Eurasian Journal of Anthropology
ISSN: 2166-7411

Euras J Anthropol 13(1):1-14, 2023

Evaluation of the relationship between the tendency to aggression and visual and auditory reaction time, mental rotation, and body structure in university students

Can Pelin[1], Berkan Kozan[1], Uğur Toprak[2], Beyazıt Kayaoğlu[3], Jerfi Cider[3], Meryem Korkmaz[3], Feyzanur Beyazlı[3], Egemen Doğan[3], Taylan Gül[3]

[1]*Department of Anatomy, Başkent University, Ankara, Turkey*

[2]*Instute of Health and Science, Ankara University, Ankara, Turkey*

[3]*Faculty of Medicine, Başkent University, Ankara, Turkey*

Article info

Received: 31 October 2022

Accepted: 21 February 2023

Key words

Aggression, visuo-spatial ability, reaction time, fat percentage, body mass index (BMI)

For correspondence

Berkan Kozan

Department of Anatomy, Faculty of Health and Science, Başkent University, 06790 Etimesgut, Ankara, Turkey

E-mail: kozanberkan@gmail.com

Abstract

The aim of the study is to examine the relationship between the tendency to aggression and the reaction time, visuo-spatial skill, body mass index (BMI), fat percentage, and muscle mass among university students. A convenient sample of 84 participants (43 males and 41 females) students at Başkent University were recruited using a simple random sampling method weighted for gender from university students who are voluntarily took place in the study. Correlations between variables assesed with Spearman correlation coefficient and diffirences assesed with Mann-Whitney U test. As the total aggression and verbal aggression scores of all participants increased, the number of correct answers in the mental rotation test also increased. It was determined that as the percentage of muscle increased in females, the correct numbers in the mental rotation test increased, but as the fat percentage increased, the correct numbers decreased. In females, as the percentage of muscle increases, their response times to choice visual reaction times accelerate, and as the percentage of fat increases, their responses slow down. The fact that participants with high muscle percentage and low fat percentage were more successful in the mental rotation test suggests that directing individuals to sports can improve their visuo-spatial abilities. It suggests that individuals with a high BMI or fat percentage may have slower responses to the auditory and visual reaction test, resulting in them being slower or unsuccessful in daily activities, alertness, or in activities such as sports competitions.

Introduction

While aggression has been a part of human attitudes and behavior throughout history, it is a key concept in the study of human behavior. There are multiple definitions of aggression. Aggression is defined by the World Health Organization (1996) as the act of physical force or threatening behavior towards oneself, another person or a group, towards death, injury, psychological injury, or prevention of mental and physical development. The dictionary of the American Psychological Association (APA) defines "aggression as a behavior aimed at harming others physically or psychologically."

Aggressive attitudes and behaviors can be categorized into multiple subtypes. Buss and Durkee (1957) classified aggressive attitudes and behaviors as attack, indirect hostility, irritability, negativity, anger, suspicion, verbal hostility, and guilt. Buss and Perry (1992) conducted tests on multiple models, including a one-factor model, a four-factor model, and a hierarchical model, using undergraduate students in the United States as participants. Buss and Perry performed explanatory factor analysis on the Buss-Durkee Hostility Inventory (1957). They concluded that the four-factor model, consisting of physical aggression, verbal aggression, anger, and hostility, provided better results than other models and represented a superior way of measuring and understanding aggression, leading them to create the Buss-Perry aggression questionnaire.

There are also various approaches to the causes of aggression. According to Furlow (1998), aggression is an innate, instinctive behavior. According to Bandura (1973), it is assumed to be completely culturally based. Aggression can show common features in animals and humans. However, manipulative and arbitrary aggression that occurs in the context of possessing material values and obtaining social status is unique to humans.

Reaction time, which plays an important role in general health, alertness, daily activity and most sports competitions, refers to the time elapsed between the visual, auditory or any other stimulus and the response to this stimulus. In other words, reaction time can be defined as a conscious response to many stimuli such as auditory, visual and tactile. It is also defined as the reaction time of the body to the sensory stimuli reaching the brain by different physical, chemical and mechanical means (Jose and Gideon, 2010).

Visuo-spatial ability also known as mental rotation ability can be defined as the ability to perceive an object in detail in a three-dimensional environment. In other words, it is a person's ability to describe an object's position in the three-dimensional environment and its relationship with other objects, that is, its dynamic and static properties together (Turos and Ervin, 2000; Kızıltan et al., 2015). Visuo-spatial skills can be developed and tested in different ways. It is a mental rotation test developed by Shepart and Metzler (1971), which is widely used in the evaluation of visual spatial skills. The mental rotation test, in which 2-dimensional images of objects formed by combining 3-dimensional cubes, are used, is important in studies that evaluate the development of learning and perception (Shepard and Metzler, 1971).

