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Assesment of Cognitive Skills in Billiards Players

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Research Article
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Abstract

In this study, it is aimed to reveal differences between the cognitive skills of the brain such as reaction time, speed distance estimation, nonverbal intelligence between different grade billiards players with numerical data. Research population consisted of professional and amateur male billiards players between the ages of 18-35. Cognitive abilities such as reaction time, speed-distance estimation, and judgment were measured with Vienna Test System (Schuhfried GmbH Moedling, Austria). The data was analyzed by Mann-Whitney U Test and Pearson correlation test. All statistical analysis were calculated using SPSS version 15.0 (SPSS Inc, USA). Reaction time and Speed-Distance Estimates of professional billiards players were statistically significantly higher than amateur billiards players (p=0.034, p=0.012). It was observed that the ability to make decisions under stress was higher in amateur players than in professional billiards players (p=0.155). Furthermore, a positive correlation was found between billiards scores and speed-distance estimation skills in professional billiards players (r=0.102, p=0.766). The test results indicate a positive correlation between players' cognitive skills and billiards scores, while concurrently revealing that stress negatively impacts test scores. It was observed that sport of billiards had a positive effect on cognitive skills, which are upper functions of the brain. It has been determined that billiards may be beneficial for brain development. As a result, it was concluded that it would be beneficial to expand the billiards in educational institutions and throughout country by cooperating with non-governmental organizations such as billiard federation.
Keywords: Speed, Distance estimation, Cognitive skill, Reaction time, Brain functions, Billiards players

Bilardo Oyuncularında Kognitif Becerilerin Değerlendirilmesi

Öz

Bu çalışmada farklı seviyelerdeki bilardo oyuncuları arasında, reaksiyon süresi, hız mesafe tahmin, nonverbal zekâ gibi beynin kognitif becerileri arasındaki farklılıkların sayısal verilerle ortaya konması amaçlanmaktadır. Araştırma popülasyonunu 18-35 yaş arası profesyonel ve amatör erkek bilardo oyuncuları oluşturmuştur. Tepki süresi, hız-mesafe tahmini ve muhakeme gibi kognitif yetenekler Viyana Test Sistemi (Schuhfried GmbH Moedling, Austria) ile ölçüldü. İstatistiksel analizler Mann-Whitney U Test ve Pearson korelasyon test uygulanarak SPSS 15.0 (SPSS Inc, USA) kullanılarak değerlendirildi. Profesyonel bilardo oyuncularının reaksiyon süresi ve Hız-Mesafe Tahminleri, amatör bilardo oyuncularına göre istatistiksel olarak anlamlı derecede yüksek çıkmıştır (p=0,034, p=0,012). Amatör oyuncularda stres altında karar verme yeteneği profesyonel bilardoculara göre daha yüksek olduğu görülmüştür (p=0,155). Ayrıca profesyonel bilardo oyuncularında bilardo puanları ile hız-mesafe tahmin etme becerileri arasında pozitif bir ilişki bulunmuştur (r = 0,102, p = 0,766). Test sonuçları, oyuncular arasında bilişsel beceriler ile bilardo puanları arasında pozitif bir ilişki olduğunu göstermektedir ve stresin test puanları üzerine olumsuz bir etkisi olduğu gösterilmiştir. Bilardo sporunun beynin üst fonksiyonları olan bilişsel beceriler üzerinde olumlu etkisi olduğu gözlemlendi. Bilardonun beyin gelişimi için faydalı olabileceği belirlendi. Sonuç olarak bilardo federasyonu gibi sivil toplum kuruluşları ile iş birlikleri yapılarak bilardonun eğitim kurumlarında ve ülke geneline yaygınlaştırılmasının faydalı olabileceği sonucuna varılmıştır.
Anahtar Kelimeler: Hız, Mesafe tahmini, Bilişsel beceri, Reaksiyon süresi, Beyin fonksiyonları, Bilardo oyuncuları

