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A NEW METHOD HIGHLIGHTING PSYCHOMOTOR SKILLS AND COGNITIVE ATTRIBUTES IN ATHLETE SELECTIONS

Introduction

Talent is explained as a set of traits in a field that is above normal but has not developed fully yet (Yasar, 2010). These traits in sports reflect a rather wide field and are explained as anthropometric, conditional, techno-motoric and cognitive traits and psychological factors. It is of significant importance that these traits to be determined specifically for each branch of sports in selecting and training athletes (Yasar, 2010; Muratlı, 2003). Thus, the initial tests implemented in selecting athletes are generally motoric sports tests based on the measurement of conditional traits of the athletic performance of the individual. Today, these performance criteria highly prevalent in elite level athletic training applications are inevitable for physical and conditional development (Dundar, 2013; Yasar, 2010; Muratlı, 2003).

However, it is no longer possible to attain athletic achievement only through known and determined few aspects. Because training applications have started to include new approaches that compel the limits of an athlete in many respects, different from the classical methods of the science of sports. Especially countries and athletes that compete for the Olympic and world records endeavor for superiority continuously by using different methods in a quick manner. Sports is a very dynamic concept in this respect and change rapidly in accordance with the requirements of every age (Dundar, 2013; Yasar, 2010).

Within this rapid change, the need to approach the selection, development and training applications of athletes with a different method and to evaluate the close relationship between and the effects of cognitive attributes on the performance become prevalent. In Turkey, selection processes ignoring the cognitive attributes and psycho-motor skills are widely used. Although the significance and effectiveness of the processes of attention and perception to attain learning based on movement in initial and secondary selection of the athletes are known, appropriate methods are not used. During training and competition, focusing the attention to the appropriate stimulus and sustaining the attention is a significant factor for achievement in sports. Thus, it is important for the performance to evaluate the attention levels of the athletes in early stages and to provide necessary training (Caglar, 2006). Visual perception, skills and reaction time are the most significant criteria in the evaluation of athletic performance. It is known that visual skills are trainable and visual perception education programs are effective on the development of visual skills (Allen, 2006; Allen, 2004; Polat, 2000; Bellenkes, 1997).

Thus, a new method that could be used in selection and follow up of the development levels of the athletes and could be used in evaluation of their reaction times was scrutinized in this study with the participation of athlete and non-athlete female students.

Methods

The study was conducted in Uludağ University, Faculty of Sports Sciences in June 2014. The study was conducted under the approval of the "Uludağ University Faculty of Medicine Clinical Research Ethical Committee."

9 female table tennis athletes between the ages of 10 and 14 and trained for an average of 4.8 ± 1.6 (2-7) years and for an average of 16.1 ± 3.8 (10-21) hours weekly, and 9 female students who never did sports before. Participants were informed about the study. After the briefing, demographical information, and general health data were collected for the participants.

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 using BioPack MP36 system. The click sound was transmitted in random intervals during the first 10 trials and then in fixed intervals during the latter 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 at 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 consecutive 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 ± 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 body mass index (BMI) scores of the athlete and non-athlete students. Random and fixed interval auditory reaction times for the athletes were found as 230.8 ± 23.8 (207-272) and 188.1 ± 19.7 (161-216) ms respectively. They were found as 307.6 ± 121.0 (213-578) and 271.4 ± 132.9 (172-588) ms for the students that were not athletes respectively. Both random interval and fixed interval reaction times were found to be significantly quicker in athletes when compared with the students that did not do any sports (Table-2). Furthermore, fixed interval reaction times were significantly lower than the random interval reaction times.

