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ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

Comparing the Accuracy and Reaction Times of Esports Players and Sport Sciences Students

Esporcuların ve Spor Bilimleri Öğrencilerinin İsabetlilik ve Reaksiyon Sürelerinin Karşılaştırılması

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Abstract

The aim of this study is to compare the visual, auditory reaction and accuracy times of electronic sports players and sports sciences students. A total of 60 voluntary, including 30 sports sciences students with an average age of 21.70±1.55 years, who have been doing sports for 9.43±4.22 years, and 30 professional First Person Shooter (FPS) players with an average age of 23.30±1.11 years doing esports for 5.86±1.96 years, participated in the study.The tests were administered via web-based digital platforms. Visual Reaction Time Test and Auditory Reaction Time Test were used to determine visual and auditory reaction times as well as Aim Trainer test to determine accuracy times. Auditory and visual reaction time tests were applied five times and the average of the values was recorded in milliseconds (ms). The Aim Trainer test was applied once and the resulting time was recorded in milliseconds (ms). Kolmogrov-Smirnov test was used for normality analysis of the data. Since the data showed normal distribution, they were compared with the Independent Sample T-Test. A statistically significant difference was found in the accuracy parameter between the groups ($p<0.01$). However, there was no significant difference in the auditory and visual reaction time test ($p>0.05$). As a result, while it was seen that electronic sports players hit targets faster than sports sciences students in the accuracy test, no significant difference was observed in visual and auditory reaction tests ($p>0.05$).

Keywords: Electronic Sports, Esports, Accuracy, Reaction Time

Öz

Bu çalışmanın amacı elektronik sporcular ile spor bilimleri öğrencilerinin görsel, işitsel reaksiyon ve isabetlilik sürelerini karşılaştırmaktır. Çalışmaya yaş ortalaması 21.70±1.55 yıl, 9.43±4.22 yıldır spor yapan 30 spor bilimleri öğrencisi ve yaş ortalaması 23.30±1.11 yıl, 5.86±1.96 yıldır espor yapan 30 profesyonel

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First Person Shooter (FPS) oyuncusu olmak üzere toplam 60 kişi gönüllü olarak katılmıştır. Testler web tabanlı dijital platformlar kullanılarak yapılmıştır. Katılımcıların görsel ve işitsel reaksiyon sürelerinin belirlenmesi için Görsel ve İşitsel Reaksiyon Süresi Testi, isabetlilik sürelerinin belirlenmesi için Aim Trainer testi uygulanmıştır. İşitsel ve görsel reaksiyon süresi testleri beş kez uygulanmış olup değerlerin ortalaması milisaniye (ms) cinsinden kaydedilmiştir. İsabetlilik testi bir kez uygulanmıştır ve elde edilen süre milisaniye (ms) cinsinden kaydedilmiştir. Verilerin, normallik analizi için Kolmogrov-Smirnov testi kullanılmıştır. Veriler, normal dağılım gösterdiği için Bağımsız Örneklem T-Testi ile karşılaştırılmıştır. Gruplar arasında isabetlilik parametresinde istatistiksel olarak anlamlı fark bulunmuştur($p<0.01$). Ancak işitsel ve görsel reaksiyon süresi testinde anlamlı fark bulunmamıştır($p>0.05$). Sonuç olarak, elektronik sporcuların isabetlilik testinde spor bilimleri öğrencilerinden daha hızlı hedeflere isabet ettiği görülürken, görsel ve işitsel reaksiyon testlerinde herhangi bir anlamlı farklılık görülmemiştir ($p>0.05$).
Anahtar Kelimeler: Elektronik Spor, Espor, İsabetlilik, Reaksiyon Zamanı

INTRODUCTION

Electronic sports (Esports) is often followed and preferred in recent years. Esports are video games with high competition and professionally played (Akgöl, 2018). Electronic sports have received a lot of attention with not only teenagers but also adults devoting most of their time (Bányai, et al., 2019). Esports also has own platforms, games, players, regional and global organizations, teams and international federations. Organizations related to esports operate either on local networks or online (Jenny et al., 2017). Many physical and mental skills are included in today's sports branches of esports. In electronic sports games, milliseconds can determine winning and losing. In this sense, accuracy, hand-eye coordination, muscle memory and reaction time are great importance because mastering these skills in esports increases your chances of success (Ersin et al., 2022). It has been found that the reaction time of esports players is quite important, with fast reaction time being an essential component of success in most competitive games (Nagorsky & Wiemeyer, 2020).

