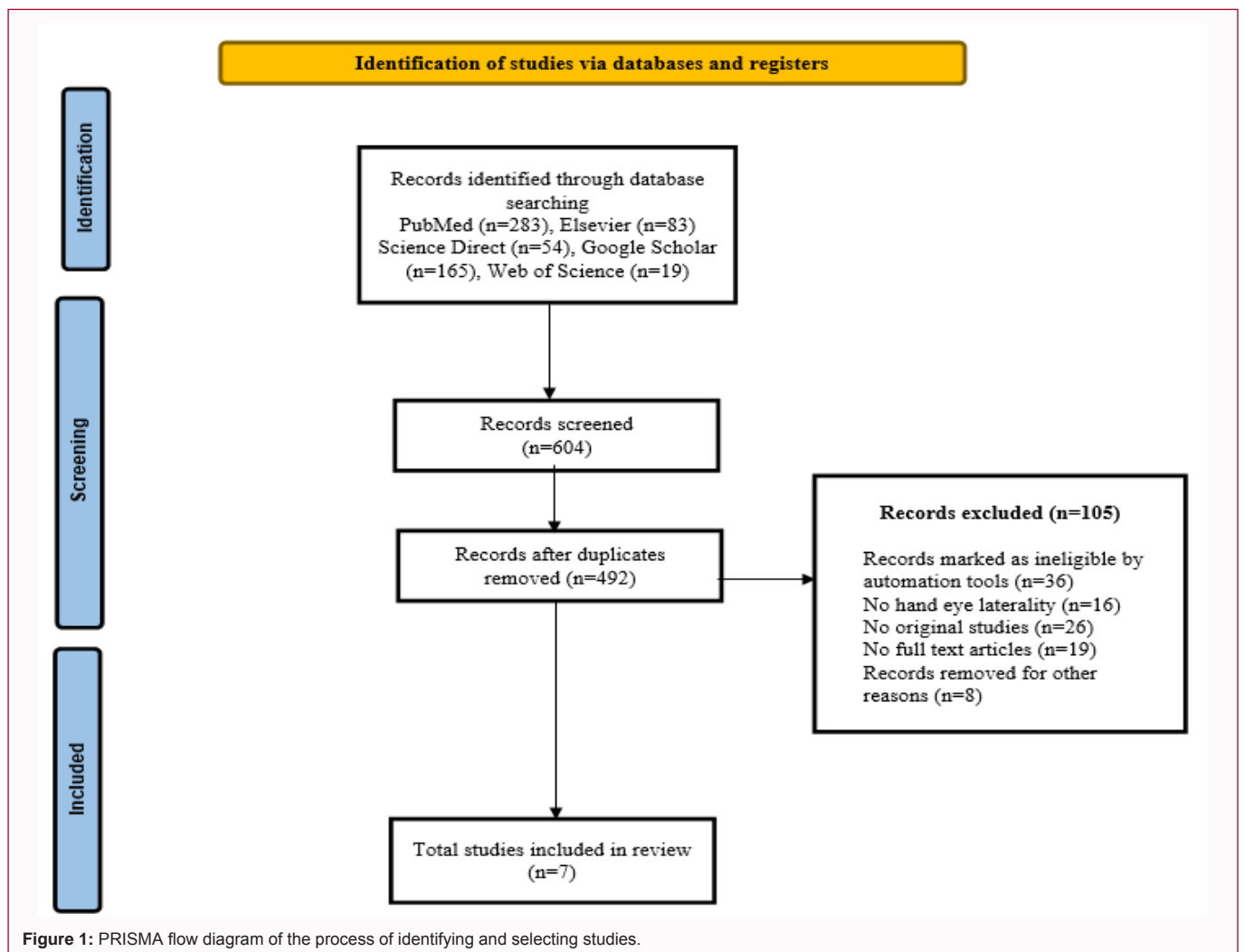
In addition to investigating the effects of ocular dominance on performance, studies on the correlation of tests evaluating dominance have been conducted. Although there are studies that

Table 3: Reviewed studies.

