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REACTION CAPACITY, ACCELERATION AND VELOCITY IN A SPECIFIC DISPLACEMENT AFTER VISUAL STIMULUS IN YOUNG TABLE TENNIS PLAYERS

Abstract

Introduction. *Table tennis is a sport in which the players must to react quickly to a great number of visual stimulus in each rally of the match. Also, displacements and specific skills must be repetitively performed in tenths of seconds. For this reason it is important to develop the reaction capacity and the velocity since the initial stages in table tennis training. Thus, the aims of this study were: a) to quantify the reaction capacity in young table tennis players; b) to determine acceleration and velocity developed in a specific displacement, and c) to compare these values with those from age-matched sedentary group.* ***Method.*** *Twenty-five young table tennis players (14 boys and 11 girls; age between 9 and 11 years) and twenty-five age-matched sedentary children (15 boys and 10 girls) took part in this study. Subjects from the two groups carried out the Take-Off Reaction Test (Newtest®) and were tested in random order. From table tennis base position (on contact mat) subjects reacted to the red light (left or right) that electronic device emitted in random order. Next, subjects leaved the contact mat and performed a lateral run until left or right photocells (placed 5 m from the mat). Subjects completed 12 attempts (6 to the left and 6 to the right) and the best result was registered.* ***Results.*** *Table tennis players showed a better reaction capacity than the sedentary children. Also, acceleration and velocity developed in 5 m in table tennis players were significantly higher than the values found in sedentary group. No significant differences were found in reaction capacity, acceleration and velocity taken into account the left or the right side of displacements.* ***Conclusions****. The Take-Off Reaction Test is a simple but valid tool to test reaction capacity to visual stimulus in table tennis players. However, the test needs of certain adaptation (to reduce the lateral run distance) for to obtain higher levels of specifity. Table tennis practice generates neuromuscular adaptations of which effects have been demonstrated in this study.*

Key words: *table tennis, reaction capacity, velocity, acceleration*

Introduction.

Visual information is the dominant channel in sport performance optimization process (Magill, 1993). Visual system plays a double role in “open” sports: semantic and sensorimotor. Semantic function permits to identify and to interpret a determined sport situation. Thanks to this function players can to consider visual pre-indexes from opponents that are used for predict their motor behaviours and the type of shot that they will perform. By other side, sensorimotor function facilitates the coordination between visual and motor systems that are implicated in shot actions (Ripoll, 1991).

Reaction and movement times (RT and MT, respectively) are part of sensorimotor function and have been studied using a wide variety of tasks and sport skills. Indeed, it have been established that physical exercise generates a positive effect on RT and MT (McMorris & Graydon, 2000; Tomporowski, 2003). Thus, it is easy to think that regular exercise or sport training can to provoke RT and MT improvements. Anthony (2003) determined the effects of a plyometric strength training program on the starting (MT) and RT of college swimmers. The results of this study showed that RT of the strength-trained swimmers was significantly decreased; however starting time (MT) was not

affected. Thomas & Harden (2005), compared RT values between cricketers and sedentary subjects. Taken into account the importance of the visual processing in cricket actions and the experience of cricket players, the authors found no significant differences in RT to a visual stimulus.

In table tennis, a sport in which the players must to react quickly to a great number of visual stimulus in each rally of the match, both semantic and sensorimotor functions must be well developed. However there is a lack of information about the effect of table tennis practice on RT and MT, particularly in young players. For this reason the aims of this study were: a) to quantify the reaction capacity in young table tennis players; b) to determine acceleration and velocity developed in a specific displacement, and c) to compare these values with those from age-matched sedentary group.

Methods.

Subjects.

Twenty-five young table tennis players (14 boys and 11 girls; mean ages ± SEM: 10.0 ± 0.2 and 9.6±0.2 years, respectively) and twenty-five age-matched sedentary children (15 boys and 10 girls; mean ages ± SEM: 10.1 ± 0.2 and 9.8 ± 0.3 years, respectively) took part in this study after inform consent was signed by the parents. Table tennis players were participating in National Sport Technification Program developed by the Spanish Table Tennis Federation while sedentary subjects were students in the last year of primary education. In any case, all of them were right handed.

