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Examination of Cognitive Flexibility Levels of Young Individual and Team Sport Athletes

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Abstract

The purpose of this study was to compare the level of cognitive flexibility of individual and team athletes who are students. The study included a total of 237 volunteer athletes, comprising 140 males (59.1%) and 97 females (40.9%) with a mean age of 18.98 ± 2.18 years (range, 16-26 years) who were licensed to participate in individual and team sports. Study data were collected using the Cognitive Flexibility Scale developed by Martin and Rubin (1995), which consists of 12 items in total. International validity and reliability studies were conducted by Martin and Rubin, and Turkish validity and reliability studies were conducted by Çelikkaleli on high school students (Çelikkaleli, 2014). The scores of the Cognitive Flexibility Scale were found to be higher in the team sports athletes compared with the individual sports athletes ($p<0.05$). No difference was determined between the levels of cognitive flexibility in male and female athletes. The results indicated that the cognitive flexibility levels of team athletes are higher than those of individual athletes.

Keywords: individual, team, sport, cognitive flexibility

1. Introduction

Psychologically, "flexibility" is the ability of individuals to adapt, and cognitive flexibility refers to the need to cope with changes in the environment (Cañas, Fajardo & Salmeron, 2006). "Cognitive flexibility" is defined as the ability to use cognitive processing strategies in new and unexpected environmental conditions (Cañas, Quesada, Antolí & Fajardo, 2003). Cognitive flexibility is an ability with an implied learning process, and can therefore be acquired with experience. Cognitive flexibility includes the adaptation of cognitive processing strategies. Within this definition, strategy is a set of processes that investigate a problem domain. Therefore, it refers to complex behavioral changes, not specific responses (Cañas, Fajardo & Salmeron, 2006) and allows the individual to cope with external and internal stress sources (Koesten, Schrodt, & Ford, 2009).

According to Segrin and Flora (2000), persons with high interpersonal skills have higher levels of psychological, emotional and physical well-being, both directly or indirectly (Koesten, Schrodt & Ford, 2009). Cognitive flexibility and adaptability are important in the accomplishment of personal goals (Martin & Anderson, 1998). Persons who are aware of situational factors and realise that they need to make changes to their behavior are more cognitive and more flexible than those who only follow a single path to resolve their difficulties (Martin & Rubin, 1995).

When a person performs a complex task, he or she must adjust his behavior according to the environmental conditions in which it is performed. However, as conditions continue to change, the task also evolves. The person who is cognitively flexible needs to focus carefully on the new conditions. In addition, for adaptation behavior to new conditions, one needs to restructure knowledge by effectively interpreting the new situation and requirements of the new task. Cognitive flexibility depends on the attention process and information display. In order for a person to have cognitive flexibility, it is first necessary to perceive the environmental conditions that affect the task area. On the other hand, cognitive flexibility represents the knowledge of people about a task and possible strategies for how to connect to that knowledge (Cañas, Fajardo, & Salmeron, 2006).

Cognitive flexibility allows a person to respond creatively in order to be able to adapt to difficulties and meet the demands expected of him (Kreutzer & Bowers, 2016). When a stressful situation occurs, the individual tries to solve the problem using various coping methods or by escaping from the stress source (Nagano, Kato, & Fukuda, 2004). One of the mechanisms of coping with stress is cognitive flexibility, which is defined as the ability to shift attention from one aspect to another (Hüttermann, Memmert, Simons, & Bock, 2013). In current day sports, physical excellence alone is

not considered sufficient for top-level sporting performance. Therefore, athletes experiencing changes in emotional direction are unable to attain the expected success despite being physically ready (Tavacıoğlu, 1999). In sports branches where performance needs to be coordinated, information about the task from complex and dynamic sources needs to be selected carefully, quickly and effectively. The ability to focus attention efficiently is an important factor for an athlete's success (Memmert, Baker, & Bertsch, 2010).

Coaches and trainers often mention the pre-eminence of creative thinking ability in sports. However, it is not clear how creative thinking can be improved (Memmert, Baker & Bertsch, 2010). Just as in more explicit cognitive processes, participation in various sports and physical activities can be valuable for the development of creativity (Abernethy, Baker, & Côté, 2005). It is important that the range of environmental variability is wide and this is perhaps necessary for the development of creativity. It is important for players to have a wide range of experience and to improve their ability to cope with unexpected situations (Memmert, Baker, & Bertsch, 2010). Especially in sports with tactical response patterns such as football, hockey or basketball, and offensive games where original solutions are critical. The aim of this study was to compare the cognitive flexibility level of individual and team athletes. The study hypothesis is "the cognitive flexibility levels of student athletes performing in team sports could be higher than those of individual student athletes.

2. Method

2.1 Research Model

The research is a descriptive study, in which the cognitive flexibility levels of athletes in different branches were revealed using the Cognitive Flexibility Scale (CFS).

