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INVESTIGATION OF THE REACTION TIMES OF 13-14 YEARS OLD VIDEO GAME PLAYERS AND RACKET ATHLETES

Yakup Zühtü Birinci[1i],
Şenay Şahin[2],
Serkan Pancar[3],
[1]Hacı Sevim Yıldız Vocational and
Technical Anatolian High School, Bursa, Turkey
[2]Uludağ University Sport Sciences Faculty, Bursa, Turkey
[3]Yeniceabat Anatolian High School, Bursa, Turkey

Abstract:
The aim of the presented research was to examine the reaction times of 13-14-years old racket athletes (RAs) (badminton, table tennis, court tennis) and video game players (VGPs). A total of 96 subjects (68 male, 28 female) participated voluntarily in the research. The mean age of the participants was 13.38± 0.74 years, body weight was 50.60 ±1.5 kilograms (kg), stature was 157.42 ± 13.12 centimeters (cm). The individuals who met the criterion of spending at least 10 hours a week by training / playing video games for at least 5 years were called as RAs / VGPs. RT against auditory and visual stimuli were recorded by using a MP36 device (Biopac System, USA). Shapiro-Wilk test was used to evaluate whether continuous variables were normally distributed. Mann-Whitney U-test and Independent Samples "t" test were used for the comparisons of continuous variables between the groups. Pearson and Spearman rank correlation coefficients were used to evaluate the correlations between the continuous variables. Statistical significance level was accepted as $p<0.05$. SPSS v.21 program was used for statistical analyzes. A statistically significant difference was determined in terms of audio-visual right hand RT ($p<0.001$) and audio-visual left hand RT ($p<0.01$) when compared values of VGPs to those of sedentary. However, no statistically significant difference was detected in the audio-visual right-left hand RT values of the VGPs compared to the RAs ($p> 0.05$). In conclusion, it was determined that the audio-visual hand RT values were similar for the VGPs and RAs.

Key words: reaction time, video games, e-sport, racket sports

[i] Correspondence: email ykpbirinci@gmail.com, skoparan2013@gmail.com, sdpancar@gmail.com

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1. Introduction

Table tennis, tennis and badminton players in racket sports perform to catch the ball moving quickly and return it without error within a very short period of time. In this respect, racket sports are also called reaction sports (Dube, Mungal & Kulkarni, 2015; Sturgess & Newton, 2008). Therefore, the key to success in racket sports is to return the ball in the right place, at the right time of action, at the desired strength and to the target area in an error-free manner. However, due to the pace of the racket sports, the player's motor movement time is limited. This makes it difficult to accurately estimate the flight information of the ball. So athlete's success is related to quick start of the movement when the ball gets its first flight information (Bankosz, Naware & Ociepa, 2013; Şahin, Sağdilek & Çimen, 2015).

In order for the athlete to achieve a high level of performance, the ability to predict next-state of the ball position is also important. In this sense, table tennis (Alexander & Honish, 2009), court tennis (Shukala, Paul & Jaspal, 2011) and badminton (Arslanoğlu, C. Arslanoğlu, Aydoğmuş & Şenel, 2010) are the braches which are based on fast movements, which require a high perceptual skill and a fast RT(Lapszo, 2002; Miller & Low, 2001). RT is defined as the process that elapses between the accruing of a stimulus and initiation of the movement. It includes reception of the stimuli by the sense organ, transmitting the information through the nerve to the brain and from the brain to the muscle contraction, and the muscle motion (Dube, Mungal & Kulkarni, 2015). According to Sperdin, Cappe, Foxe & Murray (2009), the RT, is decisive element of successful sport performance. From the perceptual direction, especially for stimuli, it is of great importance that the RT is fast or slow in order to move before the opponent (Pancar at al. 2016, Bhabhor at al., 2013; Biesen, McCulloch, Janssens & Vanlandewijck, 2017; Deepa & Sirdesai, 2016).

