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Table Tennis Motor Components and Analysis of Successful Trials Testing These Skills

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Abstract

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Sports fields are many and varied all over the world. In Israel, there are only a few organizations training persons with disabilities such as ISCD (Israel Sport Center for the Disabled) and the IDF disabled Veterans Organization. Table Tennis developed in the end of the 19th Century in England. Only a few studies have been conducted about this sport branch in terms of the normative population (Sindik, 2013; Zhang, 2012) and the population of persons with intellectual disabilities (Van Biesen et. al., 2014; Van Biesen et. al., 2010). Moreover, there are only a few studies were conducted on people with moderate intellectual disability who train in professional sport teams. In this article we will review the components of the main movements underlying table tennis game, which were selected after analyzing table tennis games , and skill tests to check each of the selected skills: balance, eye & hand coordination, power regulation, coordination.

Keywords: Cognitive disability; skills test, table tennis.

1. Introduction

Table Tennis developed in the end of the 19th Century in England. Table Tennis was first introduced as a sports branch in the 1988 Seoul Olympic Games and is highly popular in Asia and Europe. Only a few studies have been conducted about this sports branch in terms of the normative population (Sindik, 2013; Zhang, 2012) and the population of persons with intellectual disabilities (Van Biesen et. al., 2014; Van Biesen et. al., 2010).

Although it has not been researched much, there are a number of research studies engaging in Table Tennis in general (e.g. Sergio et. al., 2002; Raab, 2005; Zhang, 2012; Sindik et. al, 2013; Silva et al, 1982).

2. Literature Review

Sport in general and branches which involve rapid ball movement in particular require the athlete to make fast decisions regarding how to hit the ball and which movement to choose in order to react to the ball toward him or her. This means the game consists of two main components: technique and tactics (Abel et al, 2004; Raab et. al., 2005; Zhang et. al., 2012). Vickers (2003) proposed a training program which includes repetitive practice of the skill and dividing the skills into stages of movement, where learning occurs from the easiest aspect to the hardest ones, based on the assumption that movement is learnt from the declarative aspect to the procedural one (Vickers, 2003). Vickers (2003) designed a Table Tennis program which integrates the cognitive aspect of decision-making and the technical aspect of learning the skill, assuming that movement or training must be as realistic as possible, and since Table Tennis is a game which combines rapid decision-making, as well as matching the type of strike and its quality to the characteristic of the returning, this type of integrated training is the best in his opinion.

Research conducted by Vickers on two groups showed that the group that received motor training combined with video analysis of the way in which the game was played and drawing conclusions from the analysis improved achievements more than the group that learnt the technical skill only (Vickers, 2003; Raab et. al