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Comparison of Visual and Auditory Reaction Times in Athletes and Sedentary Individuals with Different Somatotypes: A Neuroperformance Study

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Abstract

Background: Body composition, which is affected by body fat ratio is an important factor affecting parameters such as strength, endurance, flexibility and agility required for superiority in sportive performance.
Objectives: The aim of this study is to compare visual (VRT) and auditory (ART) reaction times of athletes and sedentary individuals with different somatotypes.
Methods: The study included 148 individuals (73 athletes and 75 sedentary) with no symptoms. Somatotype character analysis was performed with Somatotype (1.2.6 trial) program using Heath-Carter formula after the determined anthropometric measurements were taken. Reaction time measurements were performed with Hubbard reaction meter.
Results: Six different somatotypes were determined in both sedentary and athlete groups that participated in the study. In the comparison of VRT and ART scores of athletes and sedentary individuals in terms of each somatotype, statistically significant difference was found in VRT score in balanced ectomorph somatotype and in both VRT and ART scores of endomorphic mesomorph somatotype ($P < 0.05$).
Conclusions: We think that regular training and sports shorten VRT and ART. We presume that these characteristics of athletes shorten their reaction times since sports events require more concentration. The results of our study are interesting in terms of being a new subject for scientists working in this field.

Keywords: Somatotype, Reaction Time, Anthropometry, Neuroperformance, Athlete

1. Background

In order to be successful in sports, the athlete must perform at a high level in terms of physiological and motoric characteristics. Moving before the opponent, especially in actions requiring short-distance and speed, gives the athlete an advantage (1). When the literature is examined, it can be seen that physical structure and anthropometric characteristics are the main factors affecting the performance of athletes and sedentary individuals (2-4). Body fat ratio is the factor that makes the physical structure important in athletes and sedentary individuals. Body composition, which is affected by body fat ratio is an important factor affecting parameters such as strength, endurance, flexibility and agility required for superiority in sportive performance (5, 6). Somatotype character analysis, which is used to determine the body composition, is a classification based on the physical structure elements made considering the external characteristics of the individual and it is obtained with the help of anthropometric measurements (7). Somatotype is the definition of the human body with its delicacy, muscularity and mass characteristics, determination of the characteristics by scientific methods and identification of the morphological shape of the body. In other words, somatotype is the formation of body composition regardless of size. Somatotype is a method that defines the characteristics of the human body as a whole (7, 8). Considering all sports branches, it may be wrong to say that a single somatotype character is superior to others. In order to prevent this false notion, it is thought that inclusion of individuals who do not have a regular sports life and who live a sedentary life will reveal objective results of somatotype on sport performance. Otherwise, for example, when 30 meters (m) running scores are obtained

from ectomorphic swimmer and ectomorphic marathon athlete, it is thought that the results will be subjectively affected by the sport branch they perform because various sports branches that have their own biomotor characters may need different customized parameters (9).

One of the important parameters affecting sporting performance is reaction time. Reaction time is the amount of time that passes from the arrival of a signal which suddenly arises and which has not been prioritised to the response to this signal. While strength is primarily required for movement performance, reaction time indicates the first muscular reaction of a person to a stimulant or the time that passes to move (10). Stimuli can be auditory, visual and tactile (1, 11). Reaction time is a decisive factor in many sports and long-term studies have shown that the reaction time can be shortened by training (1).

2. Objectives

Although publications on the physical and physiological characteristics of athletes are frequently encountered in literature, it can be said that the studies evaluating the effect of different somatotypes on the reaction times of sedentary and athlete individuals are quite limited. With the hypothesis that the sport positively affects the reaction time scores of individuals, it is aimed to reveal the effects of sport on the reaction time in different somatotypes. The aim of this study was to compare the visual and auditory reaction times of athletes and sedentary individuals with different somatotypes.

3. Methods

Permission was granted from İnönü University Scientific Research and Publication Ethics Committee (No: 2019/265) to conduct this study. Each participant gave written consent for the study which was conducted in accordance with the principles of the Declaration of Helsinki.

Of the 80 athletes and 85 sedentary individuals included in the study, 17 individuals who did not meet the inclusion criteria were excluded and 73 athletes and 75 sedentary between the ages of 18 - 38 were included in the study. Having a systemic disease, having cognitive problems, carelessness in performing optimal measurements, having any auditory-visual problems, orthopedic health problems affecting reaction were accepted as exclusion criteria.

3.1. Data Collection Process

Sociodemographic data and measurement results of each participant informed about the study were recorded.