Video games have been a popular research topic in science in recent years (Latham, Patston & Tippett, 2013; Mack, Wiesmann & Ilg, 2016). Scientific studies have shown that video games have not only negative effects, but they also develop many useful features such as superior contrast sensitivity (Li, Polat, Makous, & Bavelier, 2009), enhanced control over selective attention (Green & Bavelier, 2003), improved multitasking (Chiappe, Conger, Liao, Caldwell, & Vu, 2013), visual working memory capacity (Blacker & Curby, 2013), faster information integration (Green, Pouget, & Bavelier, 2010) and improved reading abilities in dyslexic children (Franceschini et al., 2013). Positive changes in cognitive and motoric characteristics (Orosy-Fildes & Allan, 1989) such as improved hand-eye coordination (Griffith, Voloschin, Gibb & Bailey, 1983), increase in environmental processing (Green & Baveiler, 2006a), development in mental rotation skills (Sims & Mayer, 2000), improvement in distraction ability (Greenfield, DeWinstanley, Kilpatrick & Kaye, 1994) and faster RT (Appelbaum, Cain, Darling & Mitroff, 2013; Castel, Pratt & Drummond, 2005) have been observed in VGPs as well as in RAs. Success in videos games depends on the choice of the right time and action for the duration of the answers given by the players to the lots of visual and auditory stimuli that appear instantly on the screen. It was thought that this helps to video game players to increase the skill of hand-eye coordination. In this regard, we thought that video games are similar to racket sports in terms of RT. In our literature review; the effects of racket sports and video games on RT were examined separately, but the comparison of these two headings was not reached. The aim of the presented research was to examine the RT of 13-14 year old RAs (badminton, table tennis, court tennis) and VGPs.

2. Materials and methods

2.1. Subjects

Sample of the presented research were composed of the athletes, 13-14 ages, which play infrastructure of Bursagücü Youth and Sports Club and that of Bursa Yıldırım Gymnastics Club. A total of 96 subjects (68 male, 28 female) participated voluntarily in the research. Sample was made up of three groups; first group, 55 of participants (36 male, 19 female) have participated in a competition in table tennis, badminton and court tennis. Second, one is that 17 of participants have played video games and taken part in full-day summer camp in Bursa May 19 Youth and Sports Club. Third, one is that 24 sedentary (15 male, 9 female) have never done sport or played video game. All participants signed an informed and voluntary form before the study. All subjects' body weight, height measurement and age determination were done before studying (Bilgiç, at al. 2016, Pancar, at al. 2017). The mean age of the participants was 13.38± 0.74 years, body weight was 50, 60±1.5kilograms (kg), stature was 157.42±13.12 centimeters (cm). The individuals who met the criterion of spending at least 10 hours a week by training / playing video games for at least 5 years were called as RAs / VGPs. But VGPs have never participated in a competition. The approval decision of Uludağ University Clinical Researches Ethics Committee dated 17.06.2015 and numbered B.30.2.ULU.0.20.70.02-050.99 / 389 were taken.

2.2. Procedures

2.2.1. Reaction Time Measurement

RT against auditory and visual stimuli were recorded by using a MP36 device (Biopac System, USA). The subjects were provided with a comfortable, isolated environment from the stimuli as possible in a quiet environment. The test protocol to be applied to the participant was clearly expressed. The earpiece was placed conveniently allowing the participant to hear the computer-sent signal but individual could not see the computer screen. The test button was introduced with a few repetitions to the participants. The test started when the stimulus which was transmitted to the headset by the computer to the participant. When the participant heard the incoming stimuli, individual respond to stimuli by pressing button with right/left hand. After the participant was ready, a trial application was made. The calibration of the test vehicle was tested and made ready for application. The participant was asked to respond by pressing in the shortest time to the 10 auditory stimuli that were sent by the computer at different time intervals. The same procedure was applied to the other hand of the participants. After that, in the position that the participant can see easily, the led apparatus is added which can reflect visual stimuli to the sent automatically by the computer. This time, the participant was asked to respond by pressing in the shortest time to the 10 visual stimuli that were sent by the computer at different time intervals. The same procedure was applied to the other hand of the participants. All replies that the participants gave by pressing the button or not, were automatically registered by the computer in milliseconds. The arithmetic mean of the obtained data was determined (Şahin et al., 2015).