It has been determined that visuo-spatial ability is significantly related to the superior parietal cortex and its adjacent areas (Zacks, 2008; Cohen and Bookheimer, 1994; Tagaris et al., 1998). However, there is also study showing that visuo-spatial skill is associated with most regions of the brain, rather than being limited to a specific area (Cohen et al., 1996). In the context of examining the neurobiological mechanisms of aggression, it has been observed that individuals with aggressive attitudes and behaviors have a loss of activation and a decrease in the volumes of the related cortical areas, especially in the orbitofrontal cortex and ventromedial of the prefrontal cortex (Raine et al., 2000; Tiihonen et al., 2008). In the light of this information, our hypothesis is that people with high visuo-spatial skills will have lower aggression scores in the Buss-Perry Aggression Questionnaire, based on the fact that activation is observed in most parts of the brain during the realization of visuo-spatial skills, whereas there is a decrease in activation in some parts of the brain during aggressive attitudes and behaviors. Additionally, there are opinions that aggression is an instinctive behavior and that it arises for the protection of the individual, as well as an opinion that claims that it is purely cultural origin and is a behavior that people display in order to acquire ownership and social status (Campbell, 1993). It is known that aggressive attitudes and behaviors are more common in males than in females (Burton et al., 2007; Archer, 2004; Morsunbül, 2015). On the other hand, it is emphasized in many studies that the reaction time is shorter in males than in females (Adam, 1999; Meng et al., 2015; Jain et al., 2015). In this direction, another hypothesis is that the reaction time of individuals with a high tendency to aggression will be short. Based on our hypotheses, if there is a negative correlation between visuo-spatial skills and aggression, the importance of directing the person to activities that will improve visuo-spatial skills can be emphasized. In the same direction, if it is revealed that there is an inverse ratio between aggressive behavior and reaction time, we think that studies can be conducted to show that individuals with short reaction times can direct these characteristics to other areas and reduce their aggressive behavior.

There are studies suggesting that high fat percentage may increase the risk of cognitive impairment. In this context, neurophysiological studies have suggested that brain regions related to cognition, memory, vocabulary, rapid information processing and reasoning are affected by the fat percentage (Skurvydas et al., 2009; Gunstad et al., 2007; Cournot et al., 2006). Consequently, our hypothesis is that individuals with high fat percentage will have lower visuo-spatial skills. Additionally, we anticipated that individuals with high fat percentage would have longer reaction times. If our hypotheses are confirmed, it could be argued that keeping the fat percentage in a healthy range can increase the success level of individuals in areas where visuo-spatial skills or reaction time are important (sports, chess, e-sports, etc). The study was designed for the younger generation in order to exclude the effects of age both on reaction time and cognitive abilities. Since this study was conducted with university students, it can be predicted that individuals with a low fat percentage may be more successful in their fields. The primary aim of the study is to reveal whether there is a relation between aggressiveness, reaction time, visuo-spatial ability and body composition. It was thought that reaction time could be shorter in agressive individuals. On the other hand, since metal rotation is associated with cognitive abilities, and can potentially be improved through education, it was thought that it would be easier for the intelligent individuals to control the aggressive behaviors.

Materials and method

Ethical approval

Our study protocol KA22/140, was approved by the Ethics Committee of Baskent University on 30/03/2022 (Decision no: KA22/140). This study was conducted according to the Declaration of Helsinki.

Participants and study design

Simple random sampling method weighted with gender carried out to select the participants. The core of the study is to explore correlation between pyhsical and emotional status of the young students. Our study was conducted with the voluntary participation of 84 university students, who continue their education in the Faculty of Medicine, Dentistry, and Health Sciences of Başkent University. Individuals who had a neurological disease or were using drugs for psychological treatment were not included in the study. We ensured that all participants abstained from consuming any food or beverages containing caffeine for at least 30 minutes before their participation in the study.

Measurement tools

Participants' visuo-spatial skills were evaluated using the computer-based mental rotation test. We employed a computer-based reaction time test to measure the participants' response time to a stimulus. Buss-Perry Aggression Questionnaire was used to measure the aggression level of the participants. The Tanita Sc-330S was used to measure the participants' muscle, fat percentage, and BMI values. Edinburgh Handedness Inventory was used to understand the dominant hands of the participants (Oldfield, 1971). A study suggested that left-handed individuals have a neurological advantage because they use their right hemisphere (Dane and Erzurumluoglu, 2003). In this study, individuals with left dominant hand were not included in the study. Therefore, the effect of cerebral dominance on reaction time disappeared.

Participants were given brief information about mental rotation and reaction time tests. Participants were informed that their personal information and the results obtained would be kept confidential and would not be shared elsewhere. Environments that would affect the participants' focus at a minimum level were selected. Before the test, the importance of the tests, the use of the device, the rules of the tests to be applied were clearly explained to the participants.

Reaction time test

Reaction time was applied by using a computer-based test (Yargıc et al., 2019; Kızıltan et al., 2006). Reaction time, visual and auditory reaction times were examined in two groups as simple and choice reactions. At the same time, all reaction time tests were conducted with two different ways as simple and random intervals. Visual and auditory reaction times were evaluated through computer-based test. In the simple visual reaction time test, the participant was asked to press the "1" key on the keyboard each time they observed a red object that appeared on the computer screen 10 times, respectively. The choice visual reaction time test consists of five different colored objects: red, black, blue, green, and yellow. The participants were asked to press the "1" button when they saw a red object and the "2" button for objects of other colors. Incorrect responses given by the participant were recorded as errors. In the auditory reaction time test, the participants were asked to press the "1" button each time they heard the auditory stimulus. All participants were instructed to use their dominant hand for responses. All results were automatically recorded in milliseconds by the computer.

