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## ASSESMENT OF A NEW METHOD HIGHLIGHTING COGNITIVE ATTRIBUTES WITH TABLE TENNIS ATHLETES

### Introduction

Cognition could be defined as the totality of mental processes related to the intelligent functions such as perception, comprehension, learning, recognition and remembrance. In sports sciences it includes specifications such as attention, perception, the speed of comprehension, transformations in short term visual memory, motoric rationalism (game concept), creativity, interpretation, forming correct relationships, the skill to take initiative and tactical skills. These characteristics are extremely valuable in the exhibition of athletes' performances for their athletic achievements. Thus, it is inevitable for the top-tier coaches to implement applications to develop these characteristics in their athletes. In today's extreme athletic competition, it is anticipated that the achievements are only possible through advanced performance awareness in early stages and systematic training applications (Dundar, 2013; Yasar, 2010; Sharkey, 2006).

It is known that physical, anthropometric, conditional and techno-motoric specifications evaluated during the selection and training of athletes could be developed. However, in addition to these basic specifications, the rapid and permanent effects of cognitive features to the improvement of athletes are not paid sufficient attention. Thus, it would be valuable for time and application facilities to design new methods in addition to utilizing methods that determine the cognitive characteristics (Sharkey, 2006; Murat, 1997).

The applications to be implemented are significant for the development of continuous and selective attention levels, recognition and visual skills, reaction times and motoric rationalism (game concept) abilities especially in fast sports. One of the sports that these characteristics are significant is the table tennis. Table tennis is one of the sports that are difficult to learn and perform. An athlete has to perceive the ball that could land in different points on the table, in a short distance and in different rotations and has to perform the right action. The top table tennis athletes, in addition to performing technically difficult actions within a short period of time, have to study their opponents quickly during a competition and to implement a game style that would cover their own weaknesses and attack their opponents' weaknesses to win. Thus, evaluation and development of the attention, perception, learning and adaptation skills of the athletes is a significant factor in training top athletes. This study aims to evaluate the skills of rapid learning, visual perception and adaptation of national level table tennis athletes by developing the Selective Action Array.

### Methods

The study was conducted in table tennis national camp (Bursa, Mimar Sinan Sports Hall) in June 2014. The study was conducted under the approval of the “Uludağ University Faculty of Medicine Clinical Research Ethical Committee.”

11 male and 11 female athletes between the ages of 14 and 18 competing at 2014 Balkan Youth Table Tennis Championship participated in the study. Participants were informed about the study. After the briefing, demographical information, general health data, their years as a table tennis player, daily training times and athletic achievement data were collected.

Consequently, the participants' height, weight and full body impedance measurements were taken using Tanita BC-418 equipment. Afterwards, in a silent room participants' auditory reaction times were recorded. The click sound was transmitted in random intervals during the first 10 trials and then in fixed intervals during the second 10 trials using headphones. The participants were asked to press a button using their dominant hands. Averages of these 10 trials were recorded as **random** and **fixed interval reaction (ms) times**.

### Selective Action Array

Selective Action Array was implemented using a table tennis robot (Butterfly/Amic-3000). The robot was set up to send 26 balls in different colors (6 white, 10 yellow, 10 pink) randomly to different spots on the table in a fixed speed and at a rate of 100 balls a minute. The participants were asked to ignore the white balls, to only touch the yellow balls and to catch the pink balls after the balls bounced from the table once. Participants did not witness the test before they participated. After they were explained about the details of the test, two trials were conducted. The whole test was recorded in video. Every action or the lack of it by the participants was transformed into points on a scoring scale (Table-1) between the points of 0 and 6. For each colored ball, a **color point** and **total points** for the total number of balls were assigned. Furthermore, the percentage of the achievement of the six points worth of action was designated as “**6 points achievement %**.”

### Statistics

The findings were presented as mean  $\pm$  standard deviation and minimum and maximum values. The comparison of intragroup dependent values were done using Wilcoxon rank sum test and for the intergroup comparisons, Mann-Whitney U-test was used. Significance level was accepted as  $p < 0.05$ .