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INTRODUCTION

Billiards is a sport that requires high concentration, precise visual perception, accurate planning, and full control of movements. The performance in billiards involves cognitive processing of received stimuli, judgments, and decisions in the brain, preceding the physical execution and motor skills (Corrado et al., 2015). Billiards players must have efficient fine motor skills to perform successfully on the table (Kornfeind et al., 2015). The player should correctly predict the future trajectory of the ball and its arrival time (Rodrigues et al., 2002). In many sports, the athlete's attention is not given to the game only, but also to the competitor's character, his skills, his abilities, his position, his actions and so on (Schefke & Gronek, 2011). For all this, the reaction speed-distance estimation capabilities of the players are very important (Corrado et al., 2015). A billiard player needs high intelligence and spatial perception as well as motor performance in order to pocket the ball in the desired way with quality stroke techniques and to gain an advantage over their opponents (Lin et al., 2021). A research which investigated attention performance during a billiard competition reported that, it was stated that good attention ability and cognitive performance are important for billiard players due to the necessity of focusing on the same object for a long time (Rogaleva et al., 2022).

Billiards is a game played with balls on a table covered with a tablecloth using a stick called "stecca", which is a Latin word. It is a multidisciplinary sport in which strategy and sportsmanship are at the forefront, including different branches of science such as psychology. Billiards was included in the group of immersive games during the 12th-13th centuries in which the balls moved back and forth and drifted. In the first half of the 14th-15th centuries, it started to develop separately from cricket and golf, which are drag games. Billiards is based on skill rather than strength and requires patience, sharp vision and hand control (Pekdemir, 2019).

Cognitive processes form the foundation for effectiveness in sports, particularly team sports, where athletes are required to make rapid decisions and execute precise reactions (Travassos et al., 2013). Although players are not only under a temporal restriction, they also must accurately analyses the game situation and select the correct shots. Researchers had examined the visual-perceptual and cognitive aspects of the players in snooker and found that expert athletes, before choosing the appropriate shot options, they evaluate the current situation strategically (Abernethy et al., 1994). Anticipated in the utilization of sensory, cognitive, and motor control tests is the expectation that warnings provided and/or required responses may differ across various sports. There is a need to conduct future reviews of perceptual and cognitive studies specific to each sport. Research suggests that three fundamental elements are essential for executing a motor action: Perception, cognition, and action. In the context of billiards, perception, cognition, and action, although interrelated, are considered essentially distinct entities and functions. It has been noted that, during billiards shots, perceptual-cognitive errors are significantly more pronounced than motoric errors (Morris, 2011).

The Vienna Test System (VTS) is one of the computerized systems capable of analyzing a wide range of structures related to sports psychology and physiology. VTS is a methodologically valid and reliable method developed by SchuhFried GmbH (Moedling, Austria) that includes several sports physiology tests. It is appropriate for assessing athletes' ability and personality and contains assessments of many different functions such as sustained

attention, reaction time, environmental perception, stress response, and speed-distance estimations. In a variety of sporting contexts, including football clubs such as FC Hoffenheim and OSC Lille, the Greek national basketball team, and the German and Austrian football associations, practitioners frequently use VTS. On the other hand, the number of published articles about the application of VTS is rather small. Since the potential of the VTS to provide sports psychology and physiology researchers with an additional assessment tool, complementing existing measures, underscores its significance as a crucial aspect lacking in the current literature (Ong, 2015). In this study, we aimed to investigate the relationship between brain cognitive skills such as speed-accuracy, reasoning ability, reaction time and speed-distance estimations on professional and amateur billiards players.

METHODS

Research Model

Quantitative research methods were employed in the design of this study, which took place in the Psychotechnic and Psychomotor Measurement and Evaluation Laboratory within the Department of Physiology and Neurophysiology at the Faculty of Medicine, Manisa Celal Bayar University.

Sample Group

The study population was formed of 33 billiards players; age group of 18-60 (Mean=35,32 SD=10,17) in which 12 are professional, and 21 are amateur players. Professional players are comprised of national billiards athletes who have achieved notable distinctions, including securing first place in the World Billiards Championship. Their collective experience spans approximately 20 to 25 years (mean=23,41 SD=1,68). All participants were male. The relationship between 2018 Turkish Billiards Federation classification billiard scores (TBF, 2018) and cognitive skills in professional players was evaluated.

Data Collection Tools

The cognitive and motor performances of billiards players were measured by tests in the Vienna Test System.