Mental rotation test

For the measurement of visuo-spatial skills in our study, we employed a Computer-Based Mental Rotation Test, originally developed by Shepard and Metzler in 1971. We used images from the 'Mental Rotation Stimulus Library,' for which permission was obtained from Kızıltan (2015). These images have established validity and reliability (Kızıltan et al., 2015; Peters and Battista, 2008). In the mental rotation test, 2-dimensional shapes formed by combining ten, 3-dimensional cubes were used. The participants were given 5 minutes to complete the mental rotation test, which consisted of 16 questions in total. Each question contains four different pictures. On the far left is the reference figure, and they were asked to identify which of the three other numbered pictures was the reference picture rotated in space. In 8 of the 16 questions, the "X" axis was used as the rotation axis, and the "Z" axis was used in the remaining eight questions. In both axis groups, 30-degree increments between 0-180 degrees were chosen as the "rotation angle." Participants provided their answers by using the 1, 2, 3 keys on the keyboard and their answers were automatically recorded on the computer.

Body structure

The Tanita Sc-330S provides whole body composition measurements within seconds. The easy-to-use console has been designed to guide the user through data input, making it ideal for high usage purposes. The print out also provides a quick analysis of key results so the user can instantly understand their health status at a glance. Readings such as basal metabolic rate and metabolic age have proven to be great motivators. All measurements can be printed using the integrated thermal printer or transferred automatically to software for data collection and long term analysis. The Tanita Sc-330S mobile bodyless professional body analysis monitor was used to evaluate the physical characteristics of the individual. BMI, body fat percentage, and muscle mass (%) were measured using Tanita.

Aggression

Buss Perry Aggression Questionnaire was found by Buss and Perry (1992) and consists of 29 questions in total. It includes nine questions for physical aggression, five for verbal aggression, seven for anger, and eight for hostility. To determine an individual's level of aggression, the Buss Perry aggression questionnaire (BPAQ), which is the most frequently used aggression scale in the international literature, was tested and approved by H. Andaç Demirtaş Madran for Turkey.

Hand dominance

Edinburgh Handedness Inventory was found by Oldfield (1971). Edinburgh Handedness Inventory was used to determine the dominant hands of the participants. Edinburgh hand preference questionnaire consists of 10 different questions related to various activities, including writing, drawing, brushing teeth, using a broom, lighting a match, using scissors, throwing, using a spoon, opening a box and using a knife. Participants were presented with three response options for each question: right, left, or bilateral.

Data analysis

Statistical methods suitable to be used within the scope of the project will provide 80% test power at 95% confidence level. Sample size determined according to Choen's standardized effect sizes and previous litrature by utilizing Gpower 3.1v. Differece between groups are investigated with Mann-Whitney U Test due to parametric test assumptions are not satisfied. Correlation between the variables are analyzed with significance test of the Spearman correlation coefficient. In the study, continuous data were expressed as mean ± standard deviation (SD), and discrete data were expressed as median (minimum-maximum). The probability of Type I error for all analyzes was determined as α=0.05. All analyzes were performed using SPSS v25.0.

Results

Our study included a total of 84 participants, with 43 males and 41 females, who are currently enrolled in the Faculty of Medicine, Dentistry, and Health Sciences at Başkent University. The median age for male participants was 21.00 years (ranging from a minimum of 19.0 years to a maximum of 28.0 years), while the median age for female participants was also 21.0 years (with a minimum age of 19.0 years and a maximum age of 29.0 years)

Physical aggression, anger, hostility, and verbal aggression are the sub-headins of Buss-Perry aggression questionnaire. The sum of the scores from these four dimensions gives the total score. When we compare all dimensions in the Buss Perry aggression questionnaire according to the gender, it has been determined that males have higher scores than females in terms of physical aggression (P=0.02) (Table 1).

Table 1. Comparison of aggression parameters by gender (score)

	Male		Female		
	Mean ± SD	**Median**	**Mean ± SD**	**Median**	***P***
Total Score	76.78 ± 14.94	77.00	70.95 ± 13.80	73.00	0.068[a]
Physically Agression	22.55 ± 5.22	22.00	18.98 ± 5.35	18.00	0.02*[a]
Anger	18.90 ± 4.79	19.00	18.75 ± 4.31	19	0.996[a]
Hostility	21.66 ± 5.25	20.50	20.63 ± 5.17	19	0.313[a]
Verbal Agression	14.45 ± 3.74	14.00	13.14 ± 3.77	12	0.087[a]

***P*<0.05 was considered significant; SD= Standart deviation; [a]Mann-Whitney-U test.**

Table 2. The relationship between mental rotation test and reaction times of all participants with aggression

		r	*P*
Mental Rotation Test Correct Numbers	Total score	0.217	0.049*
	Physical aggression	0.167	0.131
	Anger	0.040	0.723
	Hostiliy	0.196	0.076
	Verbal aggression	0.221	0.045*
Simple Visual Reaction Time	Total score	-0.096	0.390
	Physical aggression	-0.124	0.266
	Anger	-0.110	0.321
	Hostility	-0.083	0.454
	Verbal aggression	-0.001	0.993
Simple Visual Reaction Time (Random interval)	Total score	-0.187	0.091
	Physical aggression	-0.145	0.191
	Anger	-0.141	0.205
	Hostility	-0.067	0.548
	Verbal aggression	-0.096	0.386
Choice Visual Reaction Time	Total score	-0.113	0.311
	Physical aggression	-0.064	0.564
	Anger	-0.115	0.300
	Hostility	-0.072	0.518
	Verbal aggression	-0.061	0.586
Choice Visual Reaction Time (Random interval)	Total score	-0.021	0.848
	Physical aggression	-0.000	0.998
	Anger	0.016	0.889
	Hostility	-0.013	0.909
	Verbal aggression	-0.016	0.886
Auditory Reaction Time	Total score	0.021	0.852
	Physical aggression	-0.044	0.696
	Anger	0.061	0.581
	Hostility	-0.075	0.501
	Verbal aggression	-0.056	0.615
Auditory Reaction Time (Random interval)	Total score	-0.125	0.259
	Physical aggression	-0.063	0.574
	Anger	0.000	1.000
	Hostility	-0.227	0.039*
	Verbal aggression	-0.079	0.478

