

Reaction Time in Target Shooting Sports: Perspective of Bocce and Archery

Hedefe Atıř Sporlarında Reaksiyon Zamanı: Bocce ve Okçuluk Perspektifi

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Abstract

Bocce and archery can be categorized as static sports branches. These branches involve the athletes focusing on the target in a static position and require them to use reaction time effectively in the process of deciding and performing the shot. The aim of this research was to compare the reaction time of the athletes who participated in archery and bocce training for at least two years. Sixteen Olympic archers and 19 bocce pétanque athletes participated in the research. The Nelson hand reaction time test was used to determine the reaction time. For statistical analysis, since the distribution was normal, independent samples t-test was used to compare the two groups according to branch and gender. There was no a statistically significant difference between two groups according to branch and gender ($p > .05$). The reason why the reaction time did not differ according to the branch and gender might be that the two groups were similar in terms of physical and biomotor characteristics. It is recommended that new studies focus on the effectiveness of training practices.

Keywords: Nelson hand reaction time, performance, bocce, archery, gender

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Öz

Bocce ve okçuluk, statik spor branşları olarak sınıflandırılabilir. Bu branşlar, sporcuların statik bir pozisyonda hedefe odaklanmasını içerir ve atışa karar verme ve atış yapma sürecinde tepki süresini etkin kullanmalarını gerektirir. Bu araştırmanın amacı en az iki yıl süreyle okçuluk ve bocce antrenmanlarına katılan sporcuların reaksiyon zamanlarının karşılaştırılmasıdır. Araştırmaya 16 olimpiik okçu ve 19 bocce petank sporcusu katılmıştır. Reaksiyon zamanının belirlenmesi için Nelson el reaksiyon zamanı testi kullanılmıştır. İstatistiksel analizler için dağılım normal olduğundan dolayı iki grubun branşa ve cinsiyete göre karşılaştırılması için bağımsız gruplar t test kullanıldı. Gruplar arasında branşa ve cinsiyete göre istatistiksel olarak anlamlı farklılık gözlenmedi ($p>.05$). Reaksiyon zamanının branşa ve cinsiyete göre farklılık göstermemesinin nedeni iki grubun fiziksel ve biyomotor özellikler bakımından benzer olmasından olabilir. Yeni çalışmaların antrenman uygulamalarının etkinliğine odaklanması önerilmektedir.

Anahtar Kelimeler: Nelson el reaksiyon zamanı testi, performans, bocce, okçuluk, cinsiyet

INTRODUCTION

Reaction time is an inherited feature that determines how long it will take between the athlete's first muscular reaction or movement to sudden stimuli (Bompa, 2003). In other words, the reaction time is also explained as the preparation time required for the action to occur with the stimulation. It has been scientifically explained that athletes have a better reaction time than non-athletes (Nakamoto & Mori, 2008). It is also known that reaction time varies in different sports branches (Türkeri et al., 2019; Koç ve diğ., 2006). In many sports branches responding quickly, increases the level of success. The reaction time has been reported to consist of two stages. The time elapsed between the receipt of the stimulus and the beginning of the muscle movement is defined as the first stage of the reaction time. This time interval is the stage of deciding whether there is any response before the move occurs. The second is called motor time. This period is the time from potential muscle movement to the onset of actual movement (Çatıkkaş, Kurt, Özkaya, 2011; Çolakoğlu, Tiryaki, Morali, 1993; Schmidt, 1991). Physiologically, there are five components of reaction time. These are the emergence of a signal at the receptor level, the spread of the signal to the central nervous system, the transmission of the signal by neurological methods and the production of an effector signal, the transfer of the signal from the central nervous system to the muscles, the stimulation of the muscle upon the creation of mechanical work, respectively (Bompa & Buzzichelli, 2018). The role of reaction time on sportive performance is becoming increasingly important. Athletes with short reaction times are successful in terms of technical capacity and conditioning (Açıkada & Ergen, 1990). Since the reaction time is a performance determining feature in many sports branches, it has become necessary to train in order to shorten it (Catelli & Manaham, 1990). The reaction time may differ between athletes and according to branches. At the same time, the reaction time affects the athlete's success in the sports branch (Sciarretta & Bawa, 1990).

