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Examination of Perceived Stress and Cognitive Flexibility in Terms of Executive Functions in Young Athletes

"Genç Sporcularda Algılanan Stres ve Bilişsel Esnekliğin Yürütücü İşlevler Açısından İncelenmesi"

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ABSTRACT

Aim: Stress, known as the disease of modern society, is a condition that negatively affects individuals both mentally and physiologically. Especially in athletes, both the stress of life and the stress of training and competition arising from the nature of the sport cause negative results in terms of performance on the athletes. This study aims to investigate the perceived stress levels and cognitive flexibility of young athletes in terms of executive function.
Material and Method: This study consists of 159 volunteer young athletes. Sociodemographic data form, Cognitive Flexibility (CF) Scale and Perceived Stress (PS) Scale were administered to the participants. In addition, the executive function performances of the participants were obtained by using the Stroop Test (ST), which is a neuropsychological test battery.
Results: In the study, it was observed that there was a negative relationship between CF and PS ($r=-.784$, $p<0.001$) and ST ($r=-.427$, $p<0.01$). A significant positive correlation was found between PS and ST ($r= .303$, $p<.01$) scores. It was determined that sport branch and the educational status of the parents was statistically significant in CF scores, PS scores and ST in young athletes ($p<0.05$).
Conclusions: As a result, changes in PS, CF, and ST scores are correlated. The conclusion that the individual's psychological structure and neuropsychological structure are related in the context of the brain-behavior relationship was supported by the findings of our study. In order to minimize the perceived stress in athletes, cognitive exercises should be included in addition to sports training.

Keywords: Cognitive Flexibility, Perceived Stress, Stroop Test.

ÖZET

Amaç: Modern toplumun hastalığı olarak bilinen stres, bireyleri hem zihinsel hem de fizyolojik olarak olumsuz etkileyen bir durumdur. Özellikle sporcularda hem yaşam stresi hem de sporun doğasından kaynaklanan antrenman ve yarışma stresi sporcular üzerinde performans açısından olumsuz sonuçlara neden olmaktadır. Bu çalışma, genç sporcuların algılanan stres düzeylerini ve bilişsel esnekliğini yürütücü işlev açısından araştırmayı amaçlamaktadır.
Materyal ve Metod: Çalışma 159 gönüllü genç sporcudan oluşmaktadır. Katılımcılara sosyodemografik veri formu, Bilişsel Esneklik (BE) Ölçeği ve Algılanan Stres (AS) Ölçeği uygulanmıştır. Ayrıca nöropsikolojik bir test bataryası olan Stroop Testi (ST) kullanılarak katılımcıların yürütücü işlev performansları elde edilmiştir.
Bulgular: Çalışmada BE ile AS ($r=-.784$, $p<0.001$) ve ST ($r=-.427$, $p<0.01$) arasında negatif bir ilişki olduğu görüldü. AS ve ST ($r= .303$, $p<.01$) puanları arasında pozitif yönde anlamlı bir ilişki bulundu. Genç sporcularda bilişsel esneklik puanları, algılanan stres puanları ve stroop görevlerinde spor branşı ve ebeveynlerin eğitim durumunun istatistiksel olarak anlamlı olduğu belirlendi ($p<0.05$).
Sonuç: Sonuç olarak, algılanan stres, bilişsel esneklik ve stroop testi puanlarındaki değişiklikler birbiriyle ilişkilidir. Bireyin psikolojik yapısı ile nöropsikolojik yapısının beyin-davranış ilişkisi bağlamında ilişkili olduğu sonucu çalışmamızın bulgularıyla desteklenmiştir. Sporcularda algılanan stresi en aza indirmek için spor antrenmanlarına ek olarak bilişsel egzersizlere de yer verilmelidir.

Anahtar Kelimeler: Algılanan Stress, Bilişsel Esneklik, Stroop Test.