***P*<0.05 was considered as significant, Spearman correlation coefficent test was used.**

When the relationship between mental rotation test and reaction times and aggression parameters among all participants was examined, it was determined that as the total aggression scores increased, the correct answers to the mental rotation test increased (*P*=0.049) (Table 2). At the same time, it was determined that as the scores obtained from verbal aggression increased, the correct answers to the mental rotation test increased (*P*=0.045). On the other hand, it was determined that as hostility scores increased, the auditory reaction time (random) shortened and the response time of the individual to the auditory stimulus accelerated (*P*=0.039). After analyzing the relationship of mental rotation test and reaction times with aggression in all participants, the relationship between male and female's mental rotation test and reaction times with aggression was examined in terms of gender. While no statistically significant correlation was found between mental rotation and reaction time and aggression in males, a negative correlation was found only between total aggression and simple visual reaction time (random) in females. When we examined the relationship between muscle, fat percentage, and BMI with aggression in all participants, no difference was found.

Table 3. Comparison of mental rotation test (correct number) and reaction times (ms) in males and females

	Male		Female		
	Mean ± SD	**Median**	**Mean ± SD**	**Median**	***P***
Mental Rotation Correct Numbers	10.65 ± 2.86	11	8.71 ± 3.10	9	0.002*
Simple Visual Reaction Time	297.09 ± 96.48	272.74	308.66 ± 84.11	284.26	0.181
Simple Visual Reaction Time (Random interval)	285.10 ± 35.74	282.25	307.02 ± 43.42	313.34	0.002*
Choice Visual Reaction Time	424.73 ± 77.67	401.06	437.46 ± 69.63	428.95	0.092
Choice Visual Reaction time (Random interval)	427.62 ± 79.58	406.46	444.95 ± 68.42	433.26	0.088
Auditory Reaction Time	398.94 ± 121.00	370.05	347.96 ± 54.64	341.22	0.062
Auditory Reaction Time (Random interval)	406.04 ± 73.98	400.61	398.18 ± 73.88	386.94	0.601

***P<0.05 was considered as significant, Mann-Whitney-U test was used.**

Table 4. The correlations of muscle, fat percentage, and BMI with reaction times and correct numbers in mental rotation test in all participants

	Muscle percentage (p-r)		Fat percentage (p-r)		BMI (p-r)	
Mental Rotation Correct Numbers	0.005*	0.301	0.024*	-0.247	0.324	0.109
Simple Visual Reaction Time	0.196	-0.192	0.201	0.141	0.703	0.042
Simple Visual Reaction Time (Random interval)	0.175	-0.149	0.346	0.104	0.882	0.016
Choice Visual Reaction Time	0.075	-0.195	0.144	0.161	0.723	0.039
Choice Visual Reaction Time (Random interval)	0.346	-0.104	0.411	0.091	0.687	0.045
Auditory Reaction Time	0.512	-0.073	0.929	0.010	0.016*	0.263
Auditory Reaction Time (Random İnterval)	0.185	-0.146	0.451	0.083	0.005*	0.214

***P<0.05 was considered as significant, Spearman correlation coefficent test was used.**

When we compared the correct numbers in the mental rotation test with the reaction times between males and females, it was found that the correct numbers of the males in the mental rotation test were higher than the females (*P*=0.002) (Table 3). At the same time, it was determined that males had faster simple visual reaction times (random) compared to females (*P*=0.002).

When the relationship between muscle, fat percentage, BMI, reaction times and the correct numbers in the mental rotation test was compared, it was found that as the muscle percentage increased in all participants, the correct numbers they gave to the mental rotation test increased (*P*=0.005) (Table 4). In this context, we found that the number of correct answers given to the mental rotation test by the participants with a high fat percentage decreased (*P*=0.024). On the other hand, as the BMI increased in all participants, it was determined that the time given to the auditory stimulus was prolonged (*P*<0.05).

Correlations were determined between BMI, muscle percentage, fat percentage and the number of correct answers given to the mental rotation test and reaction times. We aimed to understand whether this relationship was created by females or males. No significant correlation was found between muscle, fat percentage and BMI, mental rotation test and reaction time tests of males (Table 5). On the contrary, it was determined that this relationship was created by females. It was determined that females with high muscle percentage were more successful in mental rotation tests (*P*=0.007). In this context, it was determined that females with high fat percentage were less successful in the mental rotation test (*P*=0.007). It was determined that the responses of females with high muscle percentage to the choice visual reaction time test were accelerated (*P*=0.018). On the other hand, it was determined that the responses of female with high fat percentage to the choice visual reaction time test were slowed down (*P*=0.025). It was determined that females with high BMI responded more slowly to the choice visual reaction time test (*P*=0.026).

