

## MENTAL CHRONOMETRY IN TABLE TENNIS PLAYERS AND FOOTBALL PLAYERS: WHO HAVE FASTER REACTION TIME?

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**Abstract: Background & objectives:** Mental chronometry uses response time in perceptual-motor tasks to understand cognitive operations. The time duration from application of a stimulus to onset of a response is known as Reaction Time. Studies have shown that table tennis (TT) players & football players have faster reaction times than those who do not play TT or football. Therefore, this study was undertaken to compare Auditory Reaction Time (ART) in young TT players and football players. **Methods:** Total 90 participants (30 TT players, 30 football players and 30 controls) volunteered for this study. ART was measured in all the participants by reaction time instrument available in the department of Physiology. Data analysis was carried out using MS Excel 2007 and SPSS version 21 applying appropriate statistical tests. **Results:** Our study showed that TT players had faster ART than healthy controls. Also, football players had faster ART than healthy controls. But TT players had faster ART than football players.

**Interpretation & conclusion:** Persons involved in physical sports such as TT & football have good reaction times. Thus, playing of TT & football is beneficial to eye-hand reaction time & co-ordination. TT players have better reaction times than football players.

**Key Words:** Athletes, Football, Reaction time, Sports, Table tennis.

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### Introduction:

Mental chronometry comprises of determination of cognitive speed i.e. actual time taken by an individual to process sensory information of different varieties and degrees of complexity. The basic measurement in mental chronometry is an individual's response time to a visual or auditory stimulus. By studying response time during a perceptual-motor task, mental chronometry attempts to deduce the duration, content and temporal sequencing of cognitive processes. Mental chronometry is one of the central paradigms of many disciplines including cognitive neuroscience, cognitive psychophysiology, and behavioural neuroscience.<sup>1</sup>

Reaction time is the time elapsed from presentation of a sensory stimulus to the onset of response. The time required to respond to an auditory stimulus is the Auditory Reaction Time (ART) and the time required to respond to a visual stimulus is the Visual Reaction Time (VRT). Reaction time is a reliable indicator of speed of processing of sensory stimulus by nervous system and its execution as motor response.<sup>2</sup>

There are three basic types of reaction time experiments: (1) Simple reaction time: only one stimulus and one response, (2) Recognition reaction time: some stimuli should be responded to ('memory set') and some should not be responded to ('distracter set') (3) Choice reaction time: the user gives a response that corresponds to the stimulus e.g. pressing a key in response to a letter appearing on the screen.<sup>3,4</sup>

Reaction time can be split into three components: (a) Perception time: time taken for the application and perception of the stimulus, (b) Decision time: time for deciding an appropriate response to the stimulus, (c) Motor time: time for execution of motor command received in response to stimulus.<sup>5,6</sup>

Reaction sports include table tennis, tennis, badminton, squash, football etc.<sup>7</sup> In most of these sports, the players need to rapidly analyze the play and react decisively. But in table tennis specifically, the ball travels at an incredible speed and there is a short distance between the opponents which permits a very nominal amount of time to react to

the ball and execute shots. Table Tennis player has to quickly strike the ball in proper direction.<sup>2</sup>

Reaction time is crucial in football because play develops rapidly, requires massive athletes racing all around the field and lasts only for a short duration of time. No matter the position on the team, the faster a football player can respond to any set of circumstances, the better are his chances of succeeding in the play. Montés-Micó R et al evaluated eye-hand and eye-foot visual reaction times and found that soccer players demonstrated faster reaction times.<sup>8</sup> Studies have also reported faster reaction times in other sportspersons like badminton players<sup>9</sup>, basketball players<sup>10</sup>, and volleyball players<sup>11</sup>, and kho-kho players.<sup>12</sup>

Thus we formulated a hypothesis that there is significant difference in auditory reaction times in non-athletes, table tennis players and football players; and devised the present study to see the effect of table tennis playing and football playing, on speed of cognitive processes (reaction time) and to find out that who have faster reaction time- TT players or football players.

#### **Material and Methods:**

This cross-sectional study was carried out in the department of Physiology, SBKS MI & RC, Sumandeep Vidyapeeth, Piparia-391760, Vadodara on 90 male participants during July to September 2014.