### Results

There was no difference between the age and BMI scores of female and male athletes. While female athletes trained for an average 15.5 hours weekly for an average of 6.4 years, male athletes trained for an average of 21.3 hours weekly for an average of 8.1 years.

**Table 1. Scoring scale**

<b>White Ball &gt; No reaction</b>	<b>Points</b>
No reaction	<b>6</b>
Reacted but did not touch	<b>4</b>
Touched	<b>2</b>
Caught	<b>0</b>
<b>Yellow Ball &gt; Touch</b>	
No reaction	<b>0</b>
Reacted but did not touch	<b>4</b>
Touched	<b>6</b>
Caught	<b>2</b>
<b>Pink Ball &gt; Catch</b>	
No reaction	<b>0</b>
Reacted but could not touch	<b>2</b>
Reacted but could not catch	<b>4</b>
Caught	<b>6</b>

**Table 2. Age, body mass index (BMI), random and fixed interval auditory reaction times of the male and female table tennis athletes**

	<b>Male Athletes (n=11)</b>	<b>Female Athletes (n=11)</b>	<b>p</b>
<b>Age (year)</b>	16,2 ± 1,3 (14-18)	15,6 ± 1,6 (14-18)	p>0,05
<b>BMI (kg/m<sup>2</sup>)</b>	21,6 ± 3,0 (16,9-27,1)	20,3 ± 2,0 (17,4-24,5)	p>0,05
<b>RI-RT (ms)</b>	211,4 ± 24,3 (178-257)	216,7 ± 26,7 (178-264)	p>0,05
<b>FI-RT (ms)</b>	174,6 ± 18,2 (153-207)	185,0 ± 23,2 (138-209)	p>0,05

BMI: Body mass index; RI-RT: Random interval-reaction time; FI-RT: Fix interval-reaction time.

Random and fixed interval auditory reaction times for female athletes were found as 216.7 ± 26.7 (178-264) and 185.0 ± 23.2 (138-209) ms respectively. They were found as 211.4 ± 24.3 (178-257) and 174.6 ± 18.2 (153-207) ms for male athletes respectively. There was no significant difference between the reaction times of female and male athletes.

Fixed interval reaction times were found to be significantly less than random interval reaction times.

First trial total points for males in selective action array were observed as 124.4 ± 14.9 (92-144) for males and 107.5 ± 13.0 (90-132) for females, while the second trial total points were 136.2 ± 14.7 (104-156), 118.9 ± 7.8 (108-130), respectively. The increase in the points for the second trial was significant, but the females could not reach the points of males on the first trial even on their second. The most increase in points based on the ball color was observed in the yellow ball.

**Table 3.** Color points, 6 points achievement% and total points for the male table tennis athletes in the Selective Action Array's first and second trials

Male Athletes (n=11)	White (n=6)			Yellow (n=10)			Pink (n=10)		
	First Trial	Second Trial	p	First Trial	Second Trial	p	First Trial	Second Trial	p
Color Point (max: 36,60,60)	28,0 ± 7,3 (16-36)	30,9 ± 6,2 (22-36)	p>0,05	49,8 ± 5,8 (42-60)	55,3 ± 6,8 (38-60)	p>0,05	46,5 ± 7,5 (34-56)	49,5 ± 4,4 (42-56)	p>0,05
6 points achievement %	61,3 ± 35,8 (0-100)	73,3 ± 35,3 (16,7-100)	p>0,05	80,0 ± 14,4 (55,6-100)	87,4 ± 17,7 (40-100)	p>0,05	45,6 ± 22,8 (10-80)	63,8 ± 21,8 (30-100)	p>0,05

Male Athletes (n=11)	First Trial	Second Trial	p
Total Points (max: 156)	124,4 ± 14,9 (92-144)	136,2 ± 14,7 (104-156)	p<0,05

