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AN EXAMINATION OF THE RELATIONSHIP BETWEEN BASKETBALL FREE-THROW PERFORMANCE AND COGNITIVE PERFORMANCE

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Abstract

The purpose of present study was to examine the relationship between basketball free-throw performance and cognitive performance. The comparison of the cognitive performance of basketball players with low and high free throw performance was also the second aim of the study. A total of twenty-four male basketball players aged 18-24 years voluntarily participated in the study. Cognitive performance was evaluated with attention, sensory motor coordination and spatial perception tests. For the free-throw test, participants performed 10 shots within 3 sets (total 30 shots). The statistical analysis detected no statistically significant correlation between the Cognitrone Test, Mental Rotation and Sensomotor Coordination variables and free throw performance ($p > .05$). Similarly, no statistically significant difference was detected between the Cognitrone test, Mental Rotation and Sensomotor Coordination Test variables in comparison of cognitive characteristics of low and high performer in free throw performance. There was a low moderate positive correlation between COG and MR components ($r = .47$, $r = .44$, $p < .05$), a moderate positive correlation between COG and MR components ($r = .58$, $p < .05$) and a low negative correlation between MR and SMK components (r = -. 40 and r = -. 45, $p < .05$). Hence, the present study has determined that there is no statistically significant relationship between cognitive performance and basketball free- throw performance, and in the cognitive performance between low and high free-throw performers.

Keywords: Basketball, free throw, attention, spatial perception, sensomotor coordination..

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Corresponding Author: Esin Kaplan
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1. Introduction

Athletes' skill differences affect performance of motor abilities, but most are not easily measured or observed. Coaches have tried to understand the reasons for skill differences among athletes and the factors that influence of these differences on learning and athletic performance.

The cognitive and perceptual characteristics of human nature have been included in the sports literature as general information, particularly in literature most of the studies concentrate on how much various activities done for a certain period of time affect them (Bańkosz, Nawara, & Ociepa, 2013; Boot et al. 2008; Crawford, Medendrop & Marotta, 2004; Ederman, Murray, Mayer & Sagendorf, 2004; Göral, Saygın & İrez, 2012; Aktop, Kuzu & Çetin, 2017). Cognitive abilities, such as attention, perception, reaction time and coordination are supposed to be the most important factors and play a major role in motor behaviour. Improving cognitive skills thus enhances an athlete's performance during training and competitions (Hijazi, 2013).

Attention is the one of the important cognitive abilities in sport environment. Within sports, coaches and athletes often use the terms concentration, attention and focus interchangeably. Attention is described as conscious or unconscious focus of perception on a certain object, action, or activity (Schefke & Gronek, 2010). Once an athlete has developed the skills necessary for competition, their ability to control one's attention in order to concentrate on the demands of the task is essential to consistently executing these skills (Apa Sheet, 2014). Reaction time refers to the time that passes between receiving a sudden and non-prefigured signal to responding to this signal. The stimuli can be auditory, visual or tactile (Göral, Saygın & İrez, 2012)

In basketball literature, there are many studies conducted to understand performance and ability differences among athletes of different levels of skill. Isaacs (1981) found that perception was correlated to free-throw shooting during competitive season but there was no significant correlation between perception and field shooting performance. In his study Olsen (1956) found that basketball skill test was not related to reaction time, perception, and visual span of apprehension.

'Shoot' in basketball is the throwing action of the player in order to pass the ball through the hoop in any way (Nalbant, 2013). Free-throw is used after certain fouls or in the case of rule violation shooting from the free throw line.

This study evaluates the relationship between cognitive performance and basketball free-throw performance and cognitive performance differences between low and high performer in basketball.

2. Problem Statement

Examination of the relationship between cognitive performance (attention, senso-motoric coordination and spatial perception) and free-throw in basketball can provide information about the how cognitive traits affects performance and will provide information for coaches to plan and organize training programs.

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Corresponding Author: Esin Kaplan
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3. Research Questions

Is there any relationship between free-throw in basketball and cognitive performance and any difference in cognitive performance of high and low free-throw performers?

4. Purpose of the Study

The purpose of present study was to examine the relationship between basketball free-throw performance and cognitive performance. Additionally, the research sought to determine the comparison of the cognitive performance of basketball players with low and high free throw performance.