Archery, which is one of the target shooting sports where reaction time is essential, is a sport that requires the forearm and shoulder belt to be in a natural and smooth harmony during the aiming and shooting stages (Lee & de Bondt, 2005). An arrow shot takes about 5-8 seconds on average. During this time, the athlete must stretch his bow, aim at the target and release the arrow. One of the factors affecting the success of these stages is reaction time (Kolayış, 2000). It has been reported that the decision to release the arrow voluntarily harms the aiming focus of the athletes, and the harming can

be eliminated by using the clicker. When an audible warning comes from the clicker utilized to reach the correct stretching of the bow, the athlete releases the arrow (Leroyer, Hoecke, Helal, 1993). When the clicker snaps against the bow handle, it is a warning for the athlete. The archer needs to react quickly to the clicker (Ertan et al., 2005). In a study, it was found that archers with a good reaction time also had a good hit rate (Çelikel, Sezer, Karadağ, 2020). Similarly with archery; In bocce petanque, the athlete's hand-eye coordination and reaction time are essential for shooting close to the Pallino at the target point, for throwing the opponent's ball out of the ring, and for executing the shot at the right time in the shooting position. Previous studies in the literature have shown the effect of reaction time on shooting accuracy in archers (Çelikel et al., 2020), the relationship between clicker reaction time and archery score in archers (Ertan, Açıkada, Aşçı, 1996), the effect of postural stability on reaction time in archers (Spratford & Campbell, 2017). To the best of our knowledge, there is no study in the literature regarding the investigation of reaction time in Bocce petanque branch. Studies have focused on the somatotype profiles of bocce athletes (Eler & Eler, 2018), and the effect of bocce on developing visual motor integration (Sood, Ahmad & Chavan, 2017). In branches that involve shooting strategies, reaction time is considered important in the planning of the shot and the release of the ball or arrow. It is known that the shooting after the clicker in archers and the moment the ball release in the shooting procedure of bocce pétanque athletes affect the quality of the shot and the result. To the best of our knowledge, no study has been found in the literature comparing these two branches in terms of the reaction time variable. Both archery and bocce can be categorized as a static sport, as it requires athletes to stand in a fixed position and use their reaction time effectively. Reaction time is essential for athletes to take action after focusing on the target. Thus, the aim of this research is to compare the reaction times of the athletes who participated in archery and bocce training for at least two years.

METHODS

Procedure

The average wind in the training area was 6.7 km/h, and the average air temperature was 27°C. "Ethics Approval Certificate" was obtained from Osmaniye Korkut Ata University Scientific Research and Publication Ethics Committee to carry out tests and measurements. (E.27661/19956/2020/26/5). At the same time, all participants and their coaches were included in the study after signing the "Informed Consent Form" prepared according to the Helsinki criteria. All necessary safety precautions for the research were taken under the supervision of the trainer, and no one other than the researchers and the participant to be measured was taken to the measurement area.

Participants

Sixteen Olympic archers and 19 bocce pétanque athletes participated in the research. Archers and Bocce athletes have been participating in regular training for at least two years. Descriptive statistics of the participants were given in Table 1. All participants train four days a week, 2 hours a day. All necessary safety precautions for the research were taken under the supervision of the trainer, and

nobody except the researchers and the participant to be measured was taken to the area where the measurement was made.

Reaction Time Measurement

The participant sits on the chair, extends his hand 8-10 cm from the table. The thumb is held opposite the other fingers (opposition). The ruler is held between the athlete's thumb and index fingers, and the athlete is told to look directly into the center of the ruler. The researcher kept the test ruler at the top and the starting point of the ruler in the middle of the participant's hands. When the ready command was given, the test ruler was released, and the participant tried to stop the ruler by closing the fingers as soon as possible. This test was repeated five times for both hands, the worst two measurements were not evaluated, and the arithmetic average of the remaining three measurements was used in statistical analysis (Tamer, 2000; Kaya et al., 2019). For the Ruler test, the data measured in cm on the ruler is converted to reaction times according to the millisecond conversion table. The conversion table is based on the following formula as $t = (\sqrt{2d/g})$ where t = reaction time, d = distance travelled by the ruler, $g = 9.81 \text{ m/s}^2$ (gravitational constant) (Aranha et al., 2015; Jha et al., 2020).