2.3. Statistical Analysis

For descriptive statistics, mean ±standard deviation was used in the analysis of continuous variables with normal distribution, and median (Minimum-Maximum) values were used in the analysis of continuous variables with non-normal distribution. Mann-Whitney U-test and independent samples "t" test were used for the comparisons of continuous variables between the groups. Pearson and Spearman rank correlation coefficients were used to evaluate the correlations between the continuous variables. Statistical significant level was accepted as $p<0.05$. SPSS v.21 program was used for statistical analyzes.

3. Results

Table 1: Distribution of age, weight and height attribute values of participants

	Table Tennis athletes n=18	Court tennis athletes n= 18	Badminton athletes n=19	RAs n=55	VGPs n=17	Sedentary n=24	Total n=96
Age	13.44 ±0.78	12.88 ±0.47	13.15 ±0.50	13.16 ±0.63	13.05 ±0.82	14.12 ± 0.33	13.38 ±0,74
Weight (kg)	47.76 ±16.45	40.55 ±12.04	46.86 ±7.26	45.09 ±12.60	48.31 ±9.09	64.77 ±14.49	50.60 ±1.5
Height (cm)	156.55 ±17.75	149 ±8.66	155.15 ±7.44	153.6 ±12.33	152.41 ±10.77	169.75 ±7.82	157.42 ±13.12

A total of 96 subjects (68 male, 28 female) participated voluntarily in the research. They included 17 male VGPs, 55 RAs (12 male, 6 female table tennis players, 10 male, 8 female court tennis players and 14 male, 5 female badminton players) and 24 subjects (15 male and 9 female) who neither played sports nor video games (sedentary). The mean age of the participants was 13.38± 0.74 years, body weight was 50.60 ±1.5 kilograms (kg), stature was 157.42 ± 13.12 centimeters (cm).

Table 2: Comparison of Auditory and Visual Reaction Times of Video Game Players and Racket Athletes

	VGPs n=17	RAs n=55	p
Auditory RH (ms)	229.68±22.22	234.20 ±24.35	0.497
Visual RH (ms)	231.94±23.12	240.51 ±23.21	0.197
Auditory LH (ms)	234.42±22.02	240.65 ±23.44	0.335
Visual LH (ms)	235.13±21.64	245.01 ±22.98	0.055

RH: Right hand LH: Left hand

Comparisons were made between right-left-handed auditory and visual RT between VGPs and RAs; no statistically significant difference was detected in the auditory-visual right-left hand RT as compared values of the VGPs to those of the RAs ($p > 0.05$).

Table 3: Comparison of Auditory and Visual Reaction Times of Video Game Players and Sedentary

	VGPs n=17	Sedentary n=24	p
Auditory RH (ms)	229.68±22.22	254.38 ±21.94	**<0.001**
Visual RH (ms)	231.94±23.12	259.10 ±20.94	**<0.001**
Auditory LH (ms)	234.42±22.02	257.41 ±24.36	**0.004**
Visual LH (ms)	235.13±21.64	258.79 ±22.80	**0.002**

RH: Right hand LH: Left hand

Comparisons were made between right-left-handed auditory and visual RT between VGPs and sedentary; a statistically significant difference was determined in terms of audio-visual right hand RT ($p < 0.001$) and audio-visual left hand RT ($p < 0.01$) when compared values of the VGPs to those of the sedentary.

Table 4: Comparison of Auditory and Visual Reaction Times of Video Game Players and Table Tennis Athletes

	VGPs n=17	Table tennis athletes n=18	p
Auditory RH (ms)	229.68±22.22	230.62 ±29.47	0.917
Visual RH (ms)	231.94±23.12	231.80 ±22.80	0.987
Auditory LH (ms)	234.42 ±22.02	237.32 ±19.43	0.682
Visual LH (ms)	235.13±21.64	239.34 ±14.15	0.498

RH: Right hand LH: Left hand

Comparisons were made between right-left-handed auditory and visual RT between VGPs and table tennis athletes; no statistically significant difference was detected in the auditory-visual right-left hand RT as compared values of the VGPs to those of the table tennis athletes ($p > 0.05$).