2.2 Research Group

The study sample of 237 student athletes comprised 140 males (59.1%) and 97 females (40.9%), with a mean age of 18.98 ± 2.18 years (range, 16-26 years). All the subjects were students and played individual or team sports in various sports clubs. Written consent was obtained from all participants.

Table 1. Distribution of educational status of the athletes

Educational Status	**n**	**%**
High school	175	72.9
Undergraduate	57	24.1
Postgraduate	5	2.1
Total	237	100.0

When the education status is examined, it can be seen that the majority (72.9%) of the participants were high school students and 2.1% were university postgraduate students (Table 1).

Table 2. Sports branch distributions of the participating athletes

Sports Branch	**n**	**%**
Football	42	17.7
Volleyball	31	13.1
Basketball	20	8.4
Handball	28	11.8
Athletics	19	8.0
Judo	17	7.2
Swimming	11	4.6
Wrestling	9	3.8
Taekwondo	12	5.1
Tennis	9	3.8
Karate	9	3.8
Archery	9	3.8
Boxing	5	2.1
Badminton	10	4.2
Step-Aerobic	6	2.5
Total	237	100.0

Distribution of the sports branches showed the highest rate of 17.2% for football and the lowest rate of 2.5% for step-aerobics (Table 2).

Table 3. Distribution of sport duration

Sport duration	**n**	**%**
1-4 years	69	29.1
5-8 years	86	36.3
9 years +	82	34.6
Total	237	100.0

The reported durations of participating in the sport showed 5-8 years as the highest rate of 36.62%, and 1-4 years at the lowest rate of 29.1% rate (Table 3).

2.3 Data Collection Tools

Demographic information was collected in the study using a personal information form.

2.4 Cognitive Flexibility Scale (CFS)

The level of cognitive flexibility of the participants was determined using the Cognitive Flexibility Scale (CFS). The scale was developed by Martin and Rubin (1995) and validity and reliability studies of the Turkish version were conducted by Çelikkaleli (2014). The scale has a total of 12 items and a one-factor structure. Responses are given as Likert type as (1) I do not participate at all, (2) I do not participate, (3) I do not attend, (4) I participate a little, (5) I participate, and (6) I definitely participate. The total score can range from 12 to 72, with high scores show high levels of cognitive flexibility, and low scores, a low level of cognitive flexibility. The Cronbach alpha value from different previous studies for the scale ranged from 0.72 to 0.87. The Cronbach alpha value obtained from this study was found to be 0.70.

2.5 Analysis of Data

Analyses of the data obtained in the study were made using SPSS software. Conformity of the data to normal distribution was assessed using the Shapiro-Wilk test. For comparisons of the data of team and individual sport athlestes, the Mann Whitney U test and Chi-square test were applied. A value of $p<0.05$ was accepted as statistically significant.

3. Results

The statistical analyses according to determinants in terms of sport type, gender, and age are presented below.

Table 4. The results of the Mann-Whitney U test in respect of the age of team and individual sport athletes.

	Sports Type	n	Mean Rank	Mean Rank Sum	U	Z	P
Age (year)	Team Sports	127	125.70	15964.00	6.13	-1.67	0.095
	Individual Sports	110	111.26	12239.00			
	Total	237					

$p<0.05$

No statistically significant difference was determined between team and individual sport athletes in respect of age (Table 4).

Table 5. Mann-Whitney U test results for the Cognitive Flexibility Scale scores of the team and individual sport athletes.

	Sports Type	n	Mean Rank	Mean Rank Sum	U	Z	P
CFS Total score	Team Sports	127	127.22	16156.50	5.94500	-1.986	**0.047**
	Individual Sports	110	109.51	12046.50			
	Total	237					

$p<0.05$

The total score of the Cognitive Flexibility Scale of athletes who perform team sports was statistically significantly higher than that of individual athletes. (Table 5).

Table 6. The Chi-square test results for gender distribution of the participants

Sports Type	Gender								
	Female		Male		Total	%	df (χ2)		P
	n	%	n	%					
Team Sports	49	8.6	78	61.4	127				
Individual Sports	48	43.6	62	56.4	110		1	0.623	0.508
Total	97	40.9	140	59.1	237	100			

No statistically significant difference was determined between team and individual sport participants according to gender ($p>0.05$). Females comprised 38.6% of the team athletes and 43.6% of the individual sport group (Table 6).

Table 7. Mann-Whitney U test results for the Cognitive Flexibility Scale scores of male and female athletes.

	Gender	n	Mean Rank	Mean Rank	Sum	U	Z	P
CFS Total score	Female	97	111.09	107775.50		6.022	-1.481	0.139
	Male	140	124.48	17427.50				
	Total	237						

p>0.05

No statistically significant difference was determined between male and female athletes in respect of the Cognitive Flexibility Scale scores (Table 7).

Table 8. Chi-square test results of the sport duration distributions in team and individual sport athletes.