**Table 4.** Color points, 6 points achievement% and total points for the female table tennis athletes in the Selective Action Array's first and second trials

Female Athletes (n=11)	White (n=6)			Yellow (n=10)			Pink (n=10)		
	First Trial	Second Trial	p	First Trial	Second Trial	p	First Trial	Second Trial	p
Color Point (max: 36,60,60)	22,4 ± 7,3 (14-32)	24,5 ± 5,3 (18-34)	p>0,05	45,6 ± 7,6 (32-58)	52,0 ± 6,8 (42-60)	p<0,05	39,5 ± 8,3 (28-54)	42,2 ± 6,2 (32-50)	p>0,05
6 points achievement %	37,3 ± 31,3 (0-83,3)	42,5 ± 18,7 (16,7-83,3)	p>0,05	67,1 ± 13,2 (40-80)	82,0 ± 12,3 (60-100)	p<0,05	29,5 ± 15,0 (10-54,5)	38,4 ± 19,9 (10-70)	p>0,05

Female Athletes (n=11)	First Trial	Second Trial	p
Total Points (max: 156)	107,5 ± 13,0 (90-132)	118,9 ± 7,8 (108-130)	p<0,05

On 6 points achievement % values, males accomplished better achievement levels both in the first and second trials than females. The biggest difference in achievement levels between the females and males was observed in white ball achievement rates. Males performed 23% better in the first trial and 31% in the second trial on white ball achievement rates. The highest increase in achievement between the first and second trials was observed in the yellow ball points among females, while it was observed in the pink ball among males.

The highest total achievement rate was observed in the yellow ball, while the lowest was observed with the pink ball.

### Discussion

In the study a new method to evaluate cognitive features and auditory reaction times in national team table tennis athletes were investigated. A gradual degree of difficulty was created in the selective action array, which was implemented by associating different actions to 3 balls in different colors sent to different areas of the table in the rate of 100 balls a minute by a table tennis robot. In the two trials conducted with the participants that did not see the trials before but only instructed what to do, cognitive concepts such as adaptation, learning and reinforcement were associated with motor skills. Visual perception and attention, continuity of the concentration and motor coordination were evaluated by different skill levels observed by catching and leaving some, by touching some and not reacting to some of the 26 table tennis balls with a diameter of 40 mm and 2.7 gr of weight that arrive successively and with speed.

The facts that table tennis athletes are subjected to visual and auditory stimuli during high-speed competition and the shortness of the length of the stimulus and the need to distinguish the direction of the stimulus demonstrate the significance of the cognitive features for the athletes who play table tennis (Bhabhor, 2013; Can, 2008). Lapszo (1999) tested psychomotor efficiency particular to table tennis in table tennis players in a simulator and determined that the expectation for the movement to hit the ball and leading expectations were high. Polat (2000) demonstrated that the reaction times of table tennis players to visual and auditory stimuli were sedentary and lower than the tennis players.

This study attempted to evaluate the achievement levels of the table tennis players in different actions based on visual perception, learning skills based on repetition and adaptation in the application using selective action array. Thus, since table tennis players react to every ball during a game, our request in the selective action array that players should not respond to the white balls was turned into a difficult task. The highest rate of success was observed with the yellow balls because it was identical to the sport of table tennis. The action that would be taken with the pink balls was significant in being the most difficult task in the array. Although the lowest achievement rates were observed with the pink balls, males displayed the highest adaptation to the pink balls in the second trial.

Fixed interval reaction time to be lower than random interval reaction time was an expected finding. Predictability of the timing of the sound results in a 35 ms quicker reaction, which is 16% quicker.

The Selective Action Array the study aimed to develop would help evaluate the adaptation skills of athletes to a new situation, their learning speed, the length of focusing their attention and their visual perceptions quantitatively. This method, which could be adjusted for other branches of sports, would introduce a different point of view to evaluate cognitive characteristics, which are as significant as condition and motor motions in sports.