After receiving approval from the Sumandeep Vidyapeeth Institutional Ethical Committee (SVIEC) young sportspersons were invited to participate as volunteers in the study. A total of 90 participants were selected (30 in each group i.e. non-athletes group, table tennis players group & football players group) as per the inclusion and exclusion criteria.

#### Inclusion criteria:

Participants who were ready to give a valid consent were included in the study. Participants who were not involved in any regular sports or athletic activities were included in the non-athletes group, who were playing table tennis for at least five hours a week, for at least 1 year regularly (with a break of less than one month) were included in the TT players group, and participants who were playing football for at least five hours a week, for at least 1 year regularly (with a break of less than

one month) were included in the football players group.<sup>2</sup>

#### Exclusion criteria:

Participants who were not willing to give valid consent, who were smoker or alcoholics, who were suffering from any medical or surgical illness which may affect reaction time (e.g. uncorrected refractive errors or hearing problems), who were taking drugs which may affect reaction time (e.g. central nervous system depressants like barbiturates, caffeine, amphetamines etc.), who are involved in any other sports or activities which may improve reaction time (e.g. video games) were excluded from the study.

On the day of study, the study method was explained properly to the participants. Personal history and medical history of the participants was collected to rule out any medical or surgical disease, which would affect reaction time.

Height was recorded during inspiration using a stadiometer. The subject was asked to stand erect on the stadiometer with bare foot. The horizontal bar of the stadiometer was placed on the vertex of the subject and the readings were recorded.

Weight was measured by digital standing scale. The subject was asked to stand erect on the digital weighing machine with bare foot. The readings were recorded from the scales of the digital weighing machine.

The Body Mass Index (BMI) was calculated using following formula:

$$\text{BMI} = \text{Weight (in kilogram)} / \text{Height}^2 \text{ (in metres)}^{13}$$

The ART was measured in all the participants using the audio-visual reaction time instrument available in the department of Physiology (accuracy of +/- 0.001 seconds). Participants were instructed that when they heard sound, they had to respond by pressing a key. Participants were given practice sessions till near about constant values of ART were obtained and then auditory stimuli were given for 3 times and minimum reaction time was taken as final ART.

The obtained data was analysed using MS Excel and SPSS (version 21), and reaction times in non-athletes, table tennis players and football players were compared using appropriate statistical tests.

**Results:****Table 1: Age and anthropometric data of the study population**

	Non-athletes (n=30) (Mean $\pm$ SD)	TT Players (n=30) (Mean $\pm$ SD)	Football Players (n=30) (Mean $\pm$ SD)	F value by ANOVA	p value
Age (years)	18.57 $\pm$ 0.62	18.37 $\pm$ 0.58	18.66 $\pm$ 0.34	2.37	0.01
Height (cms)	160.70 $\pm$ 10.21	157.80 $\pm$ 8.35	162.5 $\pm$ 10.70	1.75	0.18
Weight (Kg)	59.68 $\pm$ 10.61	60.7 $\pm$ 11.45	62.50 $\pm$ 9.75	0.54	0.58
BMI (Kg/m <sup>2</sup> )	23.31 $\pm$ 1.61	24.32 $\pm$ 1.58	23.81 $\pm$ 1.55	3.06	0.05

\*p < 0.05-statistically significant, ANOVA = Analysis of Variance.

**Table 2: ART of the study population**

	Non-athletes (n=30) (Mean $\pm$ SD)	TT Players (n=30) (Mean $\pm$ SD)	Football Players (n=30) (Mean $\pm$ SD)	F value by ANOVA	p value
ART (ms)	272.23 $\pm$ 5.52	252.74 $\pm$ 4.24	260.54 $\pm$ 6.26	98.82	< 0.0001**

\*p < 0.05-statistically significant, \*\*p < 0.01-statistically highly significant.

**Table 3: Comparison of ART of Non-athletes & TT Players**

	Non-athletes (n=30) (Mean $\pm$ SD)	TT Players (n=30) (Mean $\pm$ SD)	t value (unpaired student's t test, two tailed)	p value
ART (in ms)	272.23 $\pm$ 5.52	252.74 $\pm$ 4.24	15.3368	< 0.0001**

\*p < 0.05-statistically significant, \*\*p < 0.01-statistically highly significant.