3.1.1. Age, Height, Weight, and Body Mass Index Measurements

The patients' ages were calculated in years, and their heights were measured in cm while they stood barefooted using a steel stadiometer with a precision of 0.1 cm. Their weights were measured in kg while they stood barefooted without metal using a Tanita BC Segmental Body Analysis System (Tanita Corporation, Tokyo, Japan). The body mass indexes (BMIs) were calculated using the following formula: weight (kg)/height (m^2) (12).

3.1.2. Anthropometric Measurements

For somatotype assessment triceps, subscapular, supraspinal and calf skinfold thickness (SF), were measured by using the baseline skinfold caliper (model: 12-1110), knee and elbow widths were measured using the Harpenden anthropometer set (Holtain Ltd., Crymych, Dyfed, Wales, UK). Arm and calf circumferences were measured using the baseline circumference (13-15).

3.1.3. Calculation of Somatotypes

Somatotype (1.2.6 trial) program designed by Heath-Carter formula was used for the calculation of somatotypes and for somatotype drawings. Anthropometric measurements were taken from each student in line with the techniques set forth by the International Biological Program (IBP) and International Society for the Advancement of Kinanthropometry (ISAK) to determine somatotype (14, 16). Heights were measured with Tanita body composition analyzer (BC-418 MA) device (Tanita Europe BV, Amsterdam, Netherlands) (17).

3.1.4. Reaction Time Measurements

Visual and auditory reaction time measurements of the subjects in the study were made with Hubbard Scientific Reaction Timer (Model: 6027, USA). Reaction Timer device can give two different warnings, as visual (light) and auditory (sound). Reaction time measurements were made between 09:30 and 11:00 in a noise free environment with sufficient light. Information form was prepared for each participant before so that reaction time measurement results could be recorded. Reaction Timer was placed 10 cm away from the button on the table in front of each participant and the subjects were asked to put their dominant hands on the table. They were asked to press the buttons in shortest time in accordance with the stimulants when one of the sound or light stimuli was given with the command of "ready". The results were recorded on the previously prepared measurement papers. 10 trials were taken from each subject for sound and light stimuli. The first five were considered as practice and the average of the last trials were determined as reaction time (18, 19).

3.2. Statistical Analysis

IBM SPSS V. 22.0 software (IBM Corp., Armonk, NY, USA) was used for statistical analysis. Shapiro-Wilk test was used to analyze the normality of data and Mann Whitney U test was used to analyze data. Descriptive data were expressed in median and range. $P < 0.05$ was considered statistically significant.

4. Results

A total of 148 individuals (73 athletes and 75 sedentary) participated in this study. Based on the somatotype analysis, 6 different somatotypes were found in the athletes and the sedentary participants (Figure 1).

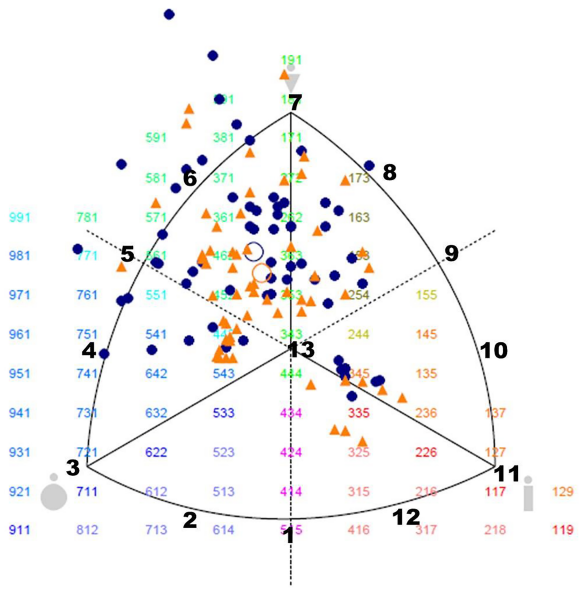

Figure 1. Somatoplot representations of the somatotype characteristics. Circle: sedentary, Triangle: athletes. 1, endomorph ectomorph; 2, ectomorphic endomorph; 3, balanced endomorph; 4, mesomorphic endomorph; 5, mesomorph endomorph; 6, endomorphic mesomorph; 7, balanced mesomorph; 8, ectomophic mesomorph; 9, mesomorph ectomorph; 10, mesomorphic ectomorph; 11, balanced ectomorph; 12, endomorphic ectomorph; 13, central; O, mean somatotype.

Somatotype distribution of 73 athletes and 75 sedentary individuals included in the study is shown in Table 1.

Table 2 summarizes the results of age, height, weight, BMI and other anthropometric measurements of athletes with different somatotypes.