Statistical Analysis

For statistical analysis, z-scores were calculated, and it was observed that the z-scores of all data ranged from +3 to -3 (Schötz, Frid, Gustafsson, Löfqvist, 2013). The normality of the distribution was evaluated with the Shapiro-Wilk test since the number of participants was below 50. Additionally, the Skewness Kurtosis values were checked (Vincent & Weir, 2014). Since the distribution was normal, Independent samples t-test was used to compare the two groups according to branch and gender. In addition, Cohen's d and effect size were calculated.

RESULTS

Nineteen bocce pétanque athletes and 16 archery athletes participated in the research. Descriptive statistics of the participants, including age, height, body mass, were presented in Table 1.

Table 1. Descriptive statistics of bocce and archery athletes

Groups	Variables	N	Mean	Std. Deviation
BOCCE	Age (year)	19	16,74	2,10
	Body Height (cm)	19	165,32	7,66
	Body Mass (kg)	19	62,74	12,04
	Right Hand Reaction Time (sec)	19	0,142	0,04
	Left Hand Reaction Time (sec)	19	0,143	0,04

ARCHERY	Age (year)	16	16,56	3,42
	Body Height (cm)	16	159,29	10,72
	Body Mass (kg)	16	60,21	15,31
	Right Hand Reaction Time (sec)	16	0,134	0,04
	Left Hand Reaction Time (sec)	16	0,127	0,04

The independent samples t-test applied to determine the difference between the reaction times of the participants according to the branch and gender were presented in Table 2. Cohen's d and Effect size values are also calculated to reveal more profound differentiation. However, no statistically significant difference was observed between the groups according to branch and gender ($p>.05$). The mean reaction times of the participants according to the branch and gender are presented in Figure 1.

Table 2. Independent samples t-test, Cohen's d and effect size results

Groups	Variables	t	df	Sig. (2-tailed)
Archery and Bocce	Right Hand Reaction Time (sec)	0,729	33	0,471
	Left Hand Reaction Time (sec)	1,127	33	0,268
Gender	Right Hand Reaction Time (sec)	-0,154	33	0,878
	Left Hand Reaction Time (sec)	-0,613	33	0,544

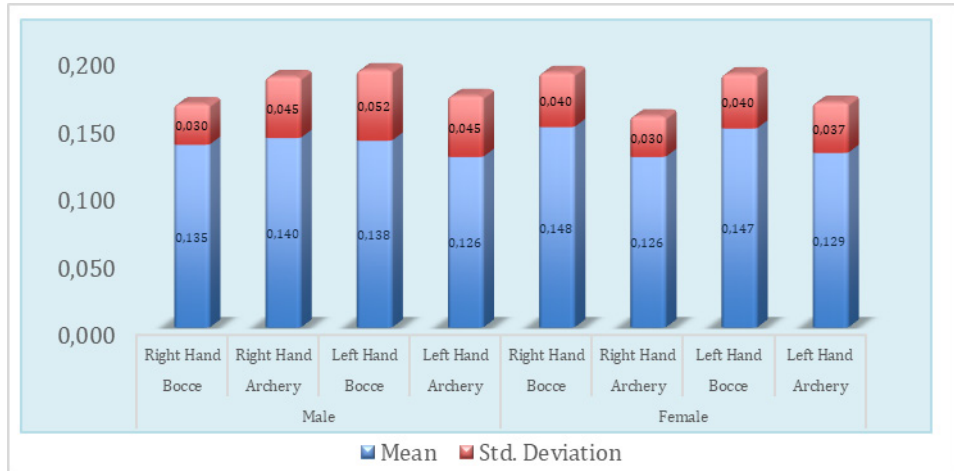


Figure 1. Descriptive statistics according to reaction time (sec) of bocce and archery athlete