**Table 4: Comparison of ART of Non-athletes & football Players**

	Non-athletes (n=30) (Mean $\pm$ SD)	Football Players (n=30) (Mean $\pm$ SD)	t value (unpaired student's t test, two tailed)	p value
ART (in ms)	272.23 $\pm$ 5.52	260.54 $\pm$ 6.26	7.6717	< 0.0001**

\*p < 0.05-statistically significant, \*\*p < 0.01-statistically highly significant.

**Table 5: Comparison of ART of TT Players & football Players**

Parameter	TT Players (n=30) (Mean $\pm$ SD)	Football Players (n=30) (Mean $\pm$ SD)	t value (unpaired student's t test, two tailed)	p value
ART (in ms)	252.74 $\pm$ 4.24	260.54 $\pm$ 6.26	5.6505	< 0.0001**

\*p < 0.05-statistically significant, \*\*p < 0.01-statistically highly significant.

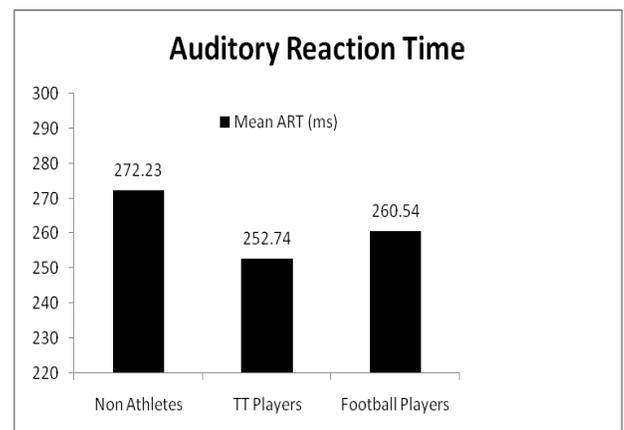
**Graph 1: Mean ART in the study groups****Discussion:**

Table 1 shows age and anthropometric data of the study population. There was no significant difference in terms of age, height, weight & BMI between the groups (p > 0.05). Thus the groups were found to be comparable.

Table 2 shows comparison of ART of the study population. As there was a significant difference in

the ART between non-athletes, TT players & football players ( $p < 0.0001$ ) by ANOVA, post-hoc analysis was done using unpaired students' t test.

Table 3 shows comparison of ART between TT players & healthy controls. TT players had faster mean ART (19.49 ms) than healthy controls & this difference was statistically significant ( $p < 0.0001$ ). Sema Can et al<sup>14</sup> also found faster auditory reaction time in table tennis players. Also, Bhabhor M et al.<sup>2</sup> found that table tennis players had faster reaction time compared to non-tennis players of same age and BMI. The faster reaction time in TT players as compared to controls could be due to better concentration, alertness, improved muscle co-ordination and improved performance in speed and accuracy task.<sup>2</sup>

Table 4 shows comparison of ART between football players & healthy controls. Football players had significantly faster mean ART (11.69 ms) than healthy controls ( $p < 0.0001$ ). Montés-Micó R et al<sup>8</sup> found similar results. They found statistically significant faster reaction times in football players than non-players. Ruschel C et al<sup>15</sup> also found that professional football players displayed faster ART. Football requires enormous racing and athletic exercise around the field. Perhaps the mechanism could be that individuals who do moderate to intense exercise at have higher cerebral blood flow rates which results in improved cognitive functioning as a result of increased supply of oxygen and glucose.<sup>16</sup> Other possible explanation is that exercise induces arousal which supports alertness to external atmosphere stimuli.<sup>17</sup>

Table 5 shows comparison of ART between TT players & football players. TT players had faster mean ART (7.8 ms) than football players. This difference was statistically significant ( $p < 0.0001$ ). This difference could be possibly due to the differing requirements of the sports. TT requires acute attention to the ball sound and ball movement that is travelling at high speeds. Whereas football involves greater visual processing compared to auditory processing. ART might be less important in football as it is fundamentally a visual game.<sup>15</sup> However, duration of playing football could have affected the improvement in ART. Nougier et al<sup>18</sup> also showed that athletes have better reaction times.

Graph 1 shows mean reaction times in the study groups. It shows that TT players had fastest mean ART (252.74 ms) followed by football players (260.54 ms) followed by non-athletes (272.23 ms) had faster ART than healthy controls. Thus, it can be deduced that TT players had faster ART than healthy controls. Also, football players had faster ART than healthy controls. But TT players had faster ART than football players.