The Vienna Test System: Is a test system for computerized psycho-motor assessment, prepared to obtain objective data and carried out in the Standard Isolated Test Room in accordance with international norms. Cognitive and motor performance tests were also performed, which consisted of Determination Test (DT accuracy-DT seconds.), Standart Progressive Matrices (SPMIQ score), Reaction Time Test (RT) and Speed-Distance Estimation Test (SDE) (Schuhfried, 2012).

Determination Test (DT): Determination test was used to measure stress tolerance (decision making in stress) and reaction quality (reaction time in stress) in this research. Determination

test refers to the number of stimuli correctly reacted to, from 540 stimuli. The determination of reaction speed is the speed median value of the correct responses to stimuli. The test then shows the scores for the median reaction time, the number of correct reactions (and delayed ones), the number of false reactions, the number of neglected reactions and the number of stimuli. The duration of the test is 6 minutes. The indexes used in this study are the number of correct responses (DTaccuracy) and the response time (DTseconds-DTs) (Schuhfried, 2012).

Standard Progressive Matrices Test (SPMIQ score): This test measures the reasoning ability of individuals, it's based on the comprehension and realization of the relationships between abstract visual shapes. The number of correct answers given was recorded and evaluated as SPMIQ score (Schuhfried, 2012).

Reaction Time Test (RTart): Along with the reaction time (speed) which is measured in milliseconds, the alertness, wrong response repression, persistence and directed attention can also be measured by this test. In the RT test, it was requested from the players to press the button with the index finger when specific warnings (visual and auditory) were displayed on the screen, and also not to respond to unwanted alerts. At the end of the test, the average reaction time (RTart-msec.) were recorded by the computer in milliseconds (Schuhfried, 2012). In our study, the difference in visual and auditory mean motor reaction time was calculated.

Speed-Distance Estimation Test (SDEaccuracy): One of the methods commonly used to measure speed to distance estimation is a special test presented in a computer-aided simulation environment Speed and Distance Estimation Test (SDE). In this test, a moving object is presented on the screen and disappearing behind a given barrier as it moves towards a target. The person is asked to predict when the object will exit the barrier and press the response button as soon as he/she thinks that the object is coming out. Since the distance of the object from the barrier and its speed change, the person should make an estimation considering these variables. The estimation accuracy indicates the person's perception level of speed and distance (Schuhfried, 2012).

Research Ethics

The study was carried out in compliance with the Declaration of Helsinki. It was approved by Manisa Celal Bayar University Faculty of Medicine Ethics Committee Decision No. 11 / 08 / 2017/ 20.47.486.

Data Analysis

The data was analysed by non-parametric independent sample Mann-Whitney U Test and pearson correlation test. All statistical analysis were calculated using SPSS version 15.0 (SPSS Inc, USA).

RESULTS

The mean, standart deviation, p values and corelations of cognitive skills are shown in the tables and figures below including groups: professional and amateur billiards players.

Table 1. Comparison of the mean cognitive skills of professional and amateur billiard players

	Professional			Amateur			
Tests	**N**	**Mean**	**Std.**	**N**	**Mean**	**Std.**	**p**
SDEaccuracy	12	63,51	7,80	21	53,32	12,27	0,012*
DTaccuracy	12	232,75	35,28	21	250,66	34,57	0,155
DTseconds	12	0,78	0,070	21	0,72	0,05	0,034*
SPMIQscore	12	92,08	16,39	21	94,9	16,28	0,599
RTart-msec.	12	562,5	93,00	21	587,76	80,14	0,410

*p<0,05; p value was calculated using the Mann-Whitney U Test for two group.

On the other hand, the decision making in stress of the amateur players was higher than the professional billiards players yet, only the reaction time in stress and were statistically significant (p<0.05) (Table 1).

As in Table 1, Speed Distance Estimates (SDEaccuracy) of professional billiards players were higher than the amateur billiards players (p<0.05).Reaction time in stress (DTseconds) were higher than the amateur billiards players (p<0.05). The reaction times (RTart-msec.) of professional billiards players were reduce than the amateur billiards players (p>0,05). The decision making in stress (DTaccuracy) of amateur billiards players was higher than the professional billiards players (p>0.05).

Table 2. The relationship between cognitive skills and billiards scores of professional players

		RTart-msec.	**DTaccuracy**	**DTseconds**	**SPMIQscore**	**SDEaccuracy**
Billiards Scores	**r**	0,612	-0,245	0,532	0,117	0,102
	p	0,045*	0,468	0,092	0,732	0,766
	N	11	11	11	11	11

*p<0,05, r value was calculated using the spearman correlation test for billiards scores of professional players.