Table 5. Correlation of mental rotation test (correct number) and reaction times (ms) with muscle, fat percentage and BMI in males and females

	Male			Female		
	Muscle Percentage (p-r)	Fat Percentage (p-r)	Body Mass Index (p-r)	Muscle Percentage (p-r)	Fat Percentage (p-r)	Body Mass Index (p-r)
Mental Rotation Correct Numbers	0.799 -0.040	0.476 0.112	0.269 0.172	0.007* 0.415	0.007* -0.418	0.072 -0.284
Simple Visual Reaction Time	0.508 0.104	0.598 -0.083	0.814 -0.037	0.100 -0.260	0.101 0.260	0.093 0.266
Simple Visual Reaction Time (Random Interval)	0.409 -0.129	0.772 0.046	0.124 0.238	0.682 -0.066	0.655 0.072	0.316 0.160
Choice Visual Reaction Time	0.433 0.123	0.315 -0.157	0.857 -0.028	0.018* -0.367	0.025* 0.349	0.026* 0.348
Choice Visual Reaction Time (Random Interval)	0.325 0.154	0.337 -0.150	0.941 -0.012	0.123 -0.245	0.105 0.257	0.071 0.285
Auditory Reaction Time	0.460 -0.116	0.909 -0.018	0.304 0.161	0.143 -0.233	0.154 0.227	0.087 0.271
Auditory Reaction Time (Random Interval)	0.207 -0.196	0.773 0.045	0.227 0.188	0.129 -0.241	0.137 0.236	0.134 0.238

***P*<0.05 was considered significant, Spearman correlation coefficent test was used.**

Discussion

The aim of the study is to investigate the relationship between the tendency to aggression and the reaction time, visuo-spatial skill, BMI, fat percentage, and muscle mass among university students. In a study conducted by Burton et al, (2007) and Morsunbul (2015) using the Buss Perry aggression questionnaire on university students, it was determined that males had higher scores than females in terms of physical aggression. It is important for us that the samples of the studies and the sample of our study are similar to each other. Our study also supports this result.

It has been suggested that individuals with high testosterone levels are more prone to aggressive attitudes and behaviors (Kreuz and Rose, 1972; Dabbs and Hargrove, 1997). In addition, low fat percentage and high muscle mass are known to increase testosterone levels (Facchiano et al., 2013). In the light of this information, individuals with high muscle percentage and low fat percentage were expected to have higher aggression scores in our study. However, no significant relationship was found between muscle, fat percentage, BMI, and aggression. Additionally, studies have found that children and adolescents with excess fat or high BMI are more physically aggressive, regardless of gender, and social exclusion, peer rejection and peer victimization have been shown as one of the most important reasons for this (Tso et al., 2018; Janssen et al., 2004).

It has been suggested that the superior parietal cortex is the most important region related to visuo-spatial skills, mapping our position in space. There are many studies reported that there are high levels of activation in the right superior parietal cortex and adjacent areas during the mental rotation test (Zacks 2008; Cohen et al., 1994; Tagaris et al., 1998). Although many studies have shown that certain regions are more effective on visuo-spatial skills, it has been suggested that visuo-spatial skills are activated in most regions of the brain, as seen in all other complex scientific activities, and work as a whole (Cohen et al., 1996). In studies on the neurobiological mechanism of aggression, dysfunction and decreased volumes in the orbitofrontal cortex and ventromedial of the prefrontal cortex have been observed in individuals with aggressive behavior. In addition, in the same studies, dysfunction was found in the anterior cingulate cortex in individuals with aggressive behavior (Raine et al., 2000; Tiihonen et al., 2008; Young et al., 2010; Ducharme et al., 2011). Based on these studies, we hypothesized that individuals with high visuo-spatial skills can better control their aggressive attitudes and behaviors, based on the fact that individuals with an increase in activation and function in most regions of the brain and loss of volume and function in certain regions of the cortex during the realization of visuo-spatial skills exhibit aggressive behavior. However, our study did not support this hypothesis, and it was determined that individuals with high total aggression and verbal aggression scores had higher correct numbers in the mental rotation test. There are multiple reasons for this, such as gender, hormones and environmental factors that affect aggression. We think that the fact that visuo-spatial skills cause an increase in activation in most parts of the brain is not sufficient to reduce aggressive attitudes and behaviors. When evaluated in the context of gender, no significant relationship was found between the success of both males and females in the mental rotation test and aggression parameters.

When visual spatial skills are evaluated in the context of gender, studies have shown that males are more successful than females (Levine et al., 2016; Titze et al., 2010; Thompson et al., 1981; Linn and Petersen, 1985; Jardine and Martin, 1983). It has been suggested that many reasons, from hunting-gathering times to wars and strategies, make up this difference (Jardine and Martin, 1983; Eals and Silverman, 1994). Today, it has been suggested that the biggest reason why males are more successful is computer games (Quaiser-Pohl et al., 2006). In our study, it was determined that the correct numbers of males in the mental rotation test were higher than females. However, study has shown that famales can reduce this difference in a short time as a result of exercises aimed at improving visuo-spatial skills (Debarnot et al., 2013).

We compared the correct numbers in the mental rotation test with muscle, fat percentage and, BMI. As a result, it was found that all participants with a high fat percentage scored lower on the mental rotation test. In the same direction, we found that individuals with high muscle percentage among all participants were more successful in the mental rotation test. After finding a relationship between mental rotation test and muscle and fat percentage in all participants, we wanted to find out by which gender this relationship occurred. Accordingly, when the relationship between mental rotation test and muscle and fat percentage was evaluated in terms of gender, females with high fat percentage were less successful in the mental rotation test. Supporting this result, it was determined that females with high muscle percentage were more successful in the mental rotation test. There are some neurophysiological studies that have suggested that brain regions related to cognition, memory, vocabulary, rapid information processing and reasoning are negatively affected by fat percentage (Skurvydas et al., 2009; Gunstad et al., 2007; Cournot et al., 2006). The mental rotation test is a cognitive test. In this context, the negative correlation between the results of the mental rotation test and fat percentage in females supports the findings of the studies mentioned above.