### Aknowledgement

This study was supported by Uludağ University Scientific Research Projects Unit [KUAP(E)-2013/57]. We are grateful for their contributions to the evaluation of video recordings to Faculty of Sports Sciences Department of Physical Education and Sports Teaching students Hazni Akın, Beyhan Aksu, Erdinç Türkyılmaz ve Umut Rona. Also, we thank to the national table tennis coaches Halil Korulu, Kadri Kocacenk and Ersin Sunay.

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### ASSESSMENT OF A NEW METHOD HIGHLIGHTING COGNITIVE ATTRIBUTES WITH TABLE TENNIS ATHLETES

*Table tennis is among sports that are difficult to learn and perform. The athlete has to perceive the ball within a small space, in various rotations, aiming at different points on the table in various speeds, and perform the correct action. Thus, assessing and improving the athletes' attention, perception, fast learning and adaptation skills are of significant importance in training top-tier athletes. This study evaluates fast learning, visual perception and adaptation skills of national athletes using Selective Action Array, developed recently for the study.*

*Out of 2014 Balkan Youth Table Tennis Championship athletes, 11 male and 11 females participated in the study. For the Selective Action Array, a table tennis robot was utilized. Robot was set up to send a total of 26 balls in 3 different colors (6 whites, 10 yellows, 10 pinks) to different areas of the table, in random colors and at the rate of 90 balls per minute. The participants were asked to ignore the white balls, to touch the yellow balls and to grab the pink balls using their dominant hands. Pursuant to*

explaining the task to the participants, two consecutive trials were executed and recorded using a camera. Every action performed/not performed by the participants was transformed into points in the scoring system.

First trial total points in the Selective Action Array were  $124 \pm 15$  for males and  $108 \pm 13$  for females, whereas on the second trial the total points were  $136 \pm 15$  and  $119 \pm 8$ , respectively. The higher scores obtained in the second trial were significant. Success rates for males were higher than females in both trials based on the percentage of correct actions executed in relation with the ball. The most significant difference between males and females was observed in white ball success rates. The highest increase in the rate of success in the second trial as compared to the first was observed in yellow balls for females and in pink balls for males. Table tennis players usually react to every ball on their side of the table; hence our request to ignore the white balls in our selective action array became a handicap for all.

The study aimed to evaluate the adaptation skills, learning speed, focus span and visual perceptions of athletes quantitatively via our experimental Selective Action Array. This method, which could also be applied to other sports branches, could introduce a different point of view to evaluate cognitive attributes, which are as important as condition and motor skills in sports.

„Blic“, 27. mart 2015.



» Prva sjednica počasnog odbora „Sportska dostignuća“

## Vojvodić: Sport vodi ozdravljenju društva

» **PODGORICA** Veća međunarodna vidljivost i osnaživanje prepoznatljivog kvaliteta crnogorskog sporta zajednički je zadatak akademske, društvene i sportske zajednice, a udruženim i posvećenim radom ti ciljevi se mogu i ostvariti. To je poruka koju je na održanoj prvoj konstitutivnoj sjednici uputio Po-

časni odbor međunarodne naučne konferencije

„Sportska dostignuća“, kojim predsjedava predsjednik Vlade Crne Gore Milo Đukanović.

Sport predstavlja najprestižniju djelatnost u našoj državi, kojom se Crna Gora danas najbudjedljivije predstavlja na međunarodnom

tržištu. Zato moramo obezbijediti šire razumijevanje i podršku ukupne društvene zajednice ljudima koji su velikim pregnućem doprinijeli tim rezultatima. Važno je razvijati i naučnu dimenziju u oblasti sporta, za šta su zaslužne institucije poput Fakulteta za sport i fizičko vaspitanje,

istakao je premijer Đukanović.

Rektorka Univerziteta Crne Gore Radmila Vojvodić naglasila je da je sport značajan za vrijednosno ozdravljenje čitavog društva, a Univerzitet predano radi na razvoju njegovog naučnoistraživačkog aspekta. ■