5. Research Methods

5.1. Participants

A total of twenty-four male basketball players aged 18-24 years voluntarily participated in the study. Cognitive performance was evaluated with the computer-based test Vienna Test System (VTS). The Vienna Test System (VTS) is a computerized system that is able to analyse many different sport psychology-related constructs. In the present study, the variables of attention were measured with Cognitrone Test (COG), spatial perception was measured with Mental Rotation Test (MR) and sensomotor coordination was measured with Sensomotor Coordination Test (SMK). All these were developed by Psikotek Consulting (2012). For the free-throw test, participants performed 10 shots within 3 sets (total 30 shots).

5.2. Methods

The assessments were conducted at the Marmara University and Antalya Bilim University. The attention, sensomotor coordination and spatial perception tests were administered to both groups in an isolated room with minimal background noise.

Cognitrone Attention-Concentration Test (COG) is a linear test consisting of 60 items measuring sustained attention. The test is based on the theory of sustained attention, which conceives sustained attention as a state that can be characterized by (a) the amount of energy devoted to a task, (b) the function of sustained attention, and (c) the precision of the task completion. It is a general ability test that assess attention and concentration among the Vienna test system batteries. It requires noticing the similarities between constantly changing figures within the tests' integrity and reacting rapidly and correctly. Participants are asked to compare the figures on the screen and make a decision about their similarities. Four different figures are displayed on the upper part of the screen, and one figure is displayed on the lower part. Participants are asked to press the green button on the panel with their right hand when they understand that the figure on the lower part matches with the figure on the upper part; or otherwise, to press the red button. The total duration of the test is 15 to 20 minutes (Psikotek Consulting, 2012).

Sensomotor Coordination Test (SMK) is a linear test measuring anticipative coordination ability defined as sensomotor coordination necessary to maneuverer an element to a pre-set goal and reactive coordination ability necessary to react adequately to an element or object's spontaneous and unforeseen

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change of direction. A three-dimensional room is depicted on the screen containing a green upside-down T and a yellow circular segment to be maneuverer. The segment stands on its point and begins to either (a) tilt, (b) move horizontally, or (c) move from front to back with corresponding changes in the size of the segment. The task of the respondent is to react to the segment's movements by steering it with joysticks in such a way that it stands upright with its point touching the intersection of the green T and is the same size as the green upside-down T. The test presentation is divided into groups of timed intervals lasting 56 sec each. The total duration of the test is 15 min. The main variables of this test are angle deviation and time in the ideal range (Psikotek Consulting, 2012).

Mental Rotation Test (MR) is a computer-assisted test used to assess participants' spatial perception skills. In other words, participants measure their ability to mentally visualize and manipulate spatial content. The MR test was designed to be used by adolescents and adults after age 16 (Psikotek Consulting, 2012).

The statistical analysis of the data was done using SPSS and Excel (Analyses Tool Pack) software. First, the data were subjected to descriptive statistics. The normal distribution criteria were determined using the Shapiro-Wilk test since the sample size was under 50. According to results of the normality test, it was found that all the measured variables was not normally distributed. For that reason, correlation analyses performed by calculating Spearman' rho coefficient and the Mann-Whitney U test was used for the comparison of low and high performer groups. Results are shown as mean ± SD, and for all comparisons $p < .05$ was considered significant.

6. Findings

A total of 24 basketball players (14 low performers, 10 high performers) voluntarily took part in the study with their permission.

The Basketball free throw test, Cognitrone Test, a computer-based attention test, Mental Rotation for spatial perception and Sensomotor Coordination Tests were then administered to the participants.

Table 01. Age and free-throw performance of low and high performer basketball players

	Low Performer (LP) (n=14)			High Performer (HP) (n=10)	
	Mean	S.D.		Mean	S.D.
Age (year)	20.45	1.62	Z=-.703 p=.48	20.76	1.39
Free-throw (Out of 30 shot)	16.21	3.04	Z=-4.113 p<.01	23.00	1.25

As shown in Table 01, no significant differences in age between low and high performer basketball players ($p>.05$) was detected. As expected, in the free-throw test, the high performer group had significantly better scores than low performer group ($p<.05$).

According to first aim of the study, correlation analyses between free throws and cognitive abilities were performed. Table 02 shows the correlation between sub scores of the MR test and free throw test.

http://dx.doi.org/10.15405/epsbs.2018.06.02.10
Corresponding Author: Esin Kaplan
Selection and peer-review under responsibility of the Organizing Committee of the conference
eISSN: 2357-1330

Table 02. Correlation matrix of Mental Rotation and Free-Throw test for all the players.

n=24	**1**	**2**	**3**	**4**	**5**
1- Mean Horizontal Deviation %					
2- Mean Vertical Deviation %	,503*				
3- Number of correctly solved items	-,817**	-,809**			
4- Working time (m.sec.)	,106	-,001	-,083		
5- Free- Throw	,206	-,132	,091	,011	,021

*. Correlation is significant at the 0.05 level.