Table 3 summarizes the results of age, height, weight, BMI and other anthropometric measurements of sedentary participants with different somatotypes.

Mann Whitney U test was used to compare VRT and ART results of athletes and sedentary participants. Analysis results and median (min-max) values of VRT and ART scores of athletes and sedentary participants are shown in Table 4.

Table 1. Distribution of Somatotypes

Somatotypes	Athletes	Sedentary
Balanced ectomorph	11 participants	10 participants
Balanced mesomorph	12 participants	11 participants
Ectomorphic mesomorph	9 participants	11 participants
Endomorphic mesomorph	22 participants	23 participants
Mesomorph endomorph	10 participants	11 participants
Mesomorphic endomorph	9 participants	9 participants
Total	73 participants	75 participants

In the comparison of VRT and ART scores of athletes and sedentary participants in terms of each somatotype, statistically significant difference was found in VRT score in balanced ectomorph somatotype and in both VRT and ART scores of endomorphic mesomorph somatotype ($P < 0.05$) (Table 4).

5. Discussion

The aim of this study was to compare the visual and auditory reaction times of athletes and sedentary individuals with different somatotypes. As a result of our study, in the comparison of VRT and ART scores of athletes and sedentary participants in terms of each somatotype, statistically significant difference was found in VRT score in balanced ectomorph somatotype and in both VRT and ART scores of endomorphic mesomorph somatotype ($P < 0.05$).

In the literature review conducted, it is seen that the thought that different mechanisms work in reaction time and movement time is proposed. While muscular strength enables individuals to accelerate, it has been shown that it determines reaction time delay, pre-movement processing period of the central nervous system and the data obtained shows that reaction time and movement time are independent elements. The time that passes in afferent nerve pathways following the stimulant in reaction time includes the time that passes for perception, time to decide for reaction and realization of motor reaction. Reaction time can be improved by 0.12s after regular training (20).

In the VRT and ART comparisons of athletes and sedentary individuals with 6 different somatotypes included in our study, statistically significant difference was found in both reaction types in endomorphic mesomorph somatotype and in VRT of balanced ectomorph individuals.

There are many studies in literature evaluating the reaction time of athletes (11, 12, 20). Gavkare et al. compared the reaction time of athletes and sedentary individuals and

Table 2. Age, Height, Weight, BMI and Other Anthropometric Measurement Results of Athletes

Parameter	Balanced Ectomorph	Balanced Mesomorph	Ectomorphic Mesomorph	Endomorphic Mesomorph	Mesomorph Endomorph	Mesomorphic Endomorph
Age, y	22.5 (20 - 26)	21 (20 - 27)	21 (20 - 24)	22 (19 - 38)	21 (20 - 26)	21 (20 - 22)
Height, cm	182.5 (172 - 195)	180 (165 - 191)	178 (172 - 185)	176.5 (167 - 188)	171.5 (162 - 178)	174 (163 - 179)
Mass, kg	66.5 (53 - 73)	73 (57 - 90)	72 (63 - 78)	77 (67 - 94)	68.5 (53 - 76)	70 (58 - 76)
BMI	20 (17.9 - 20.9)	23 (20.9 - 25.6)	22.3 (20.6 - 23)	24.4 (21.7 - 28.1)	22.8 (20.2 - 25.3)	23.1 (20.8 - 23.7)
Triceps skinfold thickness, mm	9 (4 - 14)	8 (4 - 14)	5 (2 - 9)	10.5 (3 - 15)	12 (10 - 20)	12.5 (12 - 20)
Subscapular skinfold thickness, mm	10 (8 - 13)	13 (8 - 16)	9 (7 - 10)	14 (11 - 21)	15.5 (13 - 23)	15 (13 - 18)
Supraspinale skinfold thickness, mm	9 (6 - 14)	9 (1 - 15)	6 (4 - 9)	13 (7 - 25)	17 (9 - 30)	15 (10 - 19)
Calf skinfold thickness, mm	8.5 (5 - 13)	6 (4 - 13)	6 (3 - 13)	9 (4 - 19)	11.5 (8 - 13)	7 (6 - 18)
Arm circumferences, cm	28.5 (26 - 31)	34 (30.5 - 41)	31 (27.5 - 32.5)	33.7 (29 - 39)	31.5 (27.5 - 34.5)	29 (27.5 - 34)
Calf circumferences, cm	33.7 (31.5 - 35.5)	36 (29.5 - 41.5)	36 (33 - 40)	37 (32.5 - 43)	34.7 (30 - 37)	34.5 (32 - 36.5)
Elbow width, cm	7.2 (4.9 - 7.8)	8.5 (7.3 - 9.2)	7.5 (5.8 - 8.7)	8 (5.5 - 10)	7.2 (6.7 - 8.4)	7.2 (5.6 - 7.5)
Knee width, cm	8.8 (7.9 - 9.5)	9.3 (7 - 10)	9.8 (8.8 - 10.8)	9.7 (7.8 - 11.7)	8.5 (7.6 - 9.8)	8.2 (7.2 - 8.6)
Endomorphy	2.6 (1.9 - 3.5)	2.6 (1.6 - 3.7)	2 (1.1 - 2.3)	3.9 (2.4 - 5.5)	4.5 (4.1 - 6.2)	4.2 (4.1 - 5.3)
Mesomorphy	2.3 (1.2 - 2.7)	5.8 (3.9 - 8.7)	4.5 (3.5 - 6.2)	5.3 (4.1 - 19.8)	4.4 (3.8 - 5.8)	3.5 (3 - 4.2)
Ectomorphy	4.3 (3.7 - 5.6)	2.8 (1.6 - 3.6)	3 (2.6 - 3.6)	1.6 (0.1 - 3.2)	2.4 (1.4 - 3.1)	2.3 (2.2 - 3.2)