INTRODUCTION

Stress, which is defined in many ways, constitutes an important phenomenon in the field of sports sciences as well as in the fields of medicine, social sciences and psychology (İlker, 2019; Selye, 1956). Stress is a situation where the organism cannot adapt to unexpected situations and causes physiological and psychological unusual reactions (Özden & Sertel-Berk, 2017; Selye, 1956). In this case, stress is the interaction between the environment and the person that compels the person's well-being (Lazarus & Folkman, 1984). Stress is a state of tension that occurs when unusual demands, threats, and opportunities confront individuals, this state of tension causes the deterioration of the structure of a balance provided in the organism (Şahin, Güler, & Basım, 2009). Responses to stress or the adaptation process to changes in the organism caused by stress can cause various harms that will threaten the organism in the short or long term (Bedir, 2021). Especially in individuals who do sports, both the stress of life and the stress of training and competition arising from the nature of the sport can cause negative results in terms of performance on the athletes (Jones, Swain, & Cale, 1991). During the competition, the desire to win or the fear of losing creates a mental pressure, cheering or other external factors (weather, field ground conditions, etc.) cause individuals to be exposed to more stress (Najafipour, 2016).

Cognitive (focused attention, prolonged attention, selective attention, etc.,), behavioral (irritability, feeling inadequate, insecurity, etc.,) and physiological (high blood pressure, excessive sweating, etc.,) harmful effects of stress in athletes negatively affect the success and daily routines of the athletes (Güçlü, 2001). The athletes who are least affected by these negativities are the ones who will come closest to success. As emphasized in the definitions related to stress, it occurs in individuals for various reasons and these reasons are expressed as stressors or stress factors (Selye, 1956). However, the responses to these external stimuli, called stressors, show individual differences (Schreck, Olla, & Davis, 1997). The stress response occurs not depending on what happens in the environment, but on how people interpret the event. Many factors influence how people interpret events or situations (Altunkol, 2011). There is a strong relationship between a person's lifestyle, personality structure and perspective and the effect of stress on that person (Avşaroğlu & Ömer, 2007). In this context, some studies have been conducted investigating the characteristics of the personality structure prone to stress (Holmes & Holmes, 1970; Lazarus & Folkman, 1984; Morgan, 1993). At the end of the 1970s, studies were conducted to divide people into groups exhibiting type A, B, and C behavior (Morgan, 1993). These studies mention that different personality types perceive stress differently (Avşaroğlu & Ömer, 2007). Stress is a reality of everyday life and, changes we need to adapt to. The most effective way to adapt; to be able to see the pressure and problems as they are, to make decisions, to make plans; that is, it includes skills that be helpful to changin the situation. This adaptation process is possible with the individual's high ability to think and act flexibly (Altunkol, 2011). Regardless of the coping style, being “flexible” is an important quality. The effectiveness and flexibility of any coping style is determined by whether it allows us to explore other options when in a stressful situation (Lazarus & Folkman, 1984). Flexibility allows us to be more open to change. This reduces the number of events that we perceive as stressful (Lazarus, 2020). The degree of stress experienced by an individual in the face of an event is largely determined by the way evaluates this event (Lazarus & Folkman, 1984). As the cognitive flexibility level of the person decreases, insists on a single strategy instead of alternative thinking, evaluates the events around her as stressful, and the perceived stress level will be high (Demirtaş, 2019). Flexibility allows the person to take the stressful situation as a whole, to see the variables and limits of the problem in all its dimensions, not just one aspect. It helps the person to see that the problem is no longer the same problem (Turan, Durgun, Kaya, Ertaş, & Kuvan, 2019). Because the flexible person can redefine the problem (Runco & Pritzker, 2020). The frequency of momentarily changing situations in sports environments is a stress factor, and adapting to these situations is possible with a flexible cognitive structure (Najafipour, 2016). In such situations, it is known that people who are self-confident and use their skills correctly are able

to produce many solutions and thus it is easier to adapt to the changing situation (J. J. Canas, Fajardo, & Salmeron, 2006). The ability of individuals to adapt to such situations is explained by the concept of cognitive flexibility (Kalia & Knauft, 2020). Cognitive flexibility is the ability of an individual to process cognition and activate it in unexpected situations (J. Canas, Quesada, Antolí, & Fajardo, 2003). Before individuals decide to adapt their behavior to the situation, they go through social cognition processes where they are aware of the options available and they create scenarios from these options (Roloff & Berger, 1982). Individuals with more scenarios have more complex information processing process and are more flexible (Martin & Anderson, 1998).

In order for the cognitive structure of the person to be active, first of all, there must be perception, and then the perceived situation or events must be interpreted and made mentally meaningful (Bilgiç & Bilgin, 2016; Bilgin, 2009). The realization of these processes is related to executive functions (Karakaş & Karakaş, 2000).