**. Correlation is significant at the 0.01 level.

There was no statistically significant correlation between Mean Horizontal Deviation (r=.21, p>.05), Mean Vertical Deviation (r=-13, p>.05), Number of correctly solved items (r=.09, p>.05), Working time (r=.02, p>.05) and free throw performance.

Table 03. Correlation matrix of Sensomotor Coordination and Free-Throw test of all players.

	1	**2**	**3**	**4**
1- Horizontal Deviation %				
2- Vertical Deviation %	,539**			
3- Angle Deviation %	,702**	,105		
4- Time in Ideal Range sec.	-,886**	-,594**	-,619**	
5- Free- Throw	,263	-,062	,216	-,106

*. Correlation is significant at the 0.05 level.

**. Correlation is significant at the 0.01 level.

Results of correlation analyses between sensomotor coordination and free throw test found no significant correlation between Horizontal Deviation (r=.26, p>.05), Vertical Deviation (r=-06, p>.05), Angle Deviation (r=.22, p>.05), time in Ideal Range (r=.11, p>.05) and free throw performance.

Table 04. Correlation matrix of Cognitrone and Free-Throw test of all players.

	1	**2**	**3**	**4**	**5**	**6**
1- Mean time of correct rejections (sec)						
2- Sum of correct rejections	,455*					
3- Mean time of correct reactions (sec)	,780**	,398*				
4- Sum of correct reactions	,362	,255	,524**			
5- Working time (sec)	,964**	,397*	,878**	,425*		
6- Sum of misses	-,512**	-,834**	-,558**	-,728**	-,503*	
7- Free- Throw	-,152	-,010	,072	-,166	-,120	,055

*. Correlation is significant at the 0.05 level.

**. Correlation is significant at the 0.01 level.

Table 04 gives the spearman' rho correlation coefficient between Cognitrone sub scores and free throw performance. Results showed no significant correlation between Mean time of correct rejections (r=.15, p>.05), Sum of correct rejections (r=-01, p>.05), Mean time of correct reactions (r=.07, p>.05), Sum

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Corresponding Author: Esin Kaplan
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of correct reactions (r=-.16, p>.05), Working time (r=-12, p>.05), Sum of misses (r=.06, p>.05) and free throw performance.

In the present study, correlation between cognitive performance indices also examined. Table 05 shows the correlation coefficient between spatial perception (MR), sensomotor coordination (SMK) and attention (COG). There was a low moderate positive correlation between COG and MR components (r = .47, r = .44, p <.05), a moderate positive correlation between COG and MR components (r = .58, p <.05) and a low negative correlation between MR and SMK components (r = -. 40 and r = -. 45, p <.05).

Table 05. Correlation matrix Cognitrone, MR and SMK tests of all players.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1- Mean Horizantal Deviation %													
2- Mean Vertical Deviation %	,72**												
3- Number of correctly solved items	-,86**	-,86**											
4- Working time (m.sec.)	-,08	-,08	,03										
5- Horizantal Deviation %	,35	,25	-,29	,01									
6- Vertical Deviation %	,26	,27	-,34	,10	,54**								
7- Angle Deviation %	,36	,18	-,21	,04	,70**	,11							
8- Time in Ideal Range sec.	-,41*	-,22	,32	-,15	-,89**	-,59**	-,62**						
9- Mean time of correct rejections (sec)	,23	,34	-,23	,47*	,24	,63**	,02	-,31					
10- Sum of correct rejections	-,24	-,34	,40*	,21	-,11	,14	-,14	,08	,46*				
11- Mean time of correct reactions (sec)	,226	,22	-,09	,33	,29	,42*	,05	-,34	,78**	,40*			
12- Sum of correct reactions	,37	,27	-,14	,05	,22	,05	,39	-,19	,36	,26	,52**		
13- Working time (sec)	,28	,39	-,27	,44*	,26	,58**	,02	-,32	,96**	,40*	,88**	,43*	
14- Sum of misses	-,10	,08	-,14	-,16	-,10	-,14	-,17	,10	-,51**	-,83**	-,56**	-,73**	-,50*

Table 06. Attention test values of low and high performers.