Author	Sports Branch	Participant	Aim	Method	Outcome Measurements	Results
Abernethy et al. [7] (1999)	Clay Target Shooter	Expert clay target shooter (n=11) Beginner clay target shooter (n=12)	To determine the visual characters that can affect the sports performance of clay target shooters.	By evaluating the distance between the eyes and the finger aligned with the target, a conclusion about eye dominance is reached.	<ul style="list-style-type: none"> - Static and dynamic visual acuity -Ocular muscle balance -Ocular dominance (Finger alignment test) -Depth perception -Color vision skills -Simple and Selective Reaction Time -Peripheral Response Time -Fast Tachystoscopic Detection -The timing of meeting with the target -Eye movement skill 	<p>All subjects in the study are right-handed.</p> <p>Expert clay target shooter (n=11)</p> <ul style="list-style-type: none"> -ipsilateral dominant (n=9) -cross-side dominant (n=2) <p>Beginner clay target shooter (n=12)</p> <ul style="list-style-type: none"> -ipsilateral dominant (n=10) -cross-side dominant (n=2) <p>As a result of the study, it was found that the visual function of expert shooters was not above normal.</p> <p>It has been recognized that any attempt to improve shooting performance by training general sight characteristics to above normal levels is likely to be counterproductive.</p>
Laborde et al. [8] (2009)	Archery	Beginner athletes (n=82) Instructors (n=1135)	To investigate whether the ipsilateral dominance pattern is an advantage by considering the hand-eye dominance pattern for archery instructors and athletes.	Ten arrows were fired at both targets with varying diameters at a distance of 7 m. The situation analysis of the trainers was provided through a questionnaire.	<ul style="list-style-type: none"> -Hand dominance (Edinburgh Handedness Form) -Eye dominance (Finger alignment test) -Quest for trainers Daily life dominance Archery dominance 	<ul style="list-style-type: none"> -Ipsilateral hand-eye dominance (n=54) -Crossed hand-eye dominance (n=28) <p>The same side hand-eye dominance pattern is more successful when no eye accessory is used while shooting with the bow.</p> <p>However, the effect of dominance seems to have disappeared with the fairly frequent use of aiming in trainers.</p>
Razeghi et al. [11] (2012)	Dart	Student (n=20)	To examine the effect of the interaction between hand-eye dominance on dart skill.	Each participant rested for 2 minutes after 30 darts to warm up and fired 30 more darts. This shot is called the pretest. The training program was completed 3 days a week, 12 times in 4 weeks. Scores taken at the 12 th shot were called gain, while the permanence of the shots made after 1 week was evaluated.	<ul style="list-style-type: none"> Dominant eye (Miles test and Porta test) -Dominant hand (Edinburgh Handedness Form) 	<ul style="list-style-type: none"> -Ipsilateral dominance (n=10) -Right hand-eye (n=8) -Left hand-eye (n=2) Cross (n=10) -Left eye -Right hand (n=8) -Right eye-Left hand (n=2) <p>It has been stated that the effect of the interaction between hand and eye dominance on performance in each sport depends on the type of sport and visual skills that can affect performance in those sports.</p> <p>The results of this study confirm that this factor does not affect dart throwing.</p>