Human reaction time operates by enabling the nervous system to perceive a stimulus. Neurons subsequently convey the message to the brain. The message then travels from the brain to the spinal cord, which in turn reaches the individual's hands and fingers. Motor neurons then direct the hands and fingers on how to react. (Welford, 1980). Factors that may impress the average human reaction time include age, sex, dominant hand, central or peripheral vision, practice, fatigue, fasting, breathing cycle, personality types, exercise, and intelligence of the subject (Karia et al., 2012).

Reaction time (RT) is a measure of the speed at which an organism responds to a particular stimulus. RT is the time interval between the realization of the stimulus and the response that will occur in the person (Jain et al., 2015). Reaction time is examined in two categories simple and complex reaction time. Simple reaction time covers the time between a stimulus and a response to a stimulus. Complex reaction time defines more than one stimulus and more than one reaction to these stimuli. In previous studies, it was stated that reaction time could be improved with physical exercise (Biçer and Aysan, 2008; Göral et al., 2012). Outcomes like damaging an opponent (this means damaging your opponent in order to eliminate) in FPS games are related to accuracy in electronic sports. In a study, it has been observed that accuracy training performed for a total of six minutes every day

outside the game for a week led to a significant increase in the average scores produced per round of the participants (Roldan & Prasetyo, 2021). The result from the previous study shows that physical training also contributes to performance in esports. Esports players are expected to be good at hitting targets and quick in their visual and auditory reactions. It is known that these skills can be developed with training. A previous study suggested that simple reaction time could improve by 10-15% with training, while complex reaction time could improve by 30-40% (Polat et al., 2018). All esports players should be capable of rapidly making decisions during gameplay, followed by prompt execution of those decisions. Additionally, players must attentively observe visual information on the monitor and auditory information through their headset, then react as swiftly as feasible (Akyüz, 2022).

Reaction time is a crucial element in most sports. According to Mori et al. (2002), in sports, reaction time (RT) is considered a beneficial perceptual ability for achieving success in athletic performance. Since athletes need to react to various stimuli in different environments, reaction time is one of the determinants of successful performance, and athletes with the same condition and technical capacity have shorter reaction times and are more successful (Temur & Baytar, 2019). According to Kuan et al. (2018), athletes typically exhibit faster reaction times than non-athletes. Studies have demonstrated that individuals who actively engage in sports tend to react faster than those who do not exercise.

Research indicates that esports players strive to react promptly and enhance their accuracy. Likewise it could be argued that sports sciences students also cultivate these traits throughout their athletic pursuits. However, can they be anticipated to react as rapidly or attain digital objectives comparable to an esports players? This is exactly what constituted the question of the research. The research hypothesis is grounded on the notion that sports sciences students possess slower auditory and visual reaction times as well as accuracy times compared to electronic sports players. Therefore, the aim of the study is to compare the accuracy, visual and auditory reaction time parameters of electronic sports players and sports sciences students.

METHOD

Research Model: This research is a descriptive study in the observational model, which aims to compare the auditory and visual reaction and accuracy times of students with a sports background who are actively studying in a sports sciences faculty and professional electronic sports players in the First Person Shooter (FPS) branch.

Research groups: To determine the participants in this study, a total population size of 1000 Halic University sports sciences students and 8126 licensed esports players (Bilir, 2022) was created. Then, using the SurveyMonkey sample calculator, the sample number of 65 people was calculated with a 99% confidence level and a 16% margin of error (SurveyMonkey, 2022). However, 5 volunteers who were determined not to participate in the study with their dominant hand were excluded from the study.