	Low Performer (LP) (n=14)			High Performer (HP) (n=10)	
	Mean	S.D.		Mean	S.D.
Mean time of correct rejections (sec)	2.22	0.55	Z=-.146 p=.88	2.45	0.75
Sum of correct rejections	34.57	1.40	Z=-.668 p=.50	34.00	1.89
Mean time of correct reactions (sec)	1.93	0.65	Z=-1.171 p=.24	2.27	0.77
Sum of correct reactions	22.36	1.22	Z=-.362 p=.72	22.10	1.52
Working time (sec)	127.64	34.67	Z=-.469 p=.64	143.20	42.61
Sum of misses	3.07	2.02	Z=-.562 p=.57	3.90	2.85

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Corresponding Author: Esin Kaplan
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There was no statistically significant difference between the high and low performer groups. The high performer group is better at the mean time of correct reactions, with good scores in the scores, while the low performer group is better in the sum of correct reactions, in the working time, and in the sum of misses scores. A total of 6 sub scores were evaluated for the attention.

Table 07. Spatial perception test values of low and high performers.

	Low Performer (LP) (n=14) Mean	S.D.		High Performer (HP) (n=10) Mean	S.D.
Mean Horizantal Deviation %	13.82	10.36	Z=-.615 p=.54	22.60	24.52
Mean Vertical Deviation %	11.39	8.44	Z=-.234 p=.82	11.20	7.50
Number of correctly solved items	10.14	4.42	Z=-.088 p=.93	9.80	4.71
Working time (m.sec.)	395.43	148.56	Z=-.966 p=.33	450.90	149.93

There was no statistically significant difference between the high and low performer groups. The low performer group has better, mean horizontal deviation score, mean vertical deviation score, number of correctly solved items score and working time score than high performer group. A total of 4 sub scores were evaluated for the spatial perception.

Table 08. Sensomotor coordination test values of low and high performers.

	Low Performer (LP) (n=14) Mean	S.D.		High Performer (HP) (n=10) Mean	S.D.
Horizontal deviation	50.76	13.56	Z=-1.698 p=.09	60.95	11.74
Vertical deviation	45.45	13.09	Z=-.586 p=.56	48.93	7.87
Angle deviation	28.91	4.91	Z=-.879 p=.38	31.00	6.81
Time in Ideal Range	10.14	6.76	Z=-1.090 p=.28	6.70	2.91

In evaluating the coordination of the sensomotor, four sub scores (Horizontal Deviation,Vertical Deviation, Angle Deviation, Time in Ideal Range) were evaluated. Although the high performer group had higher scores in sensomotor coordination sub scores than the low performer counterparts, there were no statistically significant differences reported between low and high performer groups.

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Corresponding Author: Esin Kaplan
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7. Conclusion

Attention, spatial perception and sensomotor coordination are cognitive and mental processes that are important traits used by athletes in the sport environment. These traits are complex in terms of their processes and results in both cognitive and behavioural aspects. Success in physical and mental terms is needed in every kind of sports. Sports require cognitive performance including attention, decision making, perception, anticipation, sensorial motor coordination, and precise information processing.

The present study has determined that there is no statistically significant relationship between cognitive performance and basketball free- throw performance, and in the cognitive performance between low (below 70%) and high free-throw (above 70%) performers. There is, however, a significant relationship between attention, spatial perception and sensomotor coordination.

Scanlan et al. (2014) investigated the influence of physical and cognitive factors on reactive agility performance in male basketball players. They found that cognitive measures have the greatest influence on reactive agility performance in men basketball players. Specifically, response time and decision making time had very large associations with reactive agility movement time. The lack of or weak relationships between morphological and physical performance variables and reactive agility movement time further highlight the large contribution of cognitive qualities to open-skill agility performance in basketball players.

Balakova et.al. (2015) was determined the relationship between football skills and cognitive skills of young elite football players. They used seven test of the Vienna Test System; Raven's Standard Progressive Matrices (SPM-S5 version) Test, time/movement anticipation test (ZBA), determination test (DT), reaction test (RT), the Corsi Block- test (LVT) and peripheral perception test (PP). They indicated that there was a significant difference in cognitive skills between the talented and less talented group.

Gierczuk & Ljach (2012) found statistically significant correlations between cognitive and coordinative abilities measured by using computer based Vienna Test System (RT; reaction time, DT: Decision Test, SIGNAL; Signal detection Test, 2HAND: hand coordination test, and MLS: motor performance test).

Kioumourtzoglou et al. (1998) examined cognitive, perceptual, and motor abilities of skilled basketball performance. They found that there were no significant differences in perception speed and selection of correct response between expert and novice groups. They argued that the recognizing irrelevant information and analytic scores of elite male players was not higher than the novice counterparts.