Reaction time refers to the time between the moment we perceive a sound, visual or other stimulus and the moment we react (Jose and Gideon, 2010). We hypothesized that individuals with higher aggression scores would have faster reaction times. In our study, it was determined that as hostility scores increased, the responses of all participants to auditory stimuli (random) accelerated. When evaluated in the context of gender, no significant relationship was found between the reaction times of males and their aggression scores. However, it was found that only as the total aggression scores of the females increased, the simple visual reaction times (random) became shorter. When reaction times are examined in terms of genders, it has been suggested that males are faster than females (Engel et al., 1972; Dane and Erzurumluoglu, 2003; Dykiert et al., 2012; Jain et al., 2015). It has been suggested that one of the reasons for the difference in reaction times between males and females is sex hormones (Müller, 1994). For example, males with lower testosterone concentrations have been found to have slower reaction times (Müller, 1994). Another reason for the difference in reaction times between the genders is thought to be the fact that males are more interested in computer games that require faster reaction (Quaiser-Pohl et al., 2006). In our study, only the simple visual reaction time of males (random) was found to be faster than females, and no significant relationship was found in other tests. Therefore, our study supported that males are faster than females in terms of simple visual reaction time.

We compared reaction times with muscle, fat percentage, and BMI values. Studies conducted in this context have shown that individuals with high BMI have slower visual reaction times (Skurvydas et al., 2009; Deore et al., 2012; Nene et al., 2011). However, in our study, it was found that as the BMI increased in all participants, the time that the participants to respond to the auditory stimulus slowed down. While our study did not find a relationship between visual reaction time and BMI, it contributed to the literature by finding a positive correlation between auditory reaction time and BMI. Such a difference may be attributed to the characteristics of the population. We re-examined it in the context of gender to find out which gender produced the result we found. As a result, it was determined that females with high BMI responded more slowly to the choice visual reaction time test. It was also determined that females with high fat percentage had slower choice visual reaction times. In the same direction, we found that females with higher muscle percentage had faster choice visual reaction times. In addition to the studies suggesting that BMI slows visual reaction time, our study suggests that a high fat percentage slows choice visual reaction time in females.

Reaction time is an important component of motor activities. Reaction time refers to the delay in the sensory nerve code passing through the peripheral and central pathways, perceptual and cognitive processing, a motor signal passing through both the central and peripheral neural structures, and finally the delay in muscle activation (Botwinick et al., 1966). Assessing a person's response speed to various stimuli is crucial for evaluating their ability to react quickly and coordinate their actions in response to environmental factors (Botwinick et al., 1966). Reaction time plays an important role in both daily activities and sports competitions. Visuo-spatial ability can also be defined as cognitive orientation ability. This ability, which can be developed, is important in terms of cognitive evaluation and problem solving. It has been suggested that fat percentage is a better measure than BMI to determine obesity status (Nooyens et al., 2007; Sarria et al., 1998). Therefore, we think that the results related to muscle and fat percentage are more meaningful than the results related to BMI. High fat levels are likely linked to underlying vascular disease, given that high fat is considered a risk factor for vascular disease and is associated with a higher risk of cognitive impairment. The underlying mechanism is related to adipose tissue secretions, such as hormones, cytokines, and growth factors, which can cross the blood-brain barrier and affect brain health (Deore et al., 2012; Sabia et al., 2009). Neurophysiological studies have suggested that the brain regions involved in cognition, memory, vocabulary, rapid information processing and reasoning are affected by fat percentage (Skurvydas et al., 2009; Gunstad et al., 2006; Cournot et al., 2006; Gunstad et al., 2007). Thus, we believe that BMI, especially fat percentage negatively affects reaction time and visuo-spatial skills. Oestrogen exposure is known to cause weight gain, especially an increase in adipose tissue primarily through thyroid inhibition and modulation of the hypothalamus (Santin and Furlanetto, 2011). It is known that oestrogene is related with female characteristics. Since female individuals are not as good as males in reaction time and visuo-spatial abilities as it is reported in the literature (Levine et al., 2016; Titze et al., 2010; Dykiert et al., 2012; Jain et al., 2015). Oestrogen related fat augmentation could be the reason of the low reaction time and insuffecient visuo-spatial abilities. We think that keeping the fat percentage in a healthy range can increase the success level of people in areas such as e-sports, where visual spatial skills or reaction time are important.

Conclusions

As a result, individuals who were found to be more aggressive according to the total aggression and verbal aggression parameters in the Buss-Perry aggression questionnaire were found to be more successful in the mental rotation test. In addition, it was determined that females with a high total aggression score had shorter simple visual reaction times. It was also concluded that females with high muscle percentage and low fat percentage performed better in the mental rotation test. On the other hand, it was determined that females with high fat percentage and low muscle percentage had slower choice visual reaction times. The effect of fat percentage both on reaction time and mental rotation in females is likely related to oestrogen levels. Further studies should be planed on this aspect. Since the individuals with better visuo-spatial abilities or cognitive abilities, tend to be more aggressive, it would be better for such students to be directed to some other activities such as sports. We think that re-exploring with a different sample would yield better results in order to better understand the relationship between aggression, visuo-spatial ability and reaction time. On the other hand, we think that if a person’s fat percentage is in the healthy range, they may have better visuo-spatial ability and faster reaction time.