Testing procedure.

Subjects from the two groups carried out the Take-Off Reaction Test (Newtest® - Finland) and were tested in random order. From table tennis base position (on contact mat) subjects reacted to the red light (left or right) that electronic device emitted in random order. Next, subjects leaved the contact mat and performed a lateral run (maximal sprint performance) until left or right photocells (placed 5 m from the mat). Subjects completed 12 attempts (6 to the left and 6 to the right) and the best result was registered (Figure 1). All attempts were carried out consecutively. At the end of each attempt subjects returned to the map starting the next one when table tennis base position was adopted.

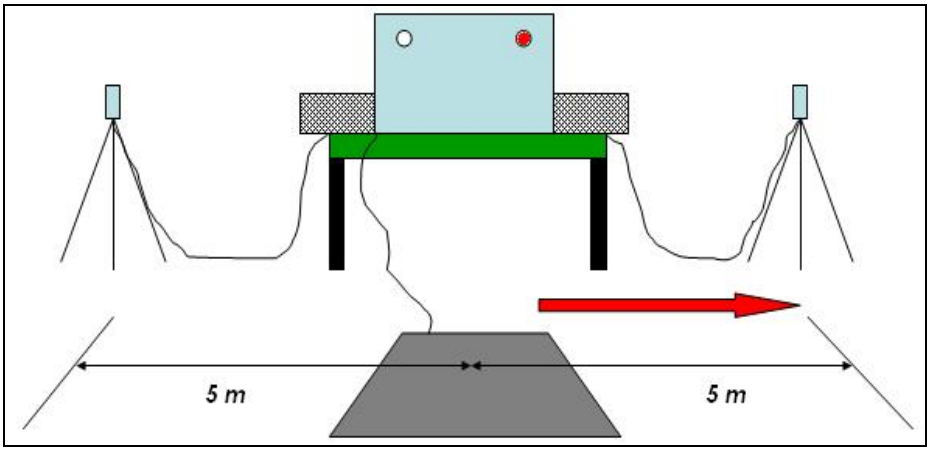


Figure 1. *Take-Off Reaction Test device emplacement.*

Parameters measured were: a) reaction capacity time (RCT): elapsed time between lights on (right or left) and the moment in which the subjects took – off from the mat (ms); b) movement time (MT): elapsed time between the take – off from the mat and the moment in which the subjects broke the photocells barrier (lateral displacement over

5 m) (ms); c) total time (TT): elapsed time between lights on (right or left) and the moment in which the subjects broke the photocells barrier (ms); d) mean velocity (V) in 5 m lateral displacement ($m \cdot s^{-1}$), and e) mean acceleration (A) in 5 m lateral displacement ($m \cdot s^{-2}$). It s important to indicate that we consider anticipation when the players reach a reaction capacity of <150 ms. Also, and for to prevent the incidence of upper limbs on automatic timing photocells were situated at the height of subjects' hips.

Statistical analysis.

A statistical analysis was carried out using SPSS v.12.0 for Windows. Statistical comparisons between groups (players and sedentary people; males and females) and between sides of the displacement (left and right) were made by using a multivariate analysis of variance (MANOVA) and t-test for paired samples (after Kolmogorov–Smirnov test). All data are expressed as mean ± SEM. A *p* value of less than 0.05 was considered statistically significant.

Results.

Taking into account only gender factor, we observed significant differences between males and females in RCT (left) and TT (right) parameters. In both cases, the values reached by females were higher than those reached by males (Table 1).

Table 1. *Temporal parameters by gender.*

	RCT (ms)		MT (ms)		TT (ms)	
	Left	**Right**	**Left**	**Right**	**Left**	**Right**
Males	650.09 ± *127.85*	723.16 ± 148.99	1521.94 ± 198.33	442.31 ± 241.60	2172.03 ± 213.48	2165.47 ± *201.67*
Females	*768.30*** ± 123.74	778.10 ± 136.67	1445.05 ± 180.17	442.31 ± 241.60	2213.35 ± 150.54	*2318.90*** ± 195.44

Values are expressed as mean ± SEM. **p<0.01 compared with females' values.