Table 1. *Scoring scale*

White Ball > No reaction	Points
No reaction	6
Reacted but did not touch	4
Touched	2
Caught	0
Yellow Ball > Touch	
No reaction	0
Reacted but did not touch	4
Touched	6
Caught	2
Pink Ball > Catch	
No reaction	0
Reacted but could not touch	2
Reacted but could not catch	4
Caught	6

Table 2. *Age, body mass index (BMI), random and fixed interval auditory reaction times of the athlete and non-athlete students*

	Non-Athletes (n=9)	Athletes (n=9)	p
Age (year)	12,4 ± 1,2 (10-14)	13,1 ± 1,1 (11-14)	p>0,05
BMI (kg/m^2)	17,5 ± 2,7 (13,8-21,2)	18,6 ± 2,5 (13,5-21,4)	p>0,05
RI-RT (ms)	307,6 ± 121,0 (213-578)	230,8 ± 23,8 (207-272)	**p<0,05**
FI-RT (ms)	271,4 ± 132,9 (172-588)	188,1 ± 19,7 (161-216)	**p<0,05**

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

In the selective action array, first trial total points for the athletes were 103.3 ± 17.3 (72-124) and for the non-athletes were 102.4 ± 18.8 (68-134), and the second trial points were 122.4 ± 10.5 (110-142) and 104.7 ± 20.3 (64-132), respectively. The increase in total points in the second trial was significant for the athletes, while the increase for non-athletes was insignificant. Non-athletes received 30% more points than the athletes with the white balls that required to no reaction, there was a very insignificant increase between the first and second trials with the white balls.

With the yellow balls, athletes and non-athletes got similar points in the first trial, while the table tennis players increased their points about 20% in the second trial; non-athletes scored almost the same points.

Table 3. *Color points, 6 points achievement% and total points for the non-athlete students in the Selective Action Array's first and second trials*

Non-Athletes (n=9)	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)	29,6 ± 6,0 (22-36)	32,9 ± 3,0 (28-36)	p<0,05	44,7 ± 6,5 (32-52)	44,4 ± 13,4 (14-58)	p>0,05	28,2 ± 9,3 (14-46)	27,3 ± 6,5 (20-40)	p>0,05
6 points achievement %	68,9 ± 26,5 (16,7-100)	83,0 ± 14,5 (50-100)	p<0,05	31,9 ± 23,6 (0-60)	47,5 ± 26,5 (0-90)	p>0,05	8,9 ± 13,6 (0-40)	5,6 ± 7,3 (0-20)	p>0,05

Non-Athletes (n=9)	First Trial	Second Trial	p
Total Points (max: 156)	102,4 ± 18,8 (68-134)	104,7 ± 20,3 (64-132)	p>0,05

Table 4. *Color points, 6 points achievement% and total points for the athlete students in the Selective Action Array's first and second trials*

Athletes (n=9)	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)	21,6 ± 8,7 (10-36)	23,8 ± 3,5 (16-28)	p>0,05	45,6 ± 6,7 (32-52)	53,3 ± 5,6 (44-60)	p<0,05	36,2 ± 11,2 (20-56)	45,3 ± 8,7 (32-58)	p<0,05
6 points achievement %	30,4 ± 30,5 (0-83,3)	37,4 ± 13,3 (16,7-50)	p>0,05	63,0 ± 11,0 (40-80)	84,7 ± 11,4 (66,7-100)	p<0,05	29,1 ± 22,4 (0-72,7)	45,3 ± 28,9 (10-90)	p<0,05

Athletes (n=9)	First Trial	Second Trial	p
Total Points (max: 156)	103,3 ± 17,3 (72-124)	122,4 ± 10,5 (110-142)	p<0,05

With the pink balls, non-athletes scored the lowest points, and their points decreased slightly in the second trial. Table tennis athletes demonstrated the highest increase in points in the second trial with the pink balls.

On 6 points achievement % values, non-athletes were significantly more successful with the white balls; athletes demonstrated the highest achievement with the yellow balls. Athletes demonstrated an increase in their achievements with all balls in the second trial, but non-athletes demonstrated a decrease in achievement with the pink balls. In total, the highest achievement was observed with the yellow balls, the lowest achievement was observed with the pink balls (Table-3-4).

Since the table tennis players were accustomed to reacting every single ball due to their training, adaptation to the white balls were more difficult for them. While the non-athletes were most successful with the white balls, they failed in the catching task with the pink balls. They could not transfer their learning even in the second trial.