A total of 60 people, including 30 professional esports players (15 female, 15 male) in the First-Person Shooter (FPS) branch, which is a branch based on target shooting in esports, and 30 Sports Sciences students (15 female, 15 male) studying at the Faculty of Sports Sciences and actively practicing sports, participated in the study voluntarily. The sports branches of the sport sciences students who participated in the study were football (36.7%), basketball (16.7%), volleyball (6.7%), pilates (6.7%) and boxing (6.7%). Other students' sports branches were swimming, rugby, karate, powerlifting, handball, fitness, kickboxing and judo. In statistical evaluation of the results, the significance level accepted as $p<0.05$.

Data Collection Tools: Electronic sports players and sports sciences students who participated in the study filled out the personal information form, and then those who were found to be eligible for the study were administered visual and auditory reaction time tests and accuracy tests via personel computer (PC). The PC specifications: I3 7100 3.90 GHz (4 CPUs) Processor, 16GB Ram, Gtx 1050 2gb Graphic Card, 500gb SSD. The data were collected from two websites. For the auditory reaction time test: www.new.cognitivefun.net and for the visual reaction time and accuracy values www.humanbenchmark.com was used. Thompson et al. (1992) said that the average RT for detecting visual stimuli was approximately 180-200 ms, while for sound it was around 140-160 ms. Since the accepted figures for the average simple reaction times for college-age individuals are approximately 190 ms for light stimuli and approximately 160 ms for sound stimuli (Jain et al., 2015), persons who received results lower than these were retested.Volunteers participated in the tests with PC components mouse, headset and monitor. Lenovo D24F-F10 monitor, with 144Hz (hertz) and 1 ms (millisecond) quality, was connected to the display port. A wired mouse Lenovo M120 and Phias SHE1350 wired earbuds were also connected with USB to the computer.

Research Ethics: The ethics committee approval was taken from the Halic University Non-Invasive Clinical Research Ethics Committee, with the decision numbered 80 and dated 27/04/2022.

Collection of Data: "Voluntary Consent Form" was obtained from the participants before the data were collected. Data about the participants were collected with the "Personal Information Form". Before starting the tests, preliminary information about how the tests works was presented and the players were allowed to practice. The data on accuracy, visual reaction time and auditory reaction time are gathered from aim trainer test, visual reaction time test and auditory reaction time test. Accuracy value was measured one time, auditory and visual reaction tests were measured five times, and the average of the results were recorded in milliseconds (ms). Volunteers used their dominant hand to administer the tests. The tests were conducted at the Sport Psychology Laboratory of Haliç University, Faculty of Sports Sciences. We maintained a quiet environment at the Lab during the testing process. In addition the participants were tested individually.

Personal Information Form

The name, surname, age, gender, branches, sports age, etc. of the participants were obtained through this form.

Visual Reaction Time Test

In this test, when the participants are ready to start the test, they start the test by pressing anywhere in the blue color on the screens. When the color turns from blue to red, the participants should wait for green. When the color returns green, the participants must respond to the first button of the mouse as quickly as possible with their dominant hands. The result of the test is calculated as milliseconds (ms). The participants applied this test five times and the average of these five values were taken (Cuthbertson et al., 2015; Wielen, 2015; Ersin et al., 2022) (Figure 1).