Attending to the group criteria, there were significant differences between table tennis players and sedentary group in TT (right), V (left and right), and A (left and right). In all cases, values found in table tennis players were higher than those observed in sedentary group. Also, the results showed a sign of statistical signification (p=0.07) in MT (right), although the higher values were found in sedentary group (Table 2).

Table 2. *Temporal parameters by group.*

		Players	Sedentary group	Total
RCT (ms)	**Left**	697.15±132.29	693.96±145.87	*695.96±137.88*$^{++}$
	Right	726.54±134.32	762.04±156.55	744.29±145.53
MT (ms)	**Left**	1452.27±193.64	1532.46±188.45	1492.37±193.46
	Right	1423.96±218.51	1536.42±252.94	1480.19±240.81
TT (ms)	**Left**	2130.67±219.87	2208.53±207.31	2172.03±213.48
	Right	2150.50±186.19	2298.46±212.13	2224.48±211.26
V ($m \cdot s^{-1}$)	**Left**	*3.54±0.45**	3.29±0.39	3.42±0.44
	Right	*3.67±0.64***	3.32±0.55	3.50±0.61
A ($m \cdot s^{-2}$)	**Left**	*2.54±0.63****	2.20±0.51	2.37±0.59
	Right	*2.67±0.99****	2.27±0.75	2.52±0.91

Values are expressed as mean ± SEM. *p<0.05, **p<0.01, and ***p<0.001 compared with sedentary group, respectively; $^{++}$p<0.01 compared with right side.

Significant differences between left and right side of displacement in TR were observed for total group (Table 2). However, there were no statistical differences when gender and group factors were combined or mixed (Figures 2 – 7; Table 3).

Table 3. *Mean velocity and acceleration values.*

		Velocity ($m \cdot s^{-1}$)		Acceleration ($m \cdot s^{-2}$)	
		Left	**Right**	**Left**	**Right**
Males	**Players**	3.44±0.46	3.79±0.70	2.40±0.62	2.97±1.14
	Sedentary group	3.23±0.38	3.41±0.58	2.12±0.48	2.39±0.82
	Total	3.33±0.42	3.59±0.66	2.25±0.56	2.66±1.01
Females	**Players**	3.67±0.43	3.50±0.52	2.73±0.61	2.49±0.72
	Sedentary group	3.41±0.41	3.15±0.46	2.12±0.48	2.03±0.58
	Total	3.59±0.66	3.34±0.51	2.56±0.60	2.29±0.69

