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Investigation of Cognitive Performance of Amateur Boxers

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Abstract

The aim of this study was to compare the cognitive performance of amateur boxers and sedentary people. 31 amateur male boxers (mean age = 20.42 ± 3.88) and sedentary healthy individuals (mean age = 20.65 ± 1.40) voluntarily participated in the study. The Stroop TBAG Form was applied to examine the cognitive performances of the participants. The given normal distribution was evaluated according to the Skewness and kurtosis values. Independent T-test was used for groups comparison. The relationship of continuous variables was evaluated by Pearson analysis. Significance level was accepted as $p<0.05$. SPSS v 26.0 (SPSS Inc., Chicago, IL, USA) package program was used. There was no significant difference in the number of corrections and errors in the Stroop test subsections between the groups. In addition, the relationship between the number of sparring, official matches and cognitive performance could not be determined. As a result, it can be said that there is no significant difference in cognitive performance between amateur boxers and healthy individuals.

Keywords: Cognitive Performance, Boxer, Stroop Test

Introduction

Performance can be defined as the combination of motor skills and cognitive perceptions that are desired to be realized in a certain period of time (Bulğay et al., 2020). Many factors affect performance. These factors include endurance, strength (Pancar, Bicer, Ozdal, 2018), speed (Pancar and Uyduran, 2022), flexibility (Ozer et al., 2017), balance/coordination (Ay and Pancar, 2022; Ozdal et al., 2019; Bilgic et al., 2016), and cognitive performance. It is stated that performance and cognitive development are also supported by exercise, nutrition and some effective supplementary food intake (Tasdogan et al., 2020; Pancar, 2020). Performance should

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not only be expressed as the development of motoric features but also should develop in the same direction with cognitive performance (Bitbrain, 2021).

Cognitive performance is affected by variables such as perception, attention, sportive learning, stress, and anxiety (Birinci et al., 2022). The athlete creates an algorithm in his mind about the positions he encounters in competition or similar environments, and he shows motor performance accordingly. There is also a relationship between motor performance and attention. Attention is the ability to diagnose, select, maintain focus, and ignore certain stimuli. These abilities play an important role in mental processes. In these processes, attention comes first and is accepted as an input channel (Ferdosi, 2002). Attention can be impaired by internal and external factors. Being affected by these factors, they move away from the environment and tire the mind, and attention disorder occurs. Impaired attention negatively affects cognitive performance, thus increasing the possibility of making mistakes (Zoccolotti et al., 2002). Although attention is important in almost every sport, it is critical in some branches. As a result of blows to the head in contact sports, cognitive functions such as attention, perception, and focus are damaged, and so the motor performance of the person may be negatively affected (Loosemore et al., 2007).

The cognitive performance (perception and attention) of the boxers should be at a high level during the competition or training. In these environments, while boxers play against each other in a strategy of cheating and then punching, the opponent's punch should be defended or avoided (Zorba et al., 1999). Mild brain damage, concentration disorder, amnesia, impaired inference and planning, and psychological and neurological deterioration may occur with the effect of a punch to the head in boxing (Rahmati et al., 2009). With these impairments, the boxer may lose the ability to acutely and chronically diagnose, select, maintain focus and ignore some stimuli, and cognitive performance may slow down (Zoccolotti et al. 2002).

The neurological effect of long pre-competition preparation training was ignored, and its effect on cognitive performance was not examined (Jordan et al., 1996). However, the effect of the blow to the head has been examined in professional boxing (Khani et al., 2012), but its effects on amateur boxing have been found in very few studies (Zazryn et al., 2006). Some studies have argued that amateur boxing has fewer neurological effects than professional boxing. The reason for this is that the number of rounds is less, the amateur boxing competition becomes a score-oriented game instead of destroying the opponent, and at the same time, it is predicted that the use of boxing head guard reduces the neurological effect (Loosemore et al., 2007).