DISCUSSION

In this study, which aimed to compare the reaction times of athletes who participated in archery and bocce training for at least two years, no statistically significant difference was observed between

bocce petanque athletes and Olympic archers in terms of reaction time ($p > .05$). Since target shooting sports are static branches that require high control in movement, reaction time is an important factor that increases performance in such sports (Zolkafi et al., 2018). This is the first study in the literature to compare bocce and archery branches in terms of reaction time. Strydom and Ferreira (2010), conducted a study to determine the most important visual skills that can be applied to archery and to determine the norms of visual skills required for elite archers and reported that visual acuity, contrast sensitivity, hand-eye coordination, eye-body coordination and visual response time may be the most important skills in archery. In studies with archers; It has been reported that, strength exercises contribute positively to the development of visual and auditory reaction time of male archers, increase the hit rate in athletes with good reaction time (Çelikel et al., 2020), and that regular exercises can shorten the reaction speed (Çolakoğlu et al., 1993), low click response time is a predictor of higher scoring shots in clicker shots in archers (Spratford & Campbell, 2017). But, in a study by Ertan et al. (1996) in which they aimed to investigate the effect of clicker reaction time on the score and the relationship between visual, auditory, and tactile reaction times in national archers, they reported that the clicker reaction time could be effective on the score in elite athletes. In a study aiming to determine the effect of traditional archery training on hand-eye coordination and upper extremity reaction time, the reaction time of the experimental group was higher than the control group. Still, the intervention effect was not statistically significant (Zolkafi et al., 2018). A comparable study investigating the reaction time of bocce athletes has not been found in the literature. The reason why there was no difference in reaction time in Bocce and Archery athletes in our study is thought to be due to the long – term effect of training since all athletes have been training for at least two years. Long-term training should target the requirements of branch-specific competence. If direct training serves to prepare the athlete for his special competitive needs in sports, the training becomes more effective. This applies both to the situations to be encountered in the competition and to the efficiency standard to be reached in the competition (Dündar, 2003).

In this study, the average hand reaction time of Bocce athletes was 0.14 sec, and the average reaction time of archers was 0.13 sec (Fig 1). Seth (2016), in a study investigating the determinants of badminton game performance, reported the average reaction time as 0.562 seconds in the measurements made by expert badminton players with the Nelson hand reaction test. In the study examining the relationship of linear sprint and agility with psychomotor components in male cricket players, the mean reaction time was reported as 0.14sec, similar to our research (Kumar & Goon, 2020). Another study aimed to determine the relationship between motor fitness parameters and performance among 100-meter female sprinters; the mean reaction time was reported as 0.11sec (Kaur & Singh, 2016). In a study comparing dancers with different athletes and sedentary in terms of reaction time, dancers' average hand reaction time was reported as 0.184 sec (Mondal & Mondal, 2013). Our research findings are similar to the studies conducted with athletes in different branches in the literature.

Regardless of the branch, no statistically significant difference was observed in reaction time according to gender ($p < .05$). Contrary to our research; In a study examining the effect of archery training on reaction time, it was shown that male patients with spina bifida responded earlier than female patients (Babagür, 2006). Taha and Chong (2013) reported that male athletes had a shorter

reaction time than female athletes in their study on the reaction time among archery, shooting, and fencing athletes. Since it is the first study to compare bocce and archery by gender, the findings can be supported by examining gender-related differences in new studies.

CONCLUSION

Archery and Bocce Petanque are static sports branches that require focus and shooting at the right time. In archery, the snap of the clicker is a warning for the athlete, and the athlete must give a correct reaction to this warning. Similarly, in the bocce petanque branch, a series of movements are performed before the throwing takes place, and if the ball is released at the right time, it results in a successful throwing. There has been no study in the literature comparing bocce and archery branches in terms of reaction time. In this respect, the research is an original study. This study observed that the reaction time of bocce pétanque and archery athletes, which are the shooting branches, did not differ. It is thought that this observed situation maybe since the athletes in both sports branches have participated in regular training for at least two years. It is recommended that further research is conducted with a control group and to examine the results of training interventions.