Conflicts of interest

The authors declare no conflict of interest.

References

Adam JJ. (1999) Gender differences in choice reaction time: evidence for differential strategies. Ergonomics 42(2):327-335.

Archer J. (2004) Sex differences in aggression in real-world settings: a meta-analytic review. Rev General Psychol 8(4):291-322.

Bandura A. (1973) Aggression: a social learning analysis. Englewood Cliffs, NJ: Prentice-Hall.

Botwinick JT, Larry W. (1966) The premotor and the motor components of the reaction time. J Exp Psychol 71(1):9-15.
Burton LA, Hafetz J, Henninger D. (2007) Gender differences in relational and physical aggression. Soc Behav Pers 35(1):41-50.
Buss AH, Durkee A. (1957) An inventory for assessing different kinds of hostility. J Cons Psychol 21(4): 343-349.
Buss AH, Perry M. (1992) The aggression questionnaire. J Pers Soc Psychol 63(3):452-459.
Campbell A. (1993) Men, women and aggression. New York: Basic Books.
Cohen MS, Bookheimer SY. (1994) Localization of brain function using magnetic resonance imaging. Trends in Neurosciences 17(7):268-277.
Cohen MS, Kosslyn SM, Breiter HC, DiGirolamo GJ, Thompson WL, Anderson AK, Belliveau JW. (1996) Changes in cortical activity during mental rotation: a mapping study using functional MRI. Brain 119(1):89-100.
Cournot M, Marquie JC, Ansiau D. (2006) Relation between body mass index and cognitive function in healthy middle aged men and women. Neurology 67:1208–1214.
Dabbs J, Hargrove MF. (1997) Age, testosterone and behaviour among female prison inmates. Psychosom Med 59(5):477-480.
Dane S, Erzurumluoglu A. (2003) Sex and handedness differences in eye-hand visual reaction times in handball players. Int J Neurosci 113(7):923-929.
Debarnot U, Piolino P, Baron JC, Guillot A. (2013) Mental rotation: effects of gender, training and sleep consolidation. PLoS One 8(3):e60296.
Deore DN, Surwase SP, Masroor S, Khan ST, Kathore V. (2012) A cross sectional study on the relationship between the body mass index (BMI) and the audiovisual reaction time (ART). JCDR 6(9):1466-1468.
Ducharme S, Hudziak JJ, Botteron KN, Ganjavi H, Lepage C, Collins DL, Brain Development Cooperative Group. (2011) Right anterior cingulate cortical thickness and bilateral striatal volume correlate with child behavior checklist aggressive behavior scores in healthy children. Biol Psychiatry 70(3):283-290.
Dykiert D, Der G, Starr JM, Deary IJ. (2012) Sex differences in reaction time mean and intraindividual variability across the life span. Develop Psychol 48(5):1262.
Eals M, Silverman I. (1994) The hunter-gatherer theory of spatial sex differences: proximate factors mediating the female advantage in recall of object arrays. Ethology and Sociobiology 15(2):95-105.
Engel BT, Phillip R. Horne T, Reginald EQ. (1972) On the relationship among sex, age, response mode, cardiac cycle phase, breathing cycle phase, and simple reaction time. J Gerontol 27:456-460.
Facchiano E, Scaringi S, Veltri M. (2013) Age as a predictive factor of testosterone improvement in male patients after bariatric surgery: preliminary results of a monocentric prospective study. Obes Surg 2:167–72.
Furlow B, Gangestad SW, Armijo P. (1998) Developmental stability and human violence. Proc R Soc B: Biol Sci 265(1390):1-6.
Gunstad J, Paul RH, Cohaen RA, Tate DF, Gordon E. (2006) Obesity is associated with memory deficits in young and middle aged adults. Eat Weight Disord 11:15–19.
Gunstad J, Paul RH, Cohen RA, Tate DF, Spitznagel MB, Gordon E. (2007) Elevated body mass index is associated with executive dysfunction in otherwise healthy adults. Compr Psychiatry 48(1):57-61.
Jain A, Bansar R, Kumar A, Singh KD. (2015) A comparative study of visual and auditory reaction times on the basis of gender and physical activity levels of medical first year students. Int J App Basic Med Res 5(2):124-127.
Janssen I, Craig WM, Boyce WF, Pickett W. (2004) Associations between overweight and obesity with bullying behaviors in school-aged children. Pediatrics 113(5):1187-1194.
Jardine R, Martin NG. (1983) Spatial ability and throwing accuracy. Behav Genet 13(4):331-340.
Jose S, Gideon PK. (2010) Comparison between auditory and visual simple reaction times. Neurosci Med 1(1):30-32.
Kiziltan E, Yazici AC, Toyran N, Bodur B, Çelik FP, Erdem I, Özbas G. (2015) Görsel-uzaysal beceriler ile akademik başarı ilişkisi: Başkent Üniversitesi Tip Fakültesi tecrübesi. Türkiye Klinikleri Tıp Bilimleri Dergisi 35(3):138.
Kiziltan E, Barut C, Gelir E. (2006) A high-precision, low cost system for evaluating finger-tapping tasks. Int J Neurosci 116(12):1471-1480.
Kreuz LE, Rose RM. (1972) Assessment of aggressive behaviour and plasma testosterone in a young criminal population. Psychosom Med 34(4):321-332.