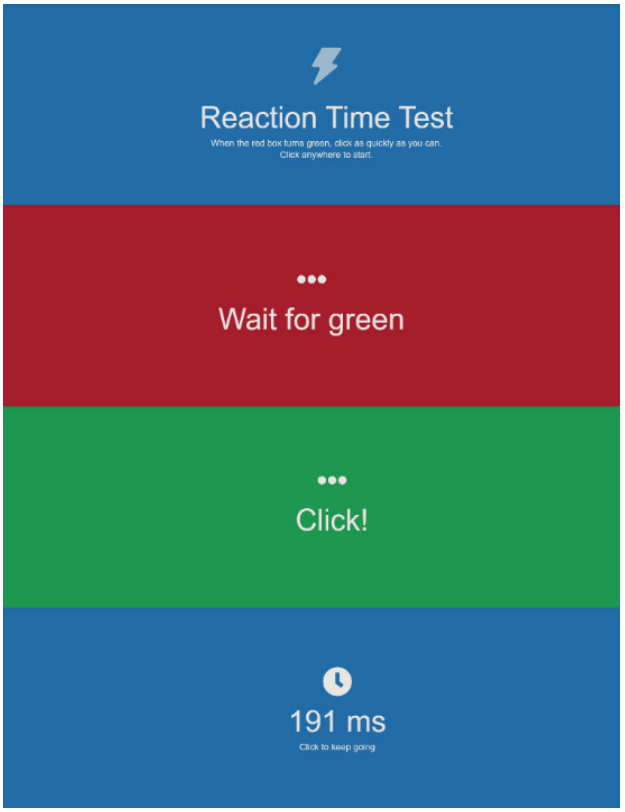

Figure 1. Visual Reaction Time Test.

Auditory Reaction Time Test

When participants are ready, they hold the mouse and move the cursor to the blue color on the screen and click to start the test. Then they need to react quickly with their dominant hands as soon as the "Beep" sound is heard in the target area on the screen. The result of the test is calculated as milliseconds (ms). The participants applied this test five times and the average of these five values were taken (Pancar et al., 2016; Kaplan et al., 2017) (Figure 2).

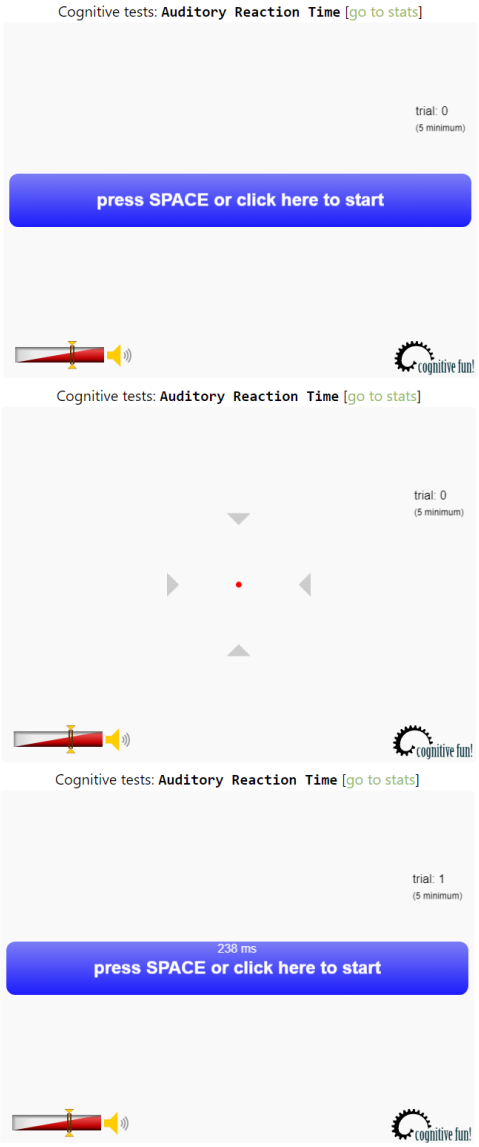

Figure 2. Auditory Reaction Time Test.

Accuracy – Aim Trainer Test

When the participants are ready, they start the test by clicking with the mouse on the screen, and then it appears in order of 30 targets in different parts of the screen. The participant needs to click on these targets as quickly as possible. This test was performed once and the result was recorded in milliseconds (Radu et al., 2021; Ersin et al., 2022) (Figure 3).