Values are expressed as mean ± SEM

Figure 2. *RCT to the left side.*

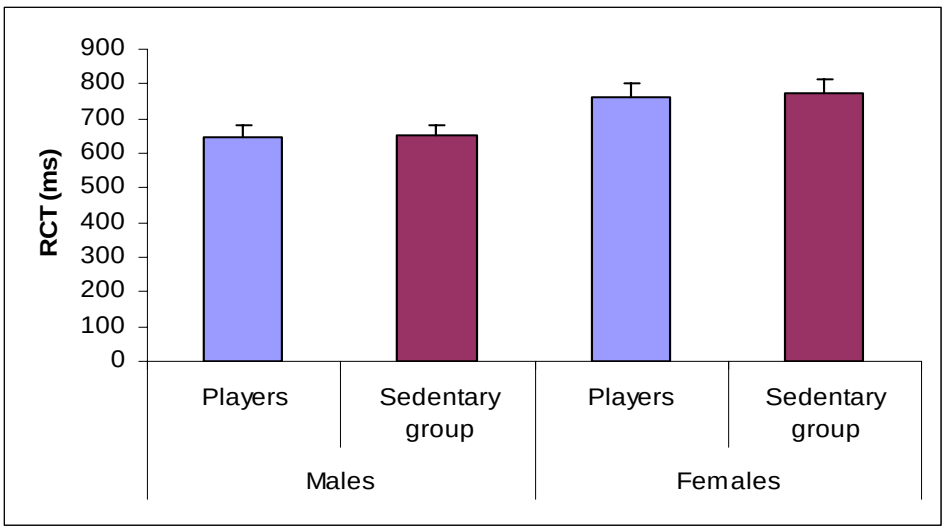


Figure 3. *RCT to the right side.*

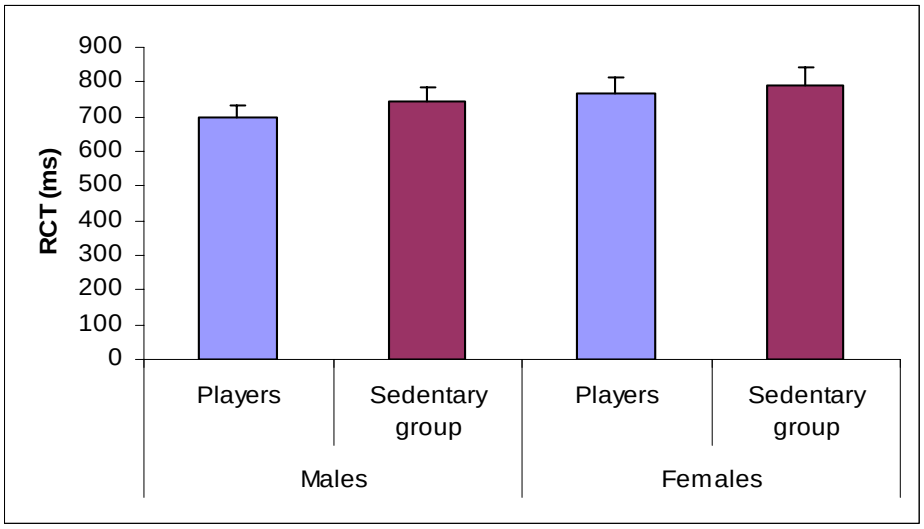


Figure 4. *MT to the left side.*

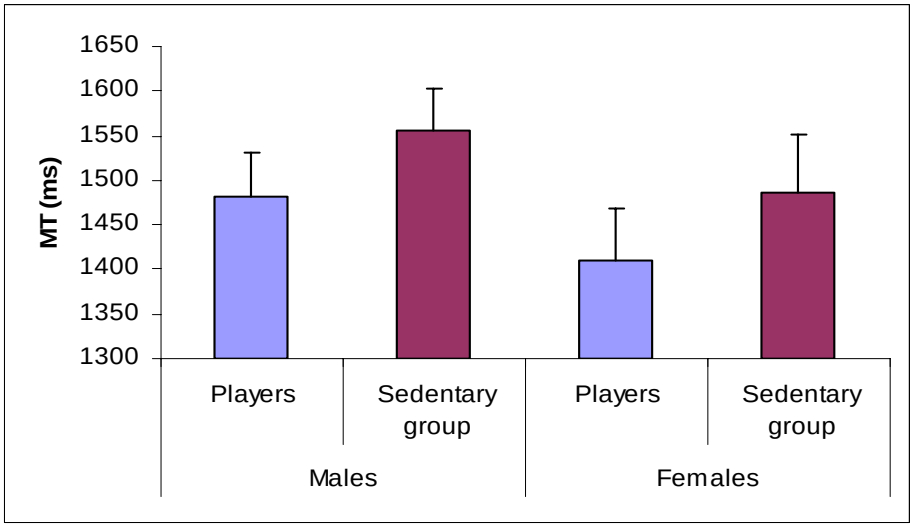