Executive functions are realized through certain neural systems. These systems arise as a result of the activities of certain parts of the brain and the connection pathways between these regions (Gilbert & Burgess, 2008). In the cognitive system, many processes such as learning, remembering, constant attention, resistance to interference influences, planning and problem solving are organized together (Karakaş & Karakaş, 2000). Stress negatively affects task performance, often as a result of disruptions in thought or cognitive functions (Çakar & İkiz, 2016). Neuropsychological measurement tools are used to evaluate these cognitive functions (Karakaş & Karakaş, 2000). In this context, one of the most frequently used tests is the stroop test. The Stroop Test is a neuropsychological test that reflects the frontal region of the brain (Kang et al., 2019). The applied test is an extremely common neuropsychological test used to measure selective attention, resistance to interference, and information processing speed (Lezak, Howieson, Loring, & Fischer, 2004; Spreen & Strauss, 1998; Stroop, 1992). In a task where a word itself should express a color, if the color used in the spelling of the word and the color the word expresses are not the same, if there is a conflict between them, the time to say the color will be longer. Stroop interference effect is about that delay (MacLeod, 1991). Resisting this interference is related to flexibility and ability to shift perceptual setup, attention, and behavior (Karakaş, 2013).

In this context, statistical relationships between cognitive flexibility, perceived stress and executive function performance in young athletes were analyzed and discussed.

MATERIAL AND METHOD

Research Model

In the study, the relational survey model (Karasar, 2012), one of the quantitative research methods, was used.

Participants and Recruitment

While the population of the research consists of competing athletes (female-male) aged between 15 and 18 who are educated in Sarıkamış Sports High School in Turkey, the sample of the study consists of a total of 190 young athletes, 130 male and 60 female, representing the population. Participants were selected from licensed athletes (through purposive sampling) among students studying at Sarıkamış Sports High School. 13 male and 18 female athletes who could not meet the inclusion criteria were not included in the study. The study was carried out with a total of 159 young athletes, 117 male and 42 female.

Inclusion Criteria for the Study

Studying at Sports High School, Doing licensed sports and participating in competitions, No history of psychological/neurological disorders or head trauma, Not using drugs that may affect the Central Nervous System or cognitive functions.

Background Characteristics

The following background characteristics were analyzed: Gender, Sport branch, Father's Education, Mother's Education, Mood.

Designing the Executive Function Test in A Computer Program and Preparing The Scales

The Stroop Test, which is a neuropsychological test, was used to evaluate the executive function performances of the participants. The test to be administered via computer was prepared by the experts of Atatürk University Sports Sciences Application and Research Center. Details about the test are given below.

Stroop Test

In the Stroop Test, which will be applied through the computer in the research, the colored texts on the screen were presented to the participants as neutral (N) – congruent (C) and incongruent (IC) blocks, and they were asked to respond. In the task block consisting of neutral stimuli, the participants answered the options that appeared on the screen with the color of the text "XXX" written in blue, red or green ink color, by using the right-left keys of the keyboard. Congruent duty, the word blue" was displayed in blue ink, the word "red" in red ink, and the word "green" in green ink. İncongruent task, the word "blue" was given in red or green, the word "red" in blue or green, and the word "green" in red or blue, and the participant was asked to answer what color the text was, as he did before. In this way, it was applied in the same session as 3 repetitions in three different situations (neutral- congruent- incongruent) as a total of 9 blocks. The answers given by the participants during the test process were calculated by taking into account the parameters of speed, stroop effect and correct and incorrect color. The transition between blocks is 5 seconds. This scoring is a type of scoring called the Jensen system, which obtains three factors by applying all the scoring types used in the literature in the same research and makes it possible to evaluate over these factors (Jensen, 1965; Karakaş, 2013). The stroop effect score was obtained by subtracting the congruent task time scores from the incongruent task time. 5 seconds break between blocks, each block continues for 40 seconds.