Levine SC, Foley A, Lourenco S, Ehrlich S, Ratliff K. (2016) Sex differences in spatial cognition: advancing the conversation. Wiley Interdiscip Rev: Cogn Sci 7(2):127-155.
Linn MC, Petersen AC. (1985) Emergence and characterization of sex differences in spatial ability: a meta-analysis. Child Dev 1479-1498.
Madran HAD. (2012) Buss-Perry saldırganlık ölçeğinin Türkçe formunun geçerlik ve güvenirlik çalışması. Türk Psikol Derg 24(2):1-6.
Meng KY, Zuhairi NA, Manan FA, Knight VF, Padri MNA, Omar R. (2015) Role of gender, age and ethnicities on visual reaction time and visual anticipation time of junior athletes. Aust J Basic Appl Sci 9(5):129-134.
Morsunbül Ü. (2015) The effect of identity development, self-esteem, low self-control and gender on aggression in adolescence and emerging adulthood. Eurasian J Educ Res (61): 99-116.
Müller MJ. (1994) Salivary testosterone and simple reaction time parameters. Neuropsychobiology 30(4):173-177.
Nene AS, Pazare PA, Sharma KD. (2011) A study of relation between body mass index and simple reaction time in healthy young females. Indian J Physiol Pharmacol 55(3):288-291.
Nooyens AC, Koppes LL, Visscher TL, Twisk JW, Kemper HC, Schuit AJ. (2007) Adolescent skinfold thickness is a better predictor of high body fatness in adults than is body mass index: The Amsterdam Growth and Health Longitudinal Study. Am J Clin Nutr 85:1533–1539.
Oldfield RC. (1971) The assessment and analysis of handedness: The Edinburgh inventory. Neuropsychologia 9(1):97-113.
Peters M, Battista C. (2008) Applications of mental rotation figures of the Shepard and Metzler type and description of a mental rotation stimulus library. Brain and Cogn 66(3):260-264.
Quaiser-Pohl C, Geiser C, Lehmann W. (2006) The relationship between computer-game preference, gender, and mental-rotation ability. Pers Individ Differ 40(3):609-619.
Raine A, Lencz T, Bihrle S, LaCasse L, Colletti P. (2000) Reduced prefrontal gray matter volume and reduced autonomic activity in antisocial personality disorder. Arch Gen Psychiatry 57(2):119-127.
Sabia S, Kivimaki M, Shipley MJ, Marmot MG, M anoux AS. (2009) Body mass index over the adult life course and cognition in midlife: The Whitehall II cohort study. Am J Clin Nutr 89:601–607.
Santin, AP, Furlanetto TW. (2011) Role of estrogen in thyroid function and growth regulation. J Thyroid Res 1-7.
Sarría A, García-Llop LA, Moreno LA, Fleta J, Morellón MP, Bueno M. (1998) Skinfold thickness measurements are better predictors of body fat percentage than body mass index in male Spanish children and adolescents. Eur J Clin Nutr 52:573–576.
Skurvydas A, Gutnik B, Zuoza AK, Nash D, Zuoziene IJ, Mickeviciene D. (2009) Relationship between simple reaction time and body mass index. Homo 60(1):77-85.
Shepard RN, Metzler J. (1971) Mental rotation of three-dimensional objects. Science 171(3972):701-703.
Şahin Ş, Cesur N, Şahin E. (2019) Kadın artistik ve aerobik cimnastikçilerin reaksiyon zamanı ve mental rotasyon performanslarının incelenmesi. Uluslararası İnsan ve Sanat Araştırmaları Dergisi 2(2):19-25.
Tagaris GA, Richter W, Kim SG, Pellizzer G, Andersen P, Uğurbil K, Georgopoulos AP. (1998) Functional magnetic resonance imaging of mental rotation and memory scanning: a multidimensional scaling analysis of brain activation patterns. Brain Res Rev 26(2-3):106-112.
Thompson EG, Mann IT, Harris LJ. (1981) Relationships among cognitive complexity, sex, and spatial task performance in college students. British J Psychol 72(2):249-256.
Tiihonen J, Rossi R, Laakso M P, Hodgins S, Testa C, Perez J, Frisoni GB. (2008) Brain anatomy of persistent violent offenders: more rather than less. Psychiatry Res: Neuroimaging 163(3):201-212.
Titze C, Jansen P, Heil M. (2010) Mental rotation performance and the effect of gender in fourth graders and adults. Eur J Dev Psychol 7(4):432-444.
Tso MK, Rowland B, Toumbourou JW, Guadagno BL. (2018) Overweight or obesity associations with physical aggression in children and adolescents: A meta-analysis. Int J Behav Dev 42(1):116-131.
Turos J, Ervin A. (2000) Training and gender differences on a web-based mental rotation task. The Penn State Behrend Psychology Journal 4(2):3-12.
Yargic MP, Aydin L, Erdagi K, Kiziltan E. (2019) The use of computer based test battery for the assessment of cognitive functions in elite-level strength training. In 2019 IEEE 19th International Conference on Bioinformatics and Bioengineering (BIBE), 334-338.
Young L, Bechara A, Tranel D, Damasio H, Hauser M, Damasio A. (2010) Damage to ventromedial prefrontal cortex impairs judgment of harmful intent. Neuron 65(6):845-851.
Zacks JM. (2008) Neuroimaging studies of mental rotation: a meta-analysis and review. J Cogn Neurosci 20(1):1-19.