Discussion

Reaction time is the time necessary to recognize the stimulus, select and program the appropriate response and activate the related muscle group. Reaction time has premotor and motor components. Reaction time is a simple measurement method that is thought to provide direct or indirect information on cognitive functions, perception and other neurological functions (Sisman, 2007). In humans, reaction time is directly related to the speed of neural transmission. Although this speed reaches 100-120 m/s, the voyage of the transmission from the sense organs to the brain and from there to the muscle groups takes a certain time (Welford, 1980; Laming, 1968). Laming (1968) designated the “average basic reaction time” as 220 ms (12). Lapszo (1999) tested the psychomotor efficiency of the table tennis players specific to the game under simulator conditions and determined that the expectation of hitting and directing the ball was high. In different sports played using a racket, when the athletes were given 3 stimuli in different speed levels (low, medium, high) and their actions towards the ball were scrutinized, it was found that badminton players reacted the best in medium speeds and table tennis players reacted the best in high speed levels (Menevse, 2011). In the study, both the random interval and fixed interval reaction times were significantly lower for the athletes when compared with the students with no athletic past. Furthermore, it was expected that the fixed interval reaction times to be found as significantly lower than the random interval reaction times.

The fact that athletes were 80 ms quicker than non-athletes in auditory reaction times could not only be explained by their increased speeds of neural transmission. The effects of sports on cognitive functions such as attention, focusing, sustaining the concentration, in other words its effects on premotor reaction time, are more dominant in this context. After an average of 5 years of playing sports, 30% increase in the speed of auditory reaction time, especially in premotor section, proves the necessity to evaluate the cognitive functions in sports from a different angle.

In selective action array, the significant increase in points in the second trial for the athletes and the failure of the non-athletes to accomplish this, demonstrated that athletes had higher learning and adaptation skills. Thus, the two trials in the selective action array and the increase in points in the second trial demonstrate that cognitive function was evaluated quantitatively.

The findings of the selective action array developed for this study showed that in the first phase, and especially in sports played using rackets, the development of the sustenance of attention and visual perception could be attained rapidly. Furthermore, it was predicted that by developing the automatism of hitting the ball in a desired fashion during the game, the learning skill would be developed positively as well. Thus, by making changes in the number and color of the balls as well as differences in actions to be taken, this method could be a new approach to be used for other sports to include the cognitive attributes in selection process of the athletes.

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Talents are extraordinary but not completely developed characteristics in a field. These attributes cover a relatively wide range in sports. Tests perused in selection of athletes are generally motoric sports tests and measure predominantly conditional attributes. It is known that in sports, performance is related to cognitive skills as well as physical features and motor skills. This study explored a new method that could be utilized in the selection and tracking the level of improvement of athletes, and evaluate their attention, perception and learning levels, on athlete and other female students.

9 female table tennis athletes that trained for 16 hours per week for the last 5 years and 9 female students that never played in any sports, aged between 10 and 14 years, were participated in our study. For the Selective Action Array, developed for this study, 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 104±17 for athletes and 102±19 for non-athletes, whereas on the second trial total points were 122±11 and 105±20, respectively. The higher scores obtained in the second trial were significant for the athletes; the difference in the scores for non-athletes was minor. Non-athletes scored 33% better for the white balls as compared to the table tennis athletes. For the yellow balls, athletes and non-athletes scored similar points on the first trial, whereas the athletes improved their points around 20%, while no improvement was observed for the non-athletes. Non-athletes scored the worst points for the pink balls and during the second trial a minor decrease in their points was observed. Table tennis athletes demonstrated the highest improvement in points in the second trial for the pink balls.

The findings of the selective action array developed for this study showed that in the first phase, and especially in sports played using rackets, the development of the sustenance of attention and visual perception could be attained rapidly. Thus, by making changes in the number and color of the balls as well as differences in actions to be taken, this method could be a new approach to be used for other sports to include the cognitive attributes in selection process of the athletes.