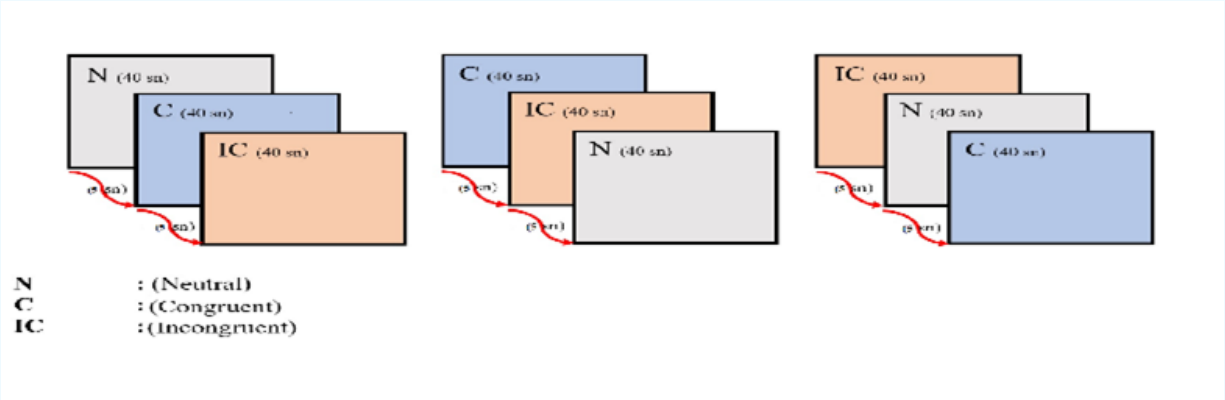

Figure1. *Stroop Test Design*

Cognitive Flexibility Scale (CFS)

CFS was developed by Martin and Rubin and adapted into Turkish by Altunkol (Altunkol, 2011). In order to determine the cognitive flexibility level of the individuals, a 6-point Likert-type cognitive flexibility scale, out of a total of 11 items, was used. Evaluation is based on the total score. The internal consistency Cronbach's alpha coefficient calculated to test the reliability of the CFS was found to be ,865.

Perceived Stress Scale (PSS)

The PSS developed by Cohen et al. is used to determine individuals' perceived stress levels(Cohen, Kamarck, & Mermelstein, 1983). PSS was adapted into Turkish by Yerlikaya and İnanç (Yerlikaya & İnanç, 2007). The 4th, 5th, 6th, 7th, 9th, 10th and 13th items of the scale consisting of 14 items are scored in reverse. Evaluation is based on the total score. The internal consistency Cronbach's alpha coefficient calculated to test the reliability of the PSS was found to be ,983.

Determination of Perceived Stress and Cognitive Flexibility Levels of Young Athletes

In order to determine the perceived stress and cognitive flexibility levels of the participants included in the study, the relevant scales were filled in face to face by the researcher at Sarıkamış Sports High School.

Determination of Executive Function Levels of Young Athletes

In order to measure the executive function performances (Stroop Task) with computer, the test design from Atatürk University Sports Sciences Application and Research Center was written via the MATLAB Program and applied to the participants face-to-face at Sarıkamış Sports High School.

Statistical Analysis

Data analysis was carried out by using SPSS version 20.0 (IBM Corp., Armonk, NY, USA). The categorical variables were provided as frequency and percentages, after the descriptive analysis was carried out, in order to examine the socio-demographic characteristics (gender, sports branch, mood, parents education status) of the participants. In order to determine whether the parametric or non-parametric tests would be used or not, initially the conformity of the normal distributions was determined with Skewness-Kurtosis values. Student t test and One-way ANOVA was used for the variables, which were in compliance with the normal distribution. In addition, Pearson correlation analysis was performed to determine the Relationship between Young Athletes' SE, CF and PS Scores. The stroop effect score was derived from difference between incongruent task time with congruent task time of the stroop sessions. The statistical significance p values were deemed as equal to 0.05 or less.

RESULTS

Table 1. *Demographic Characteristics of Participants, Frequency Analysis*

Variable	Group	f	%
Gender	Male	117	73,6
	Female	42	26,4
Sport Branch	Individual	81	50,9
	Team	78	49,1
Mood	Calm	26	16,4
	Optimistic	39	24,5
	Shy	28	17,6
	Pessimistic	40	25,2

	Furious	26	16,4
MES	Primary school	76	47,8
	Secondary school	42	26,4
	High school	16	10,1
	No education	25	15,7
FES	Primary school	12	26,4
	Secondary school	48	30,2
	High school	57	35,8
	No education	12	7,5
Total		**159**	**100**

SB: Sport Branch; MES: Mother Education Status; FES: Father Education Status; CF: Cognitive Flexibility; PS: Perceived Stress; SE: Stroop Effect

73.6% of the participants were male and 26.4% were female. 50.9% of the participants doing individual sports and 49.1% doing team sports. 16.4% of the participants described themselves as Calm, 24.5% as Optimistic, 17.6% as Shy, 25.2% as Pessimistic and 16.4% as Furious. Parent education status of the participants; 47.8% mother primary school 26.4% father primary school 26.4% mother secondary school 30.2% father secondary school 10.1% mother high school, 35.9% father high school, and 15.7% of them were answered as no mother's education level, 7.5% no father's education level.