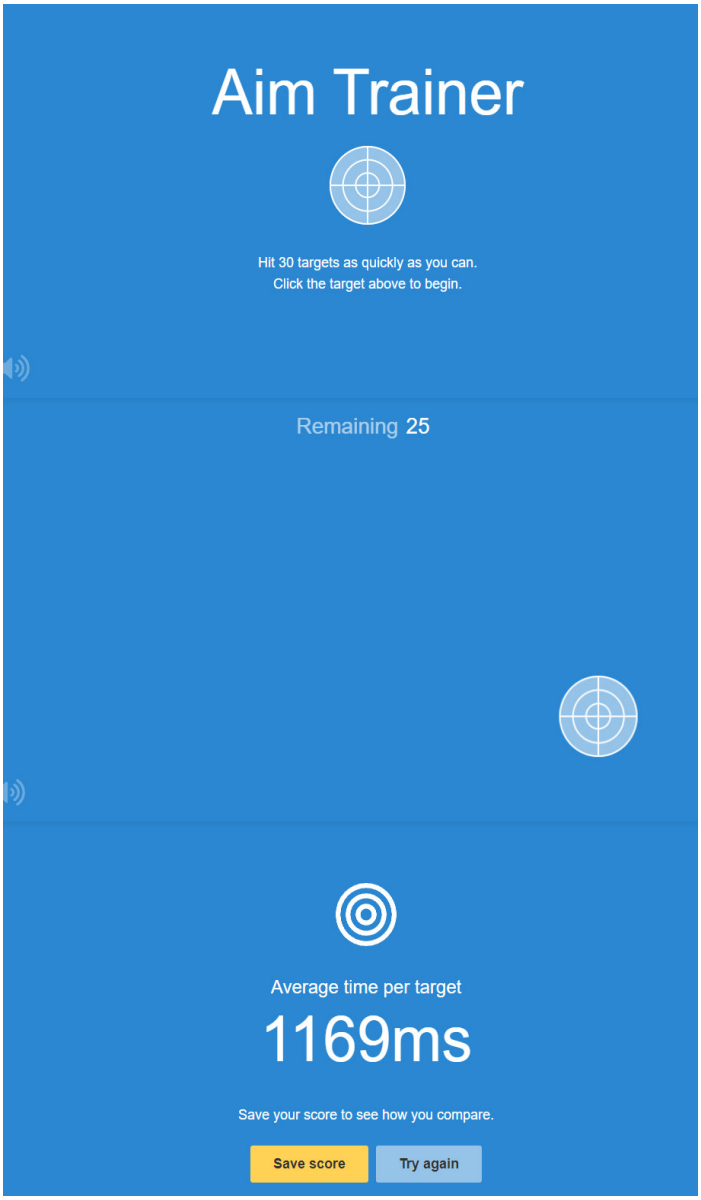

Figure 3. Aim Trainer Test.

Analysis of Data: Data was evaluated with the IBM SPSS 22.0 statistics program. In the analysis of the data, parametric tests were applied because the skewness and kurtosis values did not exceed the – 1 and +1 range. The Kolmogorov-Smirnov test was also performed on the data. In the statistical analysis of the study, variables were evaluated and defined using arithmetic mean (M), standard

deviation (SD), number, and percentage (%) values. Electronic sports players and sports sciences students were compared with an independent sample T-test.

FINDINGS

Table 1. Demographic characteristics of the participants

	Sports Sciences Students (n=30)			Esports Players (n=30)		
	Min.	**Max.**	**X±SD**	**Min.**	**Max.**	**X±SD**
Age (years)	19.0	25.00	21.70±1.55	21.00	25.00	23.30±1.11
Height (cm)	1.55	1.92	1.72±0.09	1.54	1.86	1.69±0.08
Weight (kg)	46.80	120.00	69.16±16.09	48.00	87.00	65.50±13.34
Sports age (years)	2.00	16.00	9.43±4.22	3.00	11.00	5.86±1.96

Table 1 shows the demographic information of sports sciences students and electronic sports players. Accordingly, the average age of the sports sciences student participants was 21.70±1.55 years, their average height was 1.72±0.09 cm, their weight was 69.16±16.09 kg, and their average time spent doing sports was 9.43±4.22 years. Also, the average age of the participants who played electronic sports games was 23.30±1.11 years, their average height was 1.69±0.08 cm, their weight was 65.50±13.34 kg, and their average time spent playing electronic sports games was 5.86±1.96 years.