Figure 5. *MT to the right side.*

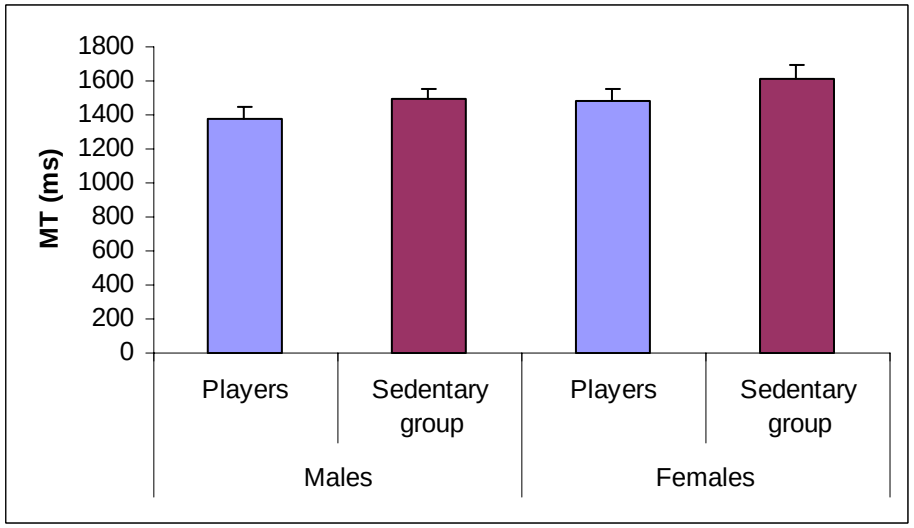


Figure 6. *TT to the left side.*

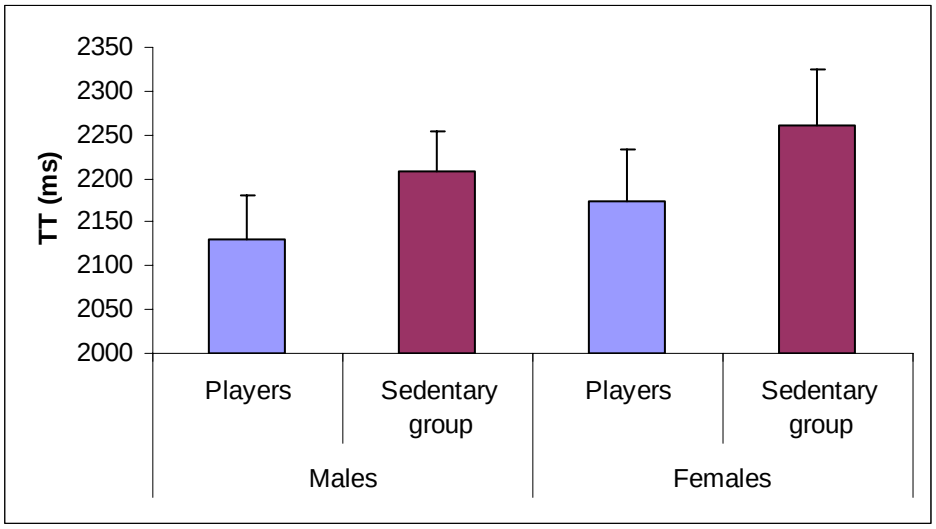
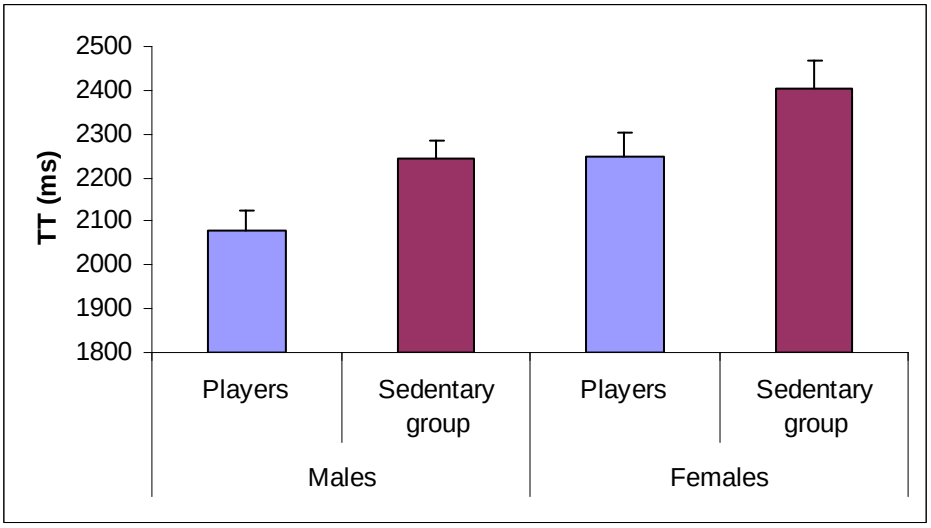


Figure 7. *TT to the right side.*



Discussion.