In conclusion, this study found that the attention, spatial perception and sensomotor coordination were not related with free throw performance and these cognitive performances were similar in both high and low free-throw performers. There was low to moderate correlation between attention, spatial perception and sensomotor coordination.

8. Implications

The findings of this study will aid coaches in planning effective trainings for players in order to attain optimal sport performance since success in physical and mental terms is needed in every kind of sport. Additionally, these findings can also help researchers to further investigate the relationship of cognitive influence on sport performance.

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References

Aktop, A., Kuzu, O., & Çetin, E. (2017). Analysis of Attention, Eye-Hand Coordination and Reaction Time Of Young Soccer Players, International Conference on Sport, Education & Psychology. The European Proceedings of Social & Behavioural Sciences, *XXIV*, 1-91. http://dx.doi.org/10.15405/epsbs.2017.06.2

APA Sheet. (2014). Concentration and Attention in Sport. In Exercise and Sport Psychology, APA 47, *Sport Psych Works, May 2*(1), 1-2. http://www.apadivisions.org/division-47/publications/sportpsych-works/concentration-and-attention.pdf

Baláková, V., Boschek P., XXIV, Pages 1- 91(12 June 2017) Skalíková L. (year?). Selected Cognitive Abilities in Elite Youth Soccer Players, *Journal of Human Kinetics. 49*, 267-276. doi: 10.1515/hukin-2015-0129

Bańkosz, Z., Nawara, H. & Ociepa, M. (2013). Assessment of simple reaction time in badminton players. *Trends in Sport Sciences*, *1*(20), 54-61.

Boot, W. R., Kramer, A. F., Simons, D. J., Fabiani, M., & Gratton,G. (2008). The effects of video game playing on attention, memory, and executive control. *Acta Psychologica 129*, 387–398.

Crawford, J., Medendorp, W., Marotta, J. (2004). Spatial Transformations for Eye–Hand Coordination. J., *Neurophysiol. 92*, 10-19, 10.1152/jn.00117

Ederman, B.E., Murray, S.R., Mayer, J.M. & Sagendorf, K. (2004). Influence of Cup Stackıng on Hand-Eye Coordination and Reaction Time of Second-Grade Students. *Perceptual and Motor Skills, 98*, 409-411,

Gierczuk D., Ljach W., (2012). Evaluating the coordination of motor abilities in Greco-Roman wrestlers by computer testing. *Human Movement*, *13*(4), 323- 329

Göral K, Saygın Ö, İrez G. (2012). Examination of Visual and Auditory Reaction Times by Professional Soccer Players (Profesyonel Futbolcuların Oynadıkları Mevkilere Göre Görsel ve İşitsel Reaksiyon Sürelerinin İncelenmesi). *Journal of Physical Education and Sport Science Selçuk University, 14*(1), 5-11.

Hijazi, M.M.K. (2013). Attention, Visual Perception and Their Relationship to Sport Performance in Fencing, *Journal of Human Kinetics, 39*, 195-201 DOI: 10.2478/hukin-2013-0082

Isaacs, L. (1981). Relationship between depth perception and basketball shooting performance. *Perceptual and Motor Skills,53*, 554.

Kioumourtzoglou, E., Derri, V., Tzetzls, G., and Theodorakis, Y. (1998). Cognitive, Perceptual, and Motor Abilities in Skilled Basketball Performance. *Perceptual and Motor Skills, 86*, 771-786

Nalbant Ö. (2013). Basketball with Known and Unknown Aspects in Different Perspectives (Farklı Bakış Açılarıyla Bilinen ve Bilinmeyen Yönleriyle Basketbol), Nobel Akademik Yayıncılık Eğitim Danışmanlık Tic. Ltd. Şti.

Olsen E. (1956). Relationship Between Psychological Capacities And Success in College Athletics. *The Research Quarterly, 27*, 78-89

Psikotek Consulting (2012). Cognitrone Test Structure and Sample Reports

Scanlan A., Humphries, B., Tucker, P.S., & Dalbo, V. (2014). The influence of physical and cognitive factors on reactive agility performance in men basketball players, *Journal of Sports Sciences, 32*(4), 367–374. http://dx.doi.org/10.1080/02640414.2013.825730

Schefke, T., Gronek, P. (2010). Improving Attentional Processes in Sport: Defining Attention, Attentional Skills and Attention Types. *Studies in Physical Culture and Tourism, 17*(4), 295-299.