Table 2. Comparison of Demographic Information, VRT, ART and Accuracy Times Between Sports Sciences Students and Esports Players

	Sports Sciences Students (n=30)	Esports Players (n=30)	
	X±SD	**X±SD**	**p**
Age (years)	21.70±1.55	23.30±1.11	.000*
Height (cm)	1.72±0.09	1.69±0.08	.360
Weight (kg)	69.16±16.09	65.50±13.34	.341
Sports Age (years)	9.43±4.22	5.86±1.96	.000*
Visual reaction time (ms)	229.51±18.97	229.52±30.48	.999
Auditory reaction time (ms)	257.01±25.61	248.33±34.98	.278
Accuracy time (ms)	559.06±59.27	414.70±48.52	**.000***

*$p<0.05$

When compared sports sciences students and electronic sports players, differences were found only in age, sports age and accuracy parameters ($p<0.01$). Although they had very similar values in visual reaction time, it was found that sports sciences students were slower in auditory reaction time. It was also noted that the participants' auditory reaction times were slower than their visual reaction times.

Table 3. VRT and ART and Accuracy Values of Sport Sciences Students and Electronic Sports Players

Sports Sciences Students (n=30)	Male (n=15) X±SD	Female (n=15) X±SD
Visual reaction time (ms)	228.90±20.64	230.12±17.86
Auditory reaction time (ms)	256.94±27.71	257.07±24.30
Accuracy time (ms)	547.53±56.75	570.60±61.41
Esports Players (n=30)	**Male (n=15) X±SD**	**Female (n=15) X±SD**
Visual reaction time (ms)	222.98±28.74	236.05±31.73
Auditory reaction time (ms)	244.20±45.98	252.46±19.60
Accuracy time (ms)	405.40±53.77	424.00±42.41

Table 3 shows the, mean audio-visual reaction times and accuracy values in milliseconds (ms) for the sports sciences students and the electronic sports players, classified by gender. It was found that female students of sports sciences had slower reaction times than male students. However, these values seem to be very close. Nevertheless, male students were able to reach the target much faster than female students in terms of accuracy. Looking at the electronic sports players by gender, it can be seen that men are faster than women on all three measures. Furthermore, when the two groups are compared by gender, it is noticeable that the electronic sports players are superior in almost all values. However, in the visual reaction time parameters, female sports sciences students were found to be faster than female electronic sports players.

Table 4. Comparison of Demographic Information, VRT, ART and Accuracy Time Values of by Gender

	Sports Sciences Students (n=30)			Esports Players (n=30)		
	Male(n=15) X±SD	Female(n=15) X±SD	p	Male(n=15) X±SD	Female(n=15) X±SD	p
Age (years)	22.13±1.59	21.26±1.43	.531	22.93±1.09	23.66±1.04	.072
Height (m)	1.77±0.07	1.66±0.05	.251	1.76±0.05	1.62±0.04	.000*
Weight (kg)	78.78±16.06	59.54±8.96	.000*	77.33±7.24	53.66±4.02	.000*
Sports Age (years)	11.40±2.74	7.46±4.59	.009*	6.60±2.16	5.13±1.45	.038*
Visual reaction time (ms)	228.90±20.64	230.12±17.86	.644	222.98±28.74	236.05±31.73	.247
Auditory reaction time (ms)	256.94±27.71	257.07±24.30	.479	244.20±45.98	252.46±19.60	.530
Accuracy time (ms)	547.53±56.75	570.70±61.41	.712	405.40±53.77	424.00±42.41	.302

*p<0.05

Table 4 shows the comparison of sports sciences students and electronic sports players by gender. Differences were found in the weight and sports age parameters of sports sciences students according to gender. Differences were found in the parameters of height, weight and sports age of electronic sports players according to gender. Accordingly, it seems that male sports sciences students have been doing sports longer and are more overweight than females. Likewise, with electronic sports players, men have been involved in esports longer and are taller and heavier than females.