In many sports, the capacity to react to visual stimulus is a key factor to obtain a successful performance, acquiring a vital importance in those sports in which players must to shot or to receipt a ball that has been throwed previously by an opposite player. In racket sports, and specially in table tennis, is very important the reaction capacity to the opposite actions. Indeed, several authors have proposed the assessment of perceptual skills like a fundamental evaluation to identify young sport talents (Williams et al., 1999). Parameters such us reaction time and movement time must to be taking into account in table tennis training and testing in young players.

Reaction time is the elapsed time between the receiving of stimuli and the subsequent reaction. Reaction time can be classified in simple reaction time and complex reaction time. Simple reaction time is the time it takes to react to stimuli. The average human's reaction time falls somewhere between 200 and 270 ms, although athletes and others who train themselves can achieve reaction times approaching 150 ms. Complex reaction time is the latency between a variable stimulus and a respectively variable response. In this investigation we have tested the use of Take-Off Reaction Test (Newtest®) for to evaluate the reaction capacity and the specific displacement efficacy in a group of young table tennis players. It is important to note that reaction capacity time measured in this study is not equal to reaction time assessed in many of the investigations reviewed. In

these studies reaction time is the elapsed time between the receiving of stimuli and the muscle activation (or beginning of the electromyographical –EMG– signal). When we defined reaction capacity time we included a part of movement time considered by others authors (elapsed time between the beginning of the EMG signal and the end of the movement). Therefore movement time (MT) registered here (elapsed time between the take – off from the mat and the moment in which the subjects broke the photocells barrier) is a part of the real movement time and it is related to the time invested to cover 5 m lateral run. In any case, subjects were tested under the concept of "complex reaction time" because they reacted to the lights on (right or left lamp) and ran over the corresponding side.

In general, the results show no differences between players group and sedentary group in many of the parameters evaluated, although velocity and acceleration values (in both sides) were higher in table tennis players reaching statistical significance. Lateral running over short distances is the most frequent displacement in table tennis and its specific training in players would to generate this differences. This is, in part, in accordance with previous studies (McMorris & Graydon, 2000; Tomporowski, 2003) in which it have been established that physical exercise generates a positive effect on reaction time and movement time. Curiously, reaction capacity times were similar in players and sedentary group, results that are in accordance with those obtained by Thomas et al. (2005) who reported similar reaction times in cricketers and sedentary people. Attending to the gender factor, we observed a quicker response to the visual stimulus in males so reaction capacity times (to the left side) were significantly higher in females. Also, total time values (reaction capacity time plus movement time) to the right side were significantly higher in females than in males. In this sense, it is important to note that the Newtest® device only report the best result in a set of twelve attempts (six to each side) and for this reason we can't to discriminate differences in movement time. Significant differences between left and right side of displacement in reaction capacity time were observed for total group obtaining lower values to the left side. All of participants in this study were right-handed and it is possible that they were likely to have crossed dominance (dominant eye contralateral to dominant hand) (Thomas et al. 2005). An analysis of ocular dominance is necessary to confirm this. Lastly, there were no statistical differences when gender and group factors were combined or mixed.

As a conclusion, we can to confirm that the Take-Off Reaction Test (Newtest®) is a simple but valid tool to test reaction capacity to visual stimulus in table tennis players. However, the test needs of certain adaptations (to reduce the lateral run distance and the use of an EMG device) for to obtain higher levels of specifity and precision. Table tennis practice generates neuromuscular adaptations of which effects have been demonstrated in this study.

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