In order to test whether the scale data and Stroop effect scores showed normal distribution, Skewness and Kurtosis values were examined. According to George and Mallery (George & Mallery, 2019), if it is between -2.0 and +2.0, it can be said that it has a homogeneous distribution. In this direction, parametric statistical analyzes were used in the study.

Table 2. *Normality Test Scores of Variables*

	CF	**PS**	**SE**
N	159	159	159
Mean	4,15380	2,95193	,2158
Std. Deviation	1,726999	,761568	,20476
Skewness	-,695	,306	-,148
Kurtosis	-1,331	-1,300	-,187

CF: Cognitive Flexibility; PS: Perceived Stress; SE: Stroop Effect

Table.3 *The Independent Samples T-Test results according to Gender variable*

	Gender	**N**	**Mean±Sd**	**t**	**p**
CF Total	Male	117	4,11 ±1,73	-,472	,638
	Female	42	4,26 ±1,73		
PS Total	Male	117	2,98±,777	,923	,357
	Female	42	2,85±,715		
Stroop Effect (sec)	Male	117	,222±,203	,702	,490
	Female	42	,196±,208		

*p≤0.05; **p≤0.01

When Table 3 is examined, it has been determined that there is no significant difference in CF, PS and SE scores according to the gender variable of the young athletes. (p>0.05).

Table.4 *The Independent Samples T-Test results according to Sport Branch variable*

	Sport Branch	N	Mean±Sd	t	p
CF Total	Individual	81	3,30 ±1,82	-7,31	,000**
	Team	78	5,03 ±1,05		
AS Total	Individual	81	3,37±,720	8,77	,000**
	Team	78	2,50±,509		
Stroop Effect (sec)	Individual	81	,249±,203	2,15	,033*
	Team	78	,180±,201		

*p≤0.05; **p≤0.01

When Table 4 is examined, CF differ in favor of team sports (p=.000). However, PS (p=.000) and SE score (p= 0.33) differ in favor of those who do individual sports.

Table.5 *The One-Way ANOVA (Welch's) results according to mood variable*

	Mood	N	Mean±Sd	F	p	Difference
CF Total	1-Calm	26	5,10±1,15	9,75	.000**	1,2<4,5
	2-Optimistic	39	4,56±1,48			
	3- Shy	28	4,79±1,55			
	4- Pessimistic	40	3,12±1,79			
	5- Furious	26	3,48±1,65			
PS Total	1-Calm	26	2,57±,507	3,02	.020*	4,5>1
	2-Optimistic	39	2,87±,727			
	3- Shy	28	2,93±,684			
	4- Pessimistic	40	3,13±,855			
	5- Furiou0s	26	3,18±,829			
Stroop Effect (sec)	1-Calm	26	,110±,157	17,19	,000**	4,5>1,2,3
	2-Optimistic	39	,120±,177			
	3- Shy	28	,131±,198			
	4- Pessimistic	40	,361±,173			
	5- Furious	26	,332±,144			

*p≤0.05; **p≤0.01

When Table 5 is examined, CF differ in favor of Calm ve Optimistic (p=.000). However, PS (p=.020) and SE score (p= .000) differ in favor of Pessimistic and Furious

Table.6 *The One-Way ANOVA (Welch's) results according to MES variable*

	MES	N	Mean±Sd	F	p	Difference
CF Total	1. Pri school	76	3,81±1,85	3,91	.010*	3>4,1
	2.Sec school	42	4,48±1,40			
	3.High school	16	5,23±1,05			
	4. No edu.	25	3,92±1,84			
PS Total	Pri school	76	3,09±,758	4,11	.008*	4,1>3,2
	Second school	42	2,72±,751			
	High school	16	2,57±549			
	No edu.	25	3,12±766			
Stroop Effect (sec)	Pri school	76	,250±,191	3,62	,014*	4,1>3,2
	Second school	42	,162±,208			
	High school	16	,113±,233			
	No education	25	,264±,186			