REFERENCES

- Açıkada, C., Ergen, E. (1990). *Science and Sports* [In Turkish] Ankara: Bürotek Ofset Publishing.
- Aranha, V. P., Joshi, R., Samuel, A. J., & Sharma, K. (2015). Catch the moving ruler and estimate reaction time in children. *Indian J Med Health Sci*, 2(1). <https://dx.doi.org/10.21088/ijmhs.2347.9981.2115.4>
- Babagür, A. (2006). *To research hand-grip power, reaction time and the change of biochemical parameters before and after archery training given to children with spina who are over seven years old*. Master of Science Thesis. Health Sciences Institute, Marmara University, İstanbul. <http://dspace.marmara.edu.tr/handle/11424/28859>
- Bompa, T. O. (2003). *Training theory and method*. Ankara: Bağırgan Publishing House.
- Bompa, T. O. & Buzzichelli, C. (2018). *Periodization-: theory and methodology of training*. Human kinetics.
- Catelli, R., & Manaham, R. (1990). Reaction Time and Movement Time. *Medicine and Science in Sport and Exercise*, 22(1), 75-77.
- Çatıkkaş, F., Kurt, C., Özkaya, G. (2011). The effect of hand preference on the determining of the visual and auditory simple reaction times in the combat sports. *Selçuk University Physical Education and Sport Sciences Journal*, 13(1), 109-111.
- Çelikel, B.E., Sezer, S.Y., & Karadağ, M. (2020). Investigation of the effect of reaction time to target hit score in the men archery. *Sports Education Sciences*, 4(1), 4-30. <https://dergipark.org.tr/en/download/article-file/1000094>
- Çolakoğlu, M., Selamoğlu, S., Gündüz, N., Acarbay, Ş., & Çolakoğlu, S. (1993). Effects of isometric exercise of correction o hamstring / quadriceps force ratios of sprinters and jumpers. *Journal of Sport Sciences*, 4(1), 24-33. <https://dergipark.org.tr/en/download/article-file/151512>
- Çolakoğlu, M., Tiryaki, Ş., Moralı, S. (1993). The effect of concentration methods on reaction time. *Hacettepe Journal of Sports Sciences*, 4(4), 32-47. <https://dergipark.org.tr/en/download/article-file/151527>
- Dündar, U. (2003). *Antrenman teorisi*. Nobel Yayın Dağıtım.