Table 5. Comparison of VRT, ART and Accuracy Values of Sports Sciences Students and Electronic Sports Players by Gender

	Male Sports Sciences Students (n=15)	**Male Electronic Sports Players (n=15)**	
	X±SD	**X±SD**	**p**
Visual reaction time (ms)	228.90±20.64	222.98±28.74	.522
Auditory reaction time (ms)	256.94±27.71	244.20±45.98	.366
Accuracy time (ms)	547.53±56.75	405.40±53.77	**.000****
	Female Sports Sciences Students (n=15)	**Female Electronic Sports Players (n=15)**	
	X±SD	**X±SD**	**p**
Visual reaction time (ms)	230.12±17.86	236.05±31.73	.533
Auditory reaction time (ms)	257.07±24.30	252.46±19.60	.572
Accuracy time (ms)	570.70±61.41	424.00±42.41	**.000****

*p<0.05

In Table 5, male electronic sports players and sports sciences students; female electronic sports players and sports sciences students were compared. According to the data obtained, two significant differences were found in the accuracy time values of males and females ($p<0.05$). Also, no significant differences were found in visual and auditory reaction times ($p>0.05$). In addition, male esports players were found to be faster than sports sciences students in all data. Compared to females, only female sports sciences students reacted faster in visual reaction time than electronic sports players. Female esports players were found to be faster in auditory reaction time and accuracy time values.

DISCUSSION

This study aimed to compare the visual reaction time (VRT), auditory reaction time (ART) and accuracy values of electronic sports players and sports sciences students. In this direction, 30 sports sciences students (15 female, 15 male) with a sports background and 30 electronic sports players (15 female, 15 male) with first-person shooter (FPS) branch in esports voluntarily participated in the research. The mean sports age from sports sciences students participating in the study was 9.43±4.22 years, and 5.86±1.96 years for the esports players (Table 1). The main hypothesis of the research was based on the idea that the ART, VRT and accuracy parameters of the sports sciences students would be slower than those of the electronic sports players. Because of fact that ART, VRT and accuracy are considered important characteristics in sport, as most sports require speed and accuracy (Atan & Akyol, 2014; Noutsos et al., 2021).

Therefore, when we looked at the averages of the participants, the means visual reaction time of the sports sciences students appeared to be similar to the reaction time of the electronic sports players.

Although this finding doesn't support the hypothesis of the research, it does show us that sports sciences students have a visual reaction time that is as good as that of electronic sports players. In addition, the fact that sports sciences students have been practising sports for an average of 9.43 years suggests that their visual reaction skills are more developed. In previous studies, the VRT of electronic sports players was recorded at 269 ms (Luu et al, 2021), 227.13 (Ersin et al., 2022), 249.27 (Bickmann et al., 2021). Our study's visual reaction time (VRT) for esports players 229.52 ms confirm those in the literature. In this sense, the results of the sports sciences students VRT (229.51 ms) showed that they had VRT like an esports player. Bickmann et al. (2021), found that there was no difference in VRT and ART between professional players and individuals doing professional physical sports. It should also be known that sports sciences students have more sports experience than esports players ($p<0.05$) (Table 2). In addition, this may have caused sports sciences students to obtain ART and VRT values like esports players. Although ART and accuracy supported the hypothesis, a significant difference was found only in the accuracy parameter.

There difference between these two sample groups in terms of accuracy times. Sports sciences students hit the 30 targets in the test 144.36 milliseconds later than esports players (Table 2). This result shows that hitting a digital target with a mouse is quite difficult for the sports sciences students. This difference was 142.13 milliseconds for the male participants and 146.6 milliseconds for the female participants. The main reason for this difference in the accuracy parameter is thought to be due to the fact that the electronic sports players involved in the research are First Person Shooter (FPS) players. In this type of FPS game, the player's main goal is to defeat their opponent using the mouse by making accurate shots as quickly as possible (Koposov et al., 2020). This may be important even though the results of the sports sciences students are close to those of the esports players. Esport players are known to train to improve these characteristics.

Esports players were faster in auditory reaction time, with a difference of 8.68 ms. This advantage is especially significant in esports where milliseconds can make the difference between winning and losing. One of the possible explanations for this result could be that sports sciences students cannot develop these characteristics in their sporting lives like esports players.