*p≤0.05; **p≤0.01

When Table 6 is examined, CF differ in favor of High school (p=.010). However, PS (p=.0,08) and SE score (p= .014) differ in favor of No education ve Primary school

Table.7 *The One-Way ANOVA (Welch's) results according to FES variable*

	FES	N	Mean±Sd	F	p	difference
CF Total	1. Pri school	42	3,67±1,85	6,40	.000***	3>4,1,2
	2.Sec school	48	4,10±1,71			
	3.High school	57	4,80±1,35			
	4.No edu.	12	2,93±1,86			
PS Total	Pri school	42	3,14±,817	4,32	.006*	4,1>3
	Second school	48	2,95±,753			
	High school	57	2,71±,680			
	No edu.	12	3,38±,640			
Stroop Effect (sec)	Pri school	42	,264±,209	2,19	,091	-
	Second school	48	,181±,200			
	High school	57	,191±,209			
	No education	12	,298±,138			

*p≤0.05; **p≤0.01

When Table 7 is examined, CF differ in favor of High school (p=.000). PS (p=.0,06) differ in favor of No education ve Primary school. However, the SE score did not differ according to FES.

Table.8 *Correlation between Stroop Effect Scores, Cognitive Flexibility and Perceived Stress scores of Young Athletes*

		CF	PS	SE
CF	Pearson's r	**1**	**-0,784****	**-0,427***
	p-value	—	<,001	<,01
PS	Pearson's r	-0,784**	—	0,303*
	p-value	<,001	—	<,01

*p≤0.05; **p≤0.01

In young athletes, when we examined the relationship between CF and PS (r=-.784, p<.001) and SE (r=-.428, p<.01) scores, significant negative correlations were found. There is a positive and significant correlation between PS and SE (r= .303, p<.01) scores.

DISCUSSION AND CONCLUSION

In our study, the perceived stress levels and cognitive flexibility of young athletes were examined in terms of executive functions.

One of the important findings of our study was the inverse correlation between CF and PS (r=-.784, p<0.001) and SE (r=-.428, p<0.01) in young athletes. As a result of this finding, the stroop test incongruent task session can be considered as a stressor and can be seen as a factor that creates stress in individuals. Another important finding was the positive correlation between the increase in SE scores and PS scores (r=.303, p<.01). On the other hand, the sports branch of young athletes differed in terms of CF(p=.000)-PS (.000) and SE (.033) scores. It is thought that this situation arises from relationships that will make the individual feel more comfortable, such as more social relations, the possibility of a teammate to make up for the mistake in the match, and sharing responsibility. In addition, MES was another finding that affected CF(P=.010)-PS (.008) and SE (.014) scores in individuals. Although FES showed similarities with MES, it did not differ significantly in SE scores (P=.091). It is seen that the athletes who have parents with a high level of education have lower PS, lower SE scores and higher CF scores than other individuals. It is seen that parent education can be explanatory in terms of CF-PS and SE in the development of individuals.

In the study we conducted to examine PS and CF in terms of executive function, young athletes with high cognitive flexibility were found to have low perceived stress levels. Accordingly, it is seen that athletes with high cognitive flexibility have fewer perseverative errors in stroop test scores and better reaction time in stroop test tasks. Previous research has reported a strong association between anxiety and depression and impulsivity (Fawcett, 2001; Moustafa, Tindle, Frydecka, & Misiak, 2017; Swann, Steinberg, Lijffijt, & Moeller, 2008; Taylor et al., 2008). The response to the incongruent task, which is one of the tasks applied in the Stroop test, is associated with impulsivity and generally refers to cognitive rigidity (Han et al., 2011). A higher cognitive flexibility would then be associated with less anxiety, depression, and stress. Our findings also confirm this. In the study, which was conducted using neuropsychological tests, the relationship between high cognitive flexibility and low stress was mentioned (Han et al., 2011). In addition, it is seen that high cognitive flexibility has less perseverative errors and better reaction time in applied neuropsychological test tasks (Castiello & Umiltà, 1992; Nougier, Ripoll, & Stein, 1989).