- Eler, N., & Eler, S. (2018). A Study on Somatotype Profiles of the Players in Turkish Bocce National Team. *Journal of Education and Training Studies*, 6(2), 28-35.
- Ertan, H., Açıkkada, C., & Aşçı, A. (1996). The effect of clicker reaction time on scoring point and the relationship among visual, auditory, and tactile RTs among Turkish archers. *Hacettepe Journal of Sports Sciences*, 7(3), 12-20.
- Ertan, H., Kentel, B.B., Tümer, S.T., Korkusuz, F. (2005). Reliability and validity testing of an archery chronometer. *Journal of Sports Sciences & Medicine*, 4(2), 95. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3880893/>
- Jha, R. K., Thapa, S., Kasti, R., & Nepal, O. (2020). Influence of body mass index, handedness and gender on ruler drop method reaction time among adults. *Journal of Nepal Health Research Council*, 18(1), 108-111. <https://doi.org/10.33314/jnhrc.v18i1.2545>
- Kaur, L., & Singh, A. (2016). Relationship of motor fitness parameters with performance among 100m female sprinters. *International Journal of Physical Education, Sports and Health*, 3(6): 452-454.
- Kaya, E. Ö., Koroğlu, Y., Sarıtaş, N., Kaya, M. & Sukan, S. (2019). Effect of participation in educational games activity on balance, reaction and agility in children. *Journal of Sports Sciences Researches*, 4(1), 35-42. <https://doi.org/10.25307/jssr.516296>
- Koç, H., Kaya, M., Sarıtaş, N., Çoksevrim, B. (2006). Comparison of some physical and physiological parameters of football players and tennis players. *Journal of Health Sciences*, 15(3), 161-167. <https://dergipark.org.tr/tr/download/article-file/692416>
- Kolayış, İ. E. (2000). *The effects of heart rate and aiming time on the shooting performers in archery national team*. Master of Science Thesis, Sakarya University, Social Sciences Institute, Sakarya. <https://hdl.handle.net/20.500.12619/94020>
- Kumar, S. & Goon, A.K. (2020). Relationship of linear sprint and agility with selected psychomotor components in the district level cricket players. *International Journal of Physiology, Nutrition and Physical Education*, 5(1), 113-116.
- Lee, K., & de Bondt, R. (2005). Total Archery. Gim Po City: Samick Sports Co. Ltd.
- Leroyer, P., Van Hoecke, J., & Helal, J. N. (1993). Biomechanical study of the final push-pull in archery. *Journal of Sports Sciences*, 11(1), 63-69. <https://doi.org/10.1080/026.404.19308729965>
- Mondal, M. S., & Mondal, I. (2013). A comparative study on some selected motor performance, anthropometry and body composition variables among khatk dancers, athletes and sedentary females. *International Journal of Physical Education, Fitness and Sports*, 2(3), 1-5.
- Nakamoto, H. and Mori, S. (2008). Sport-specific decision-making in a go/no go reaction task: difference among non-athletes and baseball and basketball players. *Perceptual and Motor Skills*, 106(1), 163-171. <https://doi.org/10.2466/pms.106.1.163-170>
- Schmidt, R.A. (1991). *Motor Learning and Performance*. USA: Human Kinetics Pub.
- Schötz, S., Frid, J., Gustafsson, L., & Löfqvist, A. (2013). Functional data analysis of tongue articulation in Gothenburg and Malmöhus Swedish/i, y, u. *Proceedings of Fonetikk*, 69. https://www.isca-speech.org/archive/archive_papers/interspeech_2013/i13_1326.pdf
- Sciarretta, D., & Bawa, P. (1990). Modulation of stretch activity with instruction. *Electromyogr Clin Neurophysiol*, 30, 353-360. <https://www.researchgate.net/profile/Parveen-Bawa/publication/20905684>
- Seth, B. (2016). Determination factors of badminton game performance. *International Journal of Physical Education, Sports and Health*, 3(1), 20-22.

- Sood, V., Ahmad, W., & Chavan, B. S. (2017). Effect of bocce game on developing visual motor integration among children with intellectual disability. *Journal of Disability Management and Rehabilitation*, 2(2), 54-58. <https://www.researchgate.net/profile/Wasim-Ahmad-8/publication/325619890>
- Spratford, W. & Campbell, R. (2017). Postural stability, clicker reaction time and bow draw force predict performance in elite recurve archery. *European Journal of Sports Sciences*, 17(5), 539-545. <https://doi.org/10.1080/17461.391.2017.1285963>
- Strydom, B., & Ferreira, J. T. (2010). Optical lenses and magnification in archery. *African Vision and Eye Health*, 69(1), 29-34. <https://doi.org/10.4102/aveh.v69i1.122>
- Tamer, K. (2000). *Measurement and evaluation of physical – physiological performance in sports*. [In Turkish]. Ankara: Baęırgan Publishing, 52-57.
- Taha, S., & Chong, R. (2013). Effectiveness of an alternate hand wall toss on reaction time among archery, shooting & fencing athletes. <https://www.researchgate.net/profile/Redzwan-Razali-Chong/publication/301618732>
- Türkeri, C., Öztürk, B., Buyuktas, B., & Öztürk, D. (2019). Comparison of balance, reaction time, attention and BMI values in individual and team sports. *Journal of Education and Learning*, 8(6), 119-128. <https://doi.org/10.5539/jel.v8n6p119>
- Vincent, W.J. & Weir, J.P. (2014) *Statistics in Kinesiology*. Human Kinetics, Turkish version by Nobel Academic Publishing, Translator; Yetkin Utku Kamuk, Ankara. ISBN:978-605-133-784-5
- Zolkafi, M. A. A., Nordin, N. J., Rahman, H. A., Sarip, N. A. M., Abdullah, N. I. T., & Sahar, M. A. (2018). Effect of 4-weeks traditional archery intervention on hand-eye coordination and upper limb reaction time among sedentary youth. *The Journal of Social Sciences Research*, 1225-1230. <https://doi.org/10.32861/jssr.spi6.1225.1230>