In modern times, children spend more time in exploring new age gadgets like smart phones and tablets, surfing internet, playing videogames, watching TV and movies. They spend relatively less time in physical sports like table tennis, football, volleyball, badminton, cricket, etc. These sports not only contribute to physical health but also improve mental alertness and concentration. Therefore, young ones should be encouraged into playing such games.

The results of our study could find possible implications in the fields of mental chronometry, sports physiology, exercise physiology, training of sports persons and sports psychology.

Limitations of our study: As female players did not volunteer for the study, gender related differences in ART could not be investigated.

Fully automated instruments for reaction time measurement may generate different results.

Directions of future research: Future research may be focussed towards involving female players.

We studied only ART. Similar study could be planned for VRT in TT players and football players.

In our study, participants were TT players & football players. Similar studies may be conducted in other types of sports.

#### **Conclusion:**

Persons involved in physical sports such as TT & football have better reaction times. Thus, playing of TT & football is beneficial to eye-hand reaction time & co-ordination. It can be said that TT and football are beneficial for the improvement of cognitive processing, concentration and alertness. However, it can be suggested that Playing TT better improves ART than football.

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**References:**

1. Jensen A. R. Mental chronometry. In: Clocking the mind: Mental chronometry and individual differences. 1<sup>st</sup> edition. Amsterdam: Elsevier. 2006:1-4.
2. Bhabhor M et al. A comparative study of visual reaction time in table tennis players and healthy controls. *Indian J Physiol Pharmacol*. 2013;57(44):439–442.
3. Luce RD. In: Response times: their role in inferring elementary mental organization. Oxford Psychology series 8. Oxford University Press: New York. 1986: 562.
4. Welford AT. In: Choice reaction time: Basic concepts. Reaction times. Academic Press: New York. 1980; 73–128.
5. Teichner WH. Recent studies of simple reaction time. *Psychol Bull* 1954; 51: 128.
6. Tripo RS. How fast can you react ? *Sci Dig* 1965; 57: 50.
7. Marion JLA, Suzanne LB. An analysis of fitness and timemotion characteristics of handball. *Am J Sports Med*. 1989;17:76–82.
8. Montés-Micó R, Bueno I, Candel J, Pons AM. Eye-hand and eye-foot visual reaction times of young soccer players. *Optometry*. 2000;71(12):775-80.
9. Ziemowit Bańkosz, Henryk Nawara and Marcin Ociepa. Assessment of simple reaction time in badminton players. *TRENDS in Sport Sciences*. 2013;1(20):54-61.
10. Ghuntla TP, Mehta HB, Gokhale PA, Shah CJ. A Comparative Study of Visual Reaction Time in Basketball Players and Healthy Controls. *NJIRM*. 2012;3:49–51.
11. Hasçelik Z, Bas, göze O, Türker K, Narman S, Özker R. The effects of physical training on physical fitness tests and auditory and visual reaction times of volleyball players. *J Sports Med Phys Fit*. 1989;2:234–239.
12. Arup Gayen, Sentu Mitra and Sagarika Bandyopadhyay. Assessment of Reaction Time of Soccer Goalkeepers, Wicketkeepers in Cricket and Kho-kho Players. *Indian Journal of Applied Research*. 2014;4(2);30-31.
13. Garrow J.S., Webster J.D. Quetelet's index (W/H<sup>2</sup>) as a measure of fatness. *Int J Obes Relat Metab Disord*. 1985;9:147-53.
14. Sema Can, Bülent Kilit, Erşan Arslan, Salih Suveren. The Comparison of Reaction Time of Male Tennis Players, Table Tennis Players And The Ones Who Don't Exercise At All. *Niğde University Journal of Physical Education And Sport Sciences*. 2014;8(2):195-201.
15. Ruschel C, Hauptenthal A, Hubert M, Fontana HB et al. Simple reaction time in soccer players from differing categories and field positions. *Motricidade*. 2011;7(4):73-82.
16. Tomporowski, Phillip DE, Norman R. Effects of exercise on cognitive processes. A review. *Psychol Bull* 1986;99:338–346.
17. Terry McMorris. Exercise and Cognition: Towards an InterDisciplinary Model. *The Open Sports Med J* 2008;2:60–68.
18. Nougier V, Ripoll H, and Stein JF. Orienting of attention with highly skilled athletes. *Int J Sport Psychol*. 1989;20:205–223.

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