Table 5: Comparison of Auditory and Visual Reaction Times of Video Game Players and Badminton Athletes

	VGPs n=17	Badminton athletes n=19	p
Auditory RH (ms)	229.68±22.22	226.61 ±20.32	0.668
Visual RH (ms)	231.94±23.12	243.46 ±28.43	0.194
Auditory LH (ms)	234.42 ±22.02	240.68 ±31.61	0.500
Visual LH (ms)	235.13±21.64	246.88 ± 22.98	0.129

RH: Right hand LH: Left hand

Comparisons were made between right-left-handed auditory and visual RT between VGPs and badminton athletes; no statistically significant difference was detected in the auditory-visual right-left hand RT as compared values of the VGPs to those of the badminton athletes (p> 0.05).

Table 6: Comparison of Auditory and Visual Reaction Times of Video Game Players and Court Tennis Athletes

	VGPs n=17	Court Tennis Athletes n=18	p
Auditory RH (ms)	229.68±22.22	245.80 ±18.91	**0.027**
Visual RH (ms)	231.94±23.12	246.10 ±14.56	**0.036**
Auditory LH (ms)	234.42 ±22.02	243.96 ±16.93	0.159
Visual LH (ms)	235.13±21.64	246.53 ±11.66	0.066

RH: Right hand LH: Left hand

Comparisons were made between right-left-handed auditory and visual RT between VGPs and court tennis athletes; a statistically significant difference was determined in terms of auditory-visual right hand RT (p <0.05) compared values of the VGPs to those of the court tennis athletes. But, no statistically significant difference was detected in the auditory-visual left hand RT when compared values of the VGPs to those of the court tennis athletes (p> 0.05).

4. Discussion

Speed ability for sport success in racket sports is indispensable. Rapid movement is proportional to the RT to be shown. Strong hunches, concentration, ability to detect and distinguish stimuli are essential conditions for fast RT. When considered in this respect, success in video games also depends largely on the speed between stimulus perception and the choice of the correct action that individuals are exposed to. In the present study, it is foreseen that similar RT values will be observed in the athletes of these branches having similar requirements in terms of RT. The similarity of the right-left hand auditory and visual RT values of the RAs and VGPs proves our hypothesis. The presented research was to examine the reaction times of 13-14-years old RAs (badminton, table tennis, court tennis) and VGPs.

4.1 RT between VGPs and Sedentary

In our literature review, a comparative study of sedentary in terms of RT with VGPs has not been reached. But there are a lot of studies separately on the RT of sedentary and VGPs. As a matter of fact, Steenbergen, Sellaro, Stock, Beste and Colzato (2015) who compared the reaction times of VGPs and non-video game players (NVGPs), have shown that visual and auditory reaction times are especially faster for players who play first person shooter and they can flexibly adapt to ever-changing situations. Lee and Peng (2006) and Chiang, Tsai and Chen (2012) have found that VGPs showed faster RZ than NVGPs. Hubert-Wallander, Green, Sugarman ve Bavelier (2011) have thought that VGPs have faster RZ because they get better stimulus-response maps than NVGPs. When the literature is examined, it is observed that the sedentary have a slower RZ than the athletes. As a matter of fact, Atan and Akyol (2014), who compared the reaction times of athletes and sedentary in different branches, have found that the reaction times of the athletes were faster. In the present study; in comparison of VGPs and sedentary according to auditory and visual RT; visual-auditory right-left hand reaction times were found to be statistically significantly faster for VGPs than sedentary. We are thinking that RT values have improved because VGPs have to react quickly and accurately to visual and auditory stimuli in order to achieve success. In addition, it is known that doing sports influences speed and decision making mechanism, and regular training improves RT values. In our study, it was thought that the RT values are slowed down because the sedentary have never experienced any of these situations.