In the study, it was determined that there was no significant difference in the CF, AS and SE scores ($p>0,05$) of the participants according to the gender variable. In another study, cognitive flexibility does not differ in terms of gender (Yu, Yu, & Lin, 2020). In a study on karate referees, it was determined that the level of cognitive flexibility did not differ according to gender in referees (Kara, Kara, Koç, & Dönmez, 2019). Another studys stated that cognitive flexibility scores did not differ according to gender (t=-72 p=.47) (Kara, 2020; Martin & Rubin, 1995). In different studies conducted with adults, university students and high school students, it was found that cognitive flexibility did not change according to gender (Bilgin, 2009; Diril, 2011; Martin & Rubin, 1995). When the number of correct answers ($p>0.05$) and average response speed ($p>0.05$) were compared according to gender in the Stroop Test, no statistically significant differences were found between female athletes and male athletes (Üngür, 2013). According to this situation, it can be deduced that there is no cognitive difference between male and female students, especially in adolescence.

Findings that are not similar to our study in the literature are given below; In a recent study, they stated that female students had higher scores than male students in terms of perceived stress (C. Wang, Zhang, Wiley, Fu, & Yan, 2022). In a different study conducted with university students, it was stated that the cognitive flexibility of boys was higher than that of girls and it was statistically ($p<.05$) significant (Altunkol, 2011). In another study on gender differences, it is stated that the cognitive flexibility levels of men differ more positively than women (Asıcı & İkiz, 2015).

Significant differences were found in the CF (P=,010), PS (P=,008) and SE scores (p=,014) according to the general mood variables of the young athletes.

Many studies have mentioned an increase in CF under positive mood (Murray, Sujan, Hirt, & Sujan, 1990; Nadler, Rabi, & Minda, 2010; Satan, 2014; Y. Wang, Chen, & Yue, 2017). In the study conducted with university students, there was a positive and significant relationship between the students' cognitive flexibility scores and their happiness scores ($r= .407$; $p<.05$)(Asıcı & İkiz, 2015). In the study conducted on adolescent students, it was determined that there was a positive and high correlation ($r=.734$) between cognitive flexibility and positive mood (Satan, 2014). In a psychopathological study, it is stated that there was a significant positive correlation between cognitive flexibility and optimism ($r=.45$, $p<.01$)(Dağ & Gülüm, 2013). In our study, it is seen that athletes with an optimistic mood ($\bar{x} = 4,561$) have a higher cognitive flexibility. It was stated that the total effect of pessimistic mood on perceived stress ($p<0.001$) was statistically significant (Demirtas & Yildiz, 2019). In the same study, the direct effects of pessimistic mood on cognitive flexibility ($t=-7.23$, $p<0.001$) were found to be statistically negative (Demirtas & Yildiz, 2019). A neuropsychological measurement tool was not used in these studies. In our study, SE scores differ in terms of mood variable, which means that individuals who are

more optimistic or calm may be more successful in cognitive tasks. In addition, when incongruent task is considered as a stress factor, it is seen that individuals who are calm or optimistic can overcome this stress factor better and have lower stroop effect scores.

Unlike our study; found that those in a happy mood were significantly slower in the transition condition of a traditional Stroop task (Phillips, Bull, Adams, & Fraser, 2002) and another study found that positive mood did not affect task switching (López-Benítez, Carretero-Dios, Acosta, & Lupiáñez, 2017).

In the current study, it is seen that there are studies in the literature showing that mood can be measured validly with a single item(Abdel-Khalek, 2006; Demir, Demir, & Doğrul, 2021; Elo, Leppänen, & Jahkola, 2003). However, measuring moods with single-item options constitutes the limitation of this study. Considering the variables used in our study in larger sample groups in the context of sportive performance, success and brain hemodynamics by using more advanced technologies will allow us to better understand and manage these variables.

Recommendations

As a result, changes in perceived stress, cognitive flexibility, and stroop test scores are correlated. The conclusion that the individual's psychological structure and neuropsychological structure are related in the context of the brain-behavior relationship was supported by the findings of our study. Sports branch, family education level, and general mood are significant for CF-PS and SE. Although the ability of individuals to be cognitively flexible and adapt to different situations seems like a psychological state, this ability can be developed with cognitive exercises. One of the important variables affecting success in sports environments is undoubtedly perceived stress, and improving the cognitive flexibility of athletes is considered important in reducing the perceived stress level. In this context, adding cognitive exercise programs to athlete training programs may be beneficial. In addition, in terms of general mood, ensuring that the athletes can be calm and optimistic is considered important in order to minimize stress. If sports psychologists consider all these variables, significant gains can be achieved in terms of sportive performance and success.

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