Moreover in table 2, it was observed that the participants' auditory reaction times (ART) were slower than their visual reaction times (VRT). Kemp (1973), says that an auditory stimulus only takes 8-10 ms to reach the brain, while a visual stimulus takes 20-40 ms because the auditory stimuli reaches the cortex faster than the visual stimuli. Shelton and Kumar (2010), also concluded that simple RT is faster for auditory stimuli than for visual stimuli, and that auditory stimuli have the fastest conduction time to the motor cortex and fast processing time in the auditory cortex. According to the Ashoke et al. (2010), the auditory stimulus produces quicker reaction than both of visual and tactile stimuli. In addition, Jain et al. (2015), found the evidence that ART is faster than the VRT even in medical college students when confounding factors are removed. Therefore, ART is expected to be faster than VRT (Kemp, 1973; Ashoke et al., 2010; Shelton and Kumar 2011; Jain et al., 2015). On the contrary to the studies in the literature, Yagi et al. (1999), found that RT for visual stimuli was faster than for auditory stimuli. Ersin et al. (2022), when they examined esports players from various branches with

esports history of 12.32 years, they found the VRT faster than the ART. Pancar et al. (2016), found the ART of young people aged 11-18 years were than VRT faster. There are many examples on this subject in the literature (Yagi et al., 1999; Ersin et al., 2022; Pancar et al., 2016). Different results have been found in the literature on this subject. The results of our research support these studies.

When the demographic characteristics of the participants were examined by gender, differences were found in sports age, height and weight parameters ($p<0.05$). No significant differences were found in the visual and auditory reaction time and accuracy values of sports sciences students and esports players according to gender (Table 4). But when the data of sports sciences students is examined by gender; visual reaction time: 1.22 ms, auditory reaction time 0.13 ms, accuracy times 23.17 ms. When the data of the esports players were analyzed by gender, a difference of 13.07 ms in visual reaction time, 8.26 ms in auditory reaction time, and 18.6 ms in accuracy was observed (Table 4). In previous studies, differences were observed in the reaction times by gender. There are studies that say that men react better than women (Alpkaya & Mengutay, 2004; Lipps et al., 2011). The results of our study support the literature.

According to Table 5, a significant difference was found only in accuracy values ($p<0.05$). It is seen that electronic sports players hit targets much faster both for men and women (Table 5). There was no significant difference between ART and VRT. Surprisingly, sports sciences students performed similarly to electronic sports players in both ART and VRT, and even female students were faster in VRT. The fact that the sports sciences students achieved similar results to the electronic sports players in ART and VRT showed that the athletes reacted like an esports players. This could be attributed to the fact that sports sciences students are active athletes with nine years of sports experience. This study stated that sports sciences students reacted like an esports player in ART and VRT values. The difference in accuracy may be due to the fact that sports sciences students have not practiced accuracy with a mouse in their sports lives and backgrounds.

CONCLUSION

In conclusion, this study showed that electronic sports players were faster than sports sciences students in accuracy time parameter. However, it may be surprising that there was no difference in the VRT and ART averages of the participants. In fact, it is very important in terms of literature that the results of sports sciences students come close to those of esports players. Although female sports sciences students achieved 5.93 ms faster VRT than female esports players, female esports players were found to be faster in all other data. In addition, when the participating groups are examined according to their gender, both female and male sports sciences students get close results. In the results of electronic sports players, it was seen that males were faster in all parameters.

In future studies, the reaction times of men and women doing active sports can be examined because in our study, these results were quite close, contrary to the literature. There are many esports players under the age of 18 in our country. It may be interesting to examine esports players in adolescence

in future research. The evolve of reaction times of sports sciences students can improve their sports skills and lead them to success.

Conflicts of Interest: There is no personal or financial conflict of interest within the scope of the study.

Authors' Contribution: This study was produced from a part of M.Sc Thesis (No: 757410) conducted by the 1st author under the consultancy of the 2nd author.

Ethics Committee: Halic University Non-Invasive Clinical Research Ethics Committee

Date: 27.04.2022 / No: 80

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