4.2 RT between VGPs and RAs (Badminton, Table Tennis, Court Tennis)

Coordinative skills are preliminary to competing and defying against competitions in racket sports including table tennis, tennis and badminton games. The RT from these coordinative properties is crucial to react quickly for sudden situations with unknown predictions. In this sense, racket sports are based on fast movements, which require high perceptual skills and fast reaction times (Lapszo, 2002; Miller & Low, 2001).The chances of success of athletes who make quick decisions and implement the right way by pre-sensing stimuli such as the position of an opponent and a ball in racket sports are higher. Badminton is at the forefront of sports branches in which balls are played fast. The investigations have shown that the badminton players have an average time of 0.13-0.30 seconds to block the opponent's movement while in the defensive position. Especially when the ball speed is considered, the badminton depends on the quick reactions in order for player to hold in the game. In studies comparing the reaction times of badminton athletes and sedentary (Bańkosz et al., 2013; Dube et al., 2015), it has been found that the reaction times of badminton athletes are considerably faster. Similarly, Phomsoupha and Laffaye (2014) compared the performance of sedentary with professional badminton athletes; they found that badminton athletes perceived visual stimuli faster and reacted more quickly. In the present study, no statistically significant difference was detected in the auditory-visual right-left hand RT when compared values of the VGPs to those of the badminton athletes. Both sports branches improve neuromuscular coordination, cognitive functions, alertness and RT. Therefore, it is considered that similar results are detected in terms of RT between two groups. The rapidity of the reaction times of the athletes in the table tennis branch is the most basic requirement of the game. According to Alexander and Honish (2009); especially in table tennis, when the ball passes very fast between the opponent players at a very short distance, it causes the player to have little time to react and perform the shot. In this case, athletes have to react quickly at every moment of the game. This causes table tennis to improve hand-eye coordination and RT. Thus, Deepa and Sirdesai (2016), Bhabhor et al., (2013) who compared table tennis athletes and sedentary, have found that the average auditory and visual RT of table tennis players were faster than those of sedentary. In the present study, no statistically significant difference was detected in the auditory-visual right-left hand RT compared values of the VGPs to those of the table tennis athletes. Table tennis and video games improve cognitive processes, RT and hand-eye coordination. Therefore, it was considered that similar results were detected in terms of RT between two groups.

Another racket sport on the court tennis ball can reach about 192 km/h. Therefore, tennis, premonition and RT skill is very important to get a quick position. The athlete who receives the visual stimulus by watching the foot movements and the hand angle during the stroke of the opponent has to process this information quickly and accurately. The studies have revealed that elite level tennis athletes were separated from other tennis players by faster RZ and good intuition. As a matter of fact, Shim, Carlton, Chow and Chae (2005) examined the cases in which 13 professional and 12 amateur tennis athletes could turn their visual cues into motor respond. They have found that the RZ shown from the opponent’s ball was faster than the one sent from the machine. These results have shown that professional tennis athletes perceive their opponent's movement model knowledge and decide to shoot. At the same time, this information reduces the lag time of the athlete's reaction. Marmeleira, Melo, Tlemcani and Fernandes (2013), who examined the effect of tennis training on RT, found that simple and choice RT of tennis players were significantly faster than control group. In court tennis, rapid reaction, acceleration, and change of body movements are very important. A good tennis athlete can capture visual stimuli more deeply and translate this information into action after quick hand-eye coordination. Similarly, VGPs must respond quickly to instantaneous, constant visual stimuli. It was expected that individuals in these two groups would have similar RZ values. However, in the presented study, it was determined that the audio-visual right hand RT of the court tennis players were slower than VGPs. The fact that the majority of the individuals in the court tennis group who consisted of female participants and the participants who meet the conditions at threshold seems to be the reason for the determination of this difference. One of the main limitations from the present study was that we regard as VGPs though they have never competed in video games.

5. Future Directions

While RT studies have previously been included in speed training, nowadays it is a special type of training. Based on the data obtained at the end of the study;

- Video game applications can be included in the content of RT training.
- By creating specific software for sports branches, specific video game training applications can be created.
- By presenting visual, auditory and sensory stimuli to the athletes, it is possible to create the virtual reality in their own branch and prepare the athlete to live that moment and compete in the near term.
- In sports branches that stand out from the RT perspective, it is possible for the athletes to benefit from the video games without any loss of the negative effect that will occur in the RT for special situations that cannot be trained due to any injuries.
- We think that by playing video games, for every age athlete intensively trained it is possible to remove the uniformity of the training from the center and create more amusing environments.
- Future work in this area can be evaluated in both simple and selective RT effects on elite level athletes and different sports branches.
- Application-oriented studies combining video games and classical training can be done in cooperation with experts in different disciplines to examine the effect of RT on the athletes.

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