Table 3. Age, Height, Weight, BMI and Other Anthropometric Measurement Results of Sedentary Participants

Parameter	Balanced Ectomorph	Balanced Mesomorph	Ectomorphic Mesomorph	Endomorphic Mesomorph	Mesomorph Endomorph	Mesomorphic Endomorph
Age, y	20 (19 - 21)	22 (20 - 24)	21 (20 - 22)	21 (20 - 23)	23 (21 - 24)	21 (20 - 22)
Height, cm	184 (170 - 184)	175 (164 - 193)	179 (173 - 188)	180 (151 - 186)	171 (164 - 178)	175 (168 - 179)
Mass, kg	67 (55 - 67)	72 (57 - 92)	73 (59 - 82)	84 (52 - 115)	70 (63 - 73)	74 (65 - 85)
BMI	19.7 (18.3 - 19.8)	23.1 (21.2 - 24.7)	22.5 (18.6 - 23.9)	25.5 (21.6 - 36.3)	23.9 (21.8 - 24.6)	24.4 (23 - 27.1)
Triceps skinfold thickness, mm	12 (6 - 12)	7 (4 - 11)	5 (3 - 9)	10 (7 - 16)	20 (14 - 20)	21 (13 - 25)
Subscapular skinfold thickness, mm	12 (9 - 13)	10 (9 - 12)	8 (7.5 - 11)	12 (9 - 19)	20 (14 - 25)	20 (15 - 28)
Supraspinale skinfold thickness, mm	9 (6 - 9)	9 (6 - 14)	7 (6 - 9)	12 (6 - 31)	20 (15 - 20)	22 (14 - 30)
Calf skinfold thickness, mm	10 (9 - 12)	9 (6 - 12)	9 (8 - 13)	11 (4 - 18)	8 (8 - 19)	13 (9 - 20)
Arm circumferences, cm	28.5 (24 - 28.5)	32 (28 - 34)	31 (28 - 35)	34.5 (25 - 40)	30 (30 - 31.5)	32 (29 - 34)
Calf circumferences, cm	34.5 (32 - 34.5)	35 (32.5 - 40)	37 (32 - 40.5)	39 (28 - 44)	38.5 (34 - 38.5)	37 (34 - 41)
Elbow width, cm	8 (6.5 - 8.1)	8.2 (5.7 - 8.5)	8 (6.2 - 9.5)	8.1 (6.7 - 9.4)	8.2 (7.3 - 8.2)	7.1 (6.9 - 8.5)
Knee width, cm	9.2 (7.5 - 9.2)	10 (9 - 11)	9.6 (9 - 11.1)	9.9 (7.2 - 15)	9.2 (8.4 - 9.5)	8.7 (7.7 - 9.2)
Endomorphy	3.1 (2.3 - 3.1)	2.7 (1.9 - 3.1)	1.8 (1.5 - 2.8)	3.3 (2.2 - 5.5)	5.5 (4.5 - 5.8)	6 (4.3 - 7.2)
Mesomorphy	3.3 (2 - 3.3)	5.7 (4.5 - 7.1)	4.8 (3.9 - 8.4)	5.8 (3.8 - 10.4)	5.7 (4.1 - 6)	4.3 (3.7 - 6.6)
Ectomorphy	4.6 (4.1 - 6.2)	2.6 (1.9 - 3.1)	3.1 (2.5 - 4.9)	1.8 (0.1 - 3.1)	1.8 (1.6 - 3.2)	1.1 (0.6 - 2.6)

they attributed better reaction time scores of athletes to increased concentration, motor coordination, neurophysiological changes, delayed fatigue and increased body-brain connectivity provided by sport19. In their study they evalu-