According to the literature review, the number of scientific studies examining the cognitive performance of amateur boxers is quite low. In this direction, this study had two aims. The first was to examine the relationship between the cognitive performance of amateur boxers, sparring (training match), and the number of official matches. The second aim was to compare the cognitive functions of amateur boxers and sedentary individuals.

Method

Sample Size

The sample size was made using the G*Power 3.1 program. When Stroop test variable effect size d (effect size): 0.86 was taken, the sample number determined for Power: 0.80 and α: 0.05 was determined as 36 people in total, including the control group (n=18) and the boxer group (n=18).

Participants

31 amateur male boxers (mean age = 20.42±3.88 years) and sedentary healthy individuals (mean age = 20.65±1.40 years) voluntarily participated in the study. Participants were allowed to complete the Stroop tests only once. Before the test, they were asked not to consume alcohol and to continue their normal lives. The present study was conducted according to the Helsinki Declaration guidelines (Ethics committee-34183927-000-00000792078).

Data Collection

The Stroop TBAG Form was applied to evaluate the cognitive performance of the participants in the study. The validity and reliability of this test has been proven (Karakaş et al., 1999). The Stroop test had 5 forms with color names printed in different colors. In the first part; reading the words written in black, in the second part; reading the words written in different colors, in the third part; reading the colors in the circles with different colors, in the fourth part; reading colorful but meaningless words, in the fifth section; using the card used in the second part, the color of the text was asked to be read (Alderman et al., 2013). Participants were allowed to do the tests in a quiet room with adequate lighting. Time was measured with a stopwatch for each segment. The participants' time to complete the section separately for each section, the number of errors, and the number of corrections, if they corrected the errors were recorded on the form evaluation sheet.

Analysis

Arithmetic mean and standard deviation analyzes were performed for the descriptive values of the research group. Skewness and kurtosis values were examined to determine whether the data were normally distributed. It is accepted that the values are normally distributed if they are between -1.5 and +1.5. Independent group t-test was performed for comparisons between groups. Pearson analysis was used for correlation analysis of continuous variables. The significance criterion for all statistical tests was determined as p<0.05. SPSS v 26.0 (SPSS Inc., Chicago, IL, USA) software was used for data analysis.

Results

Table 1. The relationship between boxers' sparring and match numbers and the Stroop test

Variables (n=33)	Sparring Number	Stroop Test	Number of Matches
Number of Sparrings	1	-,027	-,287*
Stroop Test		1	-,126
Number of Matches			1

*p<0.05

Table 1 shows the results of the correlation analysis between the boxers' sparring and match numbers and the Stroop test. It was determined that there was no significant relationship between the sparring number and the Stroop test (r = -.027; p>0.05) and between the number of matches and the Stroop test (r = -.126; p>0.05). There was a significant correlation between the number of sparring and the number of matches (r = -.287; p<0.05).

Table 2. Comparison of the Stroop test results of the participants

Grup	Stroop Test	X̄ ± SS	t	p
Control Boxer	**Part 1**	7,69±1,27 7,55±1,02	,487	,628
Control Boxer	**Part 2**	7,78±1,09 8,05±1,26	-,937	,352
Control Boxer	**Part 3**	11,07±1,87 10,87±1,41	,454	,652
Control Boxer	**Part 4**	14,65±3,68 14,42±3,17	,271	,787
Control Boxer	**Part 5**	20,85±4,57 20,22±4,91	,523	,603

p<0.05

In Table 2, the time taken by the participants to complete the 5 sections of the Stroop test separately was examined. In the comparison between the groups, it was determined that there was no significant difference in the completion times of the subsections of the test (p>0.05).