Mohammadi et al. [9] (2016)	Archery	Archer (n=57) Elite athlete (n=35) Non-elite athlete (n=22)	With the present protocol, it is to present a relatively comprehensive array of tests and evaluations on the static and dynamic aspects of vision that appears relevant to sports vision and to introduce those most useful for archery.	Parameters under the heading of measurements were evaluated for elite and non-elite athletes and characteristic results were desired to be obtained.	Visual tests -Static visual acuity -Contrast sensitivity -Ocular alignment -Stereo-acuity -Refractive error -Ocular dominance (Miles test) Direct participants were asked for the dominant hand.	In a sport involving intense vision and aiming tasks such as archery, the selection and design of a customized review protocol serving skill assessment and research purposes has resulted in success. It was concluded that the same side dominant hand and eye came to the fore.
Gürsoy et al. [10] (2017)	Archery	Elite Level Female Archer (n=44)	Determination of hand and eye dominance of female archers participating in the Turkish archery championship; to find out whether the points earned as a grand total and at the end of the archers' first and second target-based shots of 50 meters have an impact on success in sports; To assist instructors and beginner archers in selecting archers in line with the information given about hand and eye dominance.	A total of 72 shots were fired at both targets, which were set at 50 m intervals.	Hand dominance (Edinburgh Handedness Form) -Ocular dominance (Keyhole test)	Edinburgh Handedness Form -Left hand dominant (n=5), -Right hand dominant (n=39) It was observed that left-handed dominant archers scored better in target-based shooting than right-handed dominant archers. For this reason, it can be thought that left-handed archers can gain a competitive advantage in the archer selection process, and these archers can be considered advantageous in terms of being selected. As a result, it was concluded that laterality may be one of the most important factors in the success of archers.
Nosek et al. [12] (2017)	Biathlon	Biathlon athlete (n=37)	To determine whether gun position, eye dominance or upper extremity dominance affect shooting success in biathlon.	A total of 28 shots are fired prone (14) and standing (14).	Hand dominance and eye dominance (T-116 test)	Upper extremity dominance -Right hand (n=24) -Fewer right hands (n=6) -Versatile (n=2) -Fewer left hands (n=1) -Left hand (n=4) -Eye dominance -Right (n=23) -Left (n=14) -Same side (ipsilateral dominance) -Cross side (contralateral dominance) -Uncertain side A significant relationship between hand dominance, eye dominance and shooting success has not been confirmed.

<p>Daniel Mon-Lopez et al. [15] (2021)</p>	<p>Air Shooting</p>	<p>Participants (n=66) -Male(n=33) -Female(n=33) Non-athletes (n=30) Elite (n=9) Non-elite (n=27)</p>	<p>To compare differences in shooters' visual skills by level and to analyze the competition effect on them.</p>	<p>The data were collected through a pre-and post-competition simulation test. Two shooters were evaluated each session. No shooting activity was allowed before the visual measurement. The duration of the pre-competition simulation measurement was 50 min. Parameters under the heading of measurements were evaluated for non-athletes, elite and non-elite and characteristic results were desired to be obtained.</p>	<p>Dominant eye (Snellen (decimal) scale) -Visual acuity: (Sloan letter test protocol) -Static retinoscopy (Schiascopy ruler) -Patient's subjective refraction (Donder's method) -Measuring the far and near phoria (Van Graëffe's method) -Accommodation function of the participant. (Optometric test)</p>	<p>The main results of this study showed that shooting athletes had more visual acuity (right, left, and binocular visual acuity) than non-athletes, the elite shooters having higher levels of right and binocular accommodation facility than non-elite. -Shooting activity seems to improve visual acuity skills, binocular visual time and eye-hand coordination in non-elite shooters, and accommodation and eye-hand coordination in elite shooters immediately after the competition simulation.</p>
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test ocular dominance, there are studies that support and oppose the correlation of these tests among themselves. In light of these studies, it is anticipated that new studies that evaluate the correlation of analysis or testing methods will make a different contribution to the field. When the literature is examined, it is suggested that the dominant eye in aiming tests (mono-ocular gaze) is the preferred eye only for these tasks and does not have a different function. Studies on testing the dominant eye have stated that the "aiming test" is the most reliable test among all tests. The aiming test is because the person automatically prefers this eye during a mono-ocular test, with minimal external intervention [6]. They state that dominant eye does not have an essential function in the "normal population" in visual or oculomotor processes, except that it is preferred in some eye tasks.