	Duration of participating in the sport (years)										
	1-4		**5-8**		**9+**		**Total**				
Sport Type	n	%	n	%	n	%	**n**	**%**	**df**	**(χ2)**	**P**
Team Sports	31	44.9	45	52.3	51	62.2	127	53.6	2	4.578	0.101
Individual Sports	38	55.1	41	47.7	31	37.8	110	46.4			
Total	**69**	**29.1**	**86**	**36.3**	**82**	**34.6**	**237**	**100.00**			

p>0.05

In the team athletes group, the majority (62.2%) reported a duration of 9 years or more and the lowest rate of 44.9% was stated for 1-4 years. In the individual athletes group, the highest rate of 55.1% was reported for 1-4 years and the lowest rate of 37.8% for 9 years or more. No statistically significant difference was determined between the team and the individual athletes in respect of sport duration. (Table 8).

4. Discussion

In this study, a comparison was made of the cognitive flexibility levels of team and individuals sport athletes and the results demonstrated that the cognitive flexibility levels of the team sports athletes were higher than those of the individual athletes. The reason that individual athletes have less flexibilty could be that individual sports require less cognitive function than team sports. For example, there are fewer unexpected situations in swimming or running sports compared with team sports (basketball, football etc.). In a review by Diamond (2015) the effect on executive functions was evaluated of different physical exercises including simple movements or considered movements. The review showed that studies of the cognitive benefits of physical activity need to move beyond simple aerobic activities that require little thought (treadmill running, riding a stationary bicycle, or rapid walking) and resistance training. It was concluded that "cognitively-engaging exercise appears to have a stronger effect than non-[cognitively]-engaging exercise on children's executive functions. Cognitive abilities are used in ball sports for the player to follow the ball movements, to see the game field with a wide range of views, to anticipate the movements of competitors, to develop strategic awareness, and to be able to make quick and effective decisions. For example, a football goalkeeper must follow his teammates and the opposing team players at the same time in the game. Decision-making is more effective when multiple, fast and complex movements can be seen at the same time. Players in team sports are often referred to as tactical creatures. Creativity requires flexible decision-making in complex and uncommon game situations (Memmert & Roth, 2007).

In a general scientific context, Sternberg and Lubart (1999) defined creativity as "the ability to produce both new and original (unexpected), convenient" (ie useful) work" (Memmert, Baker, & Bertsch, 2010). Castillo and Umilta (1992) suggested that athletes effectively practice spontaneous repetition so that they can give their attention more quickly to appropriate targets. In addition, talented athletes who are able to adapt quickly to changes in visual knowledge are able to deliver their attention more effectively than less capable athletes. Individuals participating in team sports are thought to make better use of cognitive flexibility levels than team-based interaction, with perceptions of events at the level of cooperative learning, and probing-based learning (Dengiz, 2000). This information supports the results of the current study that the cognitive flexibility levels of the team sports athletes were higher than those of the individual sports athletes. Reasons for this outcome could be that team sports require open skills, and that during a match or competition it is important to be aware of how teammates are reacting to the opponent and the ball, to take the weather and pitch conditions into consideration, and any other external factors.

To the best of our knowledge, this study is the first to have compared the cognitive flexibility levels of team and

individuals sports athletes. Therefore, the results of the current study cannot be compared with any previous studies in literature of similar design. However, there are three studies of different design related to cognitive flexibility in athletes. Huijgen et al. (2015) examined the relationship between cognitive functions and performance levels in 47 elite young footballers (mean age 15.5 ± 0.9 years) and 41 non-elite young footballers (mean age 15.2 ± 1.2 years). It was determined that elite young footballers had better cognitive flexibility and control levels than non-elite footballers.

The second study was conducted by Han et al. (2011) in which a negative correlation was shown between stress and anxiety and better cognitive flexibility performance in professional soccer players and basketball players. It was suggested that cognitive flexibility ability may make it easier to achieve flow. This relationship may exist because of specific requirements for maintaining the flow state. In flow, skills are necessary to meet the challenge of an activity, and cognitive flexibility can allow a person to be adaptive to challenges and respond creatively to meet the demands of his activity (Kreutzer & Bowers, 2016).

In a study by Vestberg et al. (2017) it was investigated whether executive functions (EF) are associated with success in soccer in 30 young elite soccer players aged between 12–19 years. It was concluded that core EF, comprising working memory, cognitive flexibility and inhibitory control, may predict success in soccer in young players.

The results of the current study showed no difference in the levels of cognitive flexibility level between male and female athletes. As it was thought that cognitive flexibility could be influenced by the age variable, the age distribution of the athletes according to both the type of sport and gender were examined. No significant difference was determined between team and individual athletes according to age.

In conclusion, the results of this study showed higher levels of cognitive flexibility in team athletes compared to individual sport athletes. The sample of the current study included athletes engaged in many different sports. To determine whether the particular sport has an effect on cognitive flexibility and whether cognitive flexibility affects sports performance, there is a need for further studies comparing particular sports. A previous study by Han et al. (2011) indicated that the level of cognitive flexibility in team athletes can affect performance. Therefore, coaches and athletes must be made aware of the importance of cognitive flexibility to be able to determine the level and develop the abilities further.

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