As shown in Table 2, there was a positive relationship between billiards scores and speed distance estimation skills of professional billiards players. There was a significant positive relationship between average reaction time and billiards scores of professional players (p<0,05). There was a negative relationship between DTaccuracy and billiards scores of professional players. There was a significant positive relationship between DTseconds and billiards scores of professional players.

DISCUSSION AND CONCLUSION

In the present study, we investigated the relationship between cognitive skills and different billiards player groups. Speed-distance estimation skills of professional billiards players were higher than amateur billiards players ($p<0.05$); on the other hand, the reaction time in stress of the amateur players was higher than the professional billiards players ($p<0.05$) (Table 1). There was a positive relationship between cognitive skills, reaction time and billiards scores of professional billiards players. The billiard score is only available to licensed billiards players. For this reason, a correlation between billiard scores and cognitive skills was made (Table 2). A correlation could not be made because there was no billiard score for amateur players. In our study, the comparison of test means and standard deviation between amateur players and professional players is also given in the table.

In billiards players, the motor component encompasses observable skills such as maintaining correct posture and executing consistent, smooth hits, while the cognitive component involves information processing, evaluation, and decision-making. The dynamic nature of competitions, marked by unexpected errors and competitor outcomes, can significantly influence emotional states and cognitive processes. A related study found positive relationships between cognitive-sensory and motor performance in 45 billiards players (Corrado et al., 2015). In alignment with this literature, our study revealed that only the correct responses given in stressful situations decreased among professional billiards players. In a study involving tennis players, professionals exhibited higher hand-eye coordination, performance, and reaction times compared to non-professionals (Rodrigues et al., 2002). Similarly, we observed that the reaction time of professional billiards players was faster than that of amateurs. However, their decision-making speed under stress was slower, and an increase in billiards scores among professional players corresponded to a rise in short-term anxiety. This phenomenon may be attributed to the one-on-one competitive nature of billiards, wherein players' stress management diminishes as the competition intensifies. Exploring cognitive functionality in elite and sub-elite youth soccer players, a study found that elite players demonstrated superior inhibitor control, cognitive flexibility, and particularly metacognition compared to their sub-elite counterparts (Hujigen et al., 2015). In our study, which focused on individual sports players unlike team sports players, it was observed that individual sports demand greater stress coping abilities and cognitive decision-making. Consistent with existing literature, our findings indicated that the cognitive skill of professional billiards players, particularly in speed-distance estimation, surpassed that of amateur players. Another study, comparing the cognitive skills of elite basketball players with a control group, found that elite players excelled in memory retention, selective attention, and prediction measurements (Kioumourtzoglou et al., 1998), aligning with our results.

In the studies, cognitive processes were generally evaluated for team sports, and it was emphasized that the athletes should make quick decisions and then act correctly (Gil-Arias et al., 2016; Gil-Arias et al., 2019; Romeas et al., 2016). However, our study was carried out in billiards players who were not under time constraint and showed the importance of cognitive performance in correctly analyzing the game situation and choosing the right shot.

Great importance has been attached to the determination of the physical and physiological characteristics that distinguish the groups of athletes from each other. While there are fewer studies focusing on perceptual and cognitive abilities such as detecting and following a moving ball with the eyes, focusing attention, or predicting the opponent's next move. Perceptual-cognitive skills are critical for superior athletic performance, as all sports require athletes to process sensory information, distract and decide when and where to act (Balser et al., 2014; Kredel et al., 2020; Mustafovic et al., 2020; Posthumus et al., 2020)

In conclusion, it has been observed that billiards sport has a positive effect on brain cognitive skills. According to these results, it was concluded that dissemination of billiard sport throughout the country in cooperation with non-governmental organizations such as billiard federation would be beneficial. Accordingly, extensive studies can be done to reveal the other useful aspects of billiards.

Conflict of Interest: There is no personal or financial conflict of interest within the scope of the study.

Researchers' Statement of Contribution Rate: Research Design NK, Statistical analysis: BM; Preparation of the article, ŞA, BM; Data Collection was carried out by ŞA, BM.

Ethical Approval
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