The prevalence of eye-hand laterality characteristics in various sports modalities and their connections to psychological variables and athletic performance were examined in a systematic review. They found 14 studies (2,759 participants) in the literature that examined hand-eye laterality in various sports, including tennis, baseball, soccer, cricket, archery, biathlon, motorsports, darts, gymnastics, and synchro, as well as basketball, hockey, softball, and water polo, skiing, motorsport, modern pentathlon, golf, shooting, swimming, athletics, weightlifting, tennis, and table tennis also met their eligibility requirements. Their findings demonstrated that in some sports, such as golf (52.55%), soccer (53%), tennis (42%) and team sports (50.7%), regular and elite sportsmen have larger percentages of crossed hand-eye laterality profiles than the general population. On the other hand, athletes in target sports (the shooting and archery) with uncrossed hand-eye laterality characteristics seem to have an advantage given the high percentage of this profile in the group of people having the best performance (82.3%) [11,16]. The study by Moreno et al., which is similar to our study, covers the dates of 1977 and is a study covering team sports as a sports branch. In our study, we included individual sports branches and studies in 1999 and after.

Conclusion

In the literature, studies have mostly investigated the effects on performance. The studies that were looked at could lead one to believe that there is still much to learn about the connection between hand and eye dominance with performance and that more research is necessary. In addition, studies have also mentioned that athletes have developed their expertise, which has been transformed into a skill by training over the years, and that the performance-determining effect of dominance may have disappeared over time. As a result, when the studies are examined, the results that eye dominance primarily affects shooting performance in target sports are controversial. Also, whether hand-eye laterality affects athletes cognitively and psychologically during competition can also be investigated in future studies and added to the literature.

References

1. Dale P, Augustine GJ, Fitzpatrick D, Hall WC, Lamanita AS, Mooney RD, et al. Neuroscience. 6th Ed. New York: Oxford University Press, 2017.
2. Strydom B. The role of vision and visual skills in archery. *Afr Vision Eye Health*. 2010;69:21-8.
3. Appelbaum LG, Erickson G. Sports vision training: A review of the state-of-the-art in digital training techniques. *Int Rev Sport Exercise Psych*. 2018;11(1):160-89.
4. Ho R, Thompson B, Babu RJ, Dalton K. Sighting ocular dominance magnitude varies with test distance. *Clin Exp Optom*. 2018;101(2):276-80.
5. Wade NJ. Early studies of eye dominances. *Laterality*. 1998;3(2):97-108.
6. Laby DM, Kirschen DG. Thoughts on ocular dominance-is it actually a preference? *Eye Contact Lens*. 2011;37(3):140-4.
7. Abernethy B, Neal RJ. Visual characteristics of clay target shooters. *J Sci Med Sport*. 1999;2(1):1-19.
8. Laborde S, Dosseville FE, Leconte P, Margas N. Interaction of hand preference with eye dominance on accuracy in archery. *Percept Mot Skills*. 2009;108(2):558-64.
9. Mohammadi SF, Amiri MA, Naderifar H, Rakhshi E, Vakilian V, Ashrafi E, et al. Vision examination protocol for archery athletes along with an introduction to sports vision. *Asian J Sports Med*. 2016;7(1):e26591.
10. Gursoy R, Sahin S, Dalli M, Hazar K, Aggon E. The examination of the relationship between left-handedness and success in elite female archers. *Adv Phys Edu*. 2017;7(4):367.
11. Mon-López D, Bernardez-Vilaboa R, Sillero-Quintana M, Alvarez Fernandez-Balbuena A. Air shooting competition effects on visual skills depending on the sport level. *Eur J Sport Sci*. 2022;22(3):336-43.
12. Razeghi R, PS Nia, Bushehri NS, Maleki F. Effect of interaction between eye-hand dominance on dart skill. *J Neurosci Behav Health*. 2012;4(2):6-12.
13. Martin N, Lucie H, David C. Influence of laterality and eye dominance on successful shooting in a biathlon. *J Phys Edu Sport*. 2018;18(Suppl 1):366-72.
14. Mapp AP, Ono H, Barbeito R. What does the dominant eye dominate? A brief and somewhat contentious review. *Percept Psychophys*. 2003;65(2):310-7.
15. Bridgeman B, Lawrence S, editors. *The theory of binocular vision: Ewald Hering (1868)*. Springer US, 1977.
16. Moreno M, Capdevila L, Losilla JM. Could hand-eye laterality profiles affect sport performance? A systematic review. *Peer J*. 2022;10:e14385.