Table 3. Comparison of the Stroop test error and correction results of the participants

	StroopTest	Group	N	Mean Rank	Sum of Ranks	Z	p
Error Numbers	Part 1	Control	31	33,56	1040,50	-1,471	,141
		Boxer	33	31,50	1039,50		
	Part 2	Control	31	32,00	992,00	-,969	,332
		Boxer	33	32,97	1088,00		
	Part 3	Control	31	32,61	1011,00	-,093	,926
		Boxer	33	32,39	1069,00		
	Part 4	Control	31	30,03	931,00	-1,705	,088
		Boxer	33	34,82	1149,00		
	Part 5	Control	31	32,18	997,50	-,150	,881
		Boxer	33	32,80	1082,50		
Correction Numbers	Part 1	Control	31	33,56	1040,50	-1,471	,141
		Boxer	33	31,50	1039,50		
	Part 2	Control	31	31,05	962,50	-1,003	,316
		Boxer	33	33,86	1117,50		
	Part 3	Control	31	32,48	1007,00	-,008	,994
		Boxer	33	32,52	1073,00		
	Part 4	Control	31	31,06	963,00	-,666	,505
		Boxer	33	33,85	1117,00		
	Part 5	Control	31	29,52	915,00	-1,283	,199
		Boxer	33	35,30	1165,00		

In Table 3, the comparisons of the number of errors and corrections in the Stroop test of the participants were examined. In the comparison between the groups, it was determined that there was no significant difference in the number of errors and corrections (p>0.05).

Discussion

In this study, the cognitive performances of amateur boxing athletes and healthy individuals were compared. In addition, the relationship between boxers' sparring and the number of matches, and their cognitive performance was examined. In the comparison, it was determined that there was no significant difference in the cognitive performances of the control group and amateur boxers, and there was no relationship between the number of matches and sparring of the boxers and their cognitive performance. Although there are many studies examining brain structure with different measurement methods, similar studies are very few in boxing.

A concussion may occur after a blow to the head. Accordingly, deterioration in brain functions may occur (Memmedov, 2014). If the head or face is hit, the brain will turn in the opposite direction. In this case, the brain becomes unable to function properly. In particular, the rotational speed of the brain can cause injury. Memory, concentration, reaction time, ability to learn new information and ability to solve problems are damaged when an athlete suffers a concussion (Yıldırım et al., 2020). Consistent with this information, Zahn and Mirsky (1999) examined the effect of head blows on cognitive processes (reaction time) with experimental intervention. In their study, they found that the group that received a blow to the head showed a slower and more variable reaction. It has been suggested that this difference is due to blows to the frontal lobe. However, the findings of this study do not support this. However, Loosemore et al. (2007) found no evidence between amateur boxing and chronic brain damage in their systematic review. Khani et al. (2012) compared the attention of amateur boxers who did sports for at least 4 years (n=30), who boxed for at most 1 year (n=30), and 400-800 m runners (n=30). They found that there was no significant difference in attention performance between the groups. Stojsih et al. (2008) compared the pre- and post-match cognitive levels of amateur boxers. They showed that cognitive values at the end of the match did not change significantly compared to the values before the match.

According to the literature, there may be several reasons why blows to the head do not cause damage to the brain, and subsequently, cognitive processes are not adversely affected. In modern boxing, knockouts occur in very few numbers. Because in amateur boxing, athletes mostly focus on winning with technical points. For example, only 6 (1.8%) of 327 matches in the Barcelona Olympic Games boxing matches and only 1 (0.36%) out of 274 matches in the 2008 Beijing Olympic Games boxing matches resulted in a knockout (Khani et al., 2012). However, the small number of matches in amateur boxing can prevent the occurrence of brain damage. In addition, the referees follow the match closely in order to prevent the athletes from being harmed. In amateur, professional, and training matches of boxing federations, they end the match at the slightest sign of damage so that the athletes are not damaged (Bianco et al., 2013) Unlike these, it can be thought that these small damages to the head during this temporary period can be repaired if enough breaks are taken after the blows. Considering this aspect, although amateur boxing has a negative effect, the brains of athletes may not be damaged because blows to the head are not repeated frequently (Khani et al., 2012).

As a result, it was determined that there was no difference between the cognitive performances of amateur boxers and healthy individuals, and the number of sparring and official matches of boxers did not adversely affect cognitive performance

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