Table 4. Mann Whitney U Analysis Results and Median (Min - Max) Values of VRT and ART Scores of Athletes and Sedentary Participants

Participants		Balanced Ectomorph	Balanced Mesomorph	Ectomorphic Mesomorph	Endomorphic Mesomorph	Mesomorph Endomorph	Mesomorphic Endomorph
VRT							
	Athletes	35.3 (32.4 - 40.2)	38 (31.8 - 44)	35.4 (31.4 - 49.6)	34.2 (26.6 - 49.2)	36.4 (31.2 - 39.2)	43.5 (33.6 - 43.6)
	Sedentary	39.3 (35.7 - 41)	35.4 (29.8 - 43.8)	33.6 (25 - 41)	38.1 (28.6 - 48.6)	37.7 (33.3 - 47)	37.8 (36.7 - 51.1)
	P	0.018	0.447	0.315	0.034	0.315	0.520
ART							
	Athletes	40.3 (33.2 - 50.2)	36.8 (31.6 - 45.2)	34.8 (31.6 - 53.6)	36.2 (32.6 - 53.6)	36.2 (27.2 - 42.4)	43.8 (37.8 - 46.4)
	Sedentary	39.8 (37.2 - 39.8)	38.8 (30 - 46.8)	37.8 (31 - 46)	41 (30.4 - 58)	35.4 (34.6 - 47)	38.8 (35.6 - 52.6)
	P	0.215	0.543	0.874	0.049	0.885	0.161

ated VRT and ART, Parekh et al. found significant decrease in scores of aerobic exercise group when compared with the control group (21). In their study, Kaur et al. evaluated VRT and ART scores of athletes, sedentary participants and patients with type 1 diabetes mellitus and reported that athletes had shorter VRT and ART scores than sedentary individuals and sedentary individuals had shorter VRT and ART scores than patients with type 1 diabetes mellitus and they suggested that the reason for results was developed neuroperformance of athletes and diabetes patients had delays in reaction times due to possible cognitive dysfunction (22).

It is scientifically proven that physical activity and sport lead to many improvements in the human body (23). In their study they conducted on middle aged sedentary women with 8-week-long running and walking exercise, Çolakoğlu et al. reported that as a result of 8-week-long exercise program, somatotypes changed from endomorphy and mesomorphy to ectomorphy and ectomorphic somatotype caused a statistically significant decrease in reaction time (24). In their study they evaluated the reaction time of individuals with high and low body mass index, Skurvydas et al. found statistically significant difference between groups and reported that the reason for this difference was the fact that individuals with high body mass index were not doing sport and they had higher body ratio in the upper extremities than other individuals (25).

Somatotype character analysis is a commonly used method for determining body composition. It is frequently used in areas such as medicine, sports sciences, nutrition and dietetics. In sports sciences, somatotype is mostly about determining somatotypes suitable for sports branches (26). Although there are methods used to determine somatotype characters in literature, it is seen that Heath-Carter somatotype analysis, which we used in our study, is the most common.

5.1. Conclusions

In our study, upper extremity reaction times of athletes and sedentary individuals with different somatotypes were compared and statistically significant difference was found in VRT scores of balanced ectomorph athletes and both VRT and ART scores of endomorphic mesomorph athletes when compared with sedentary individuals. We think that regular exercise and sport may have affected VRT and ART. We presume that these characteristics of athletes shorten their reaction times since sports events require more concentration. The results of our study are interesting in terms of being a new subject for scientists working in this field. Our study has the characteristics to become one of the few studies that correlates somatotype character analysis, which is frequently used in sports sciences, with reaction time.

Footnotes

Authors' Contribution: Study concept and design: Deniz Şenol, and Davut Ozbağ; analysis and interpretation of data: Deniz Şenol, and Merve Altınoğlu; drafting of the manuscript: Şeyma Toy; critical revision of the manuscript for important intellectual content: Serkan Duz, Ayşegul Kısaoğlu, and Şeyma Toy; statistical analysis: Deniz Şenol and Davut Ozbağ.

Conflict of Interests: It is nothing to declared by the authors.

Ethical Approval: Permission was granted from İnönü University Scientific Research and Publication Ethics Committee (No: 2019/265) to conduct this study.

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Informed Consent: Each participant gave written consent for the study which was conducted in accordance with the principles of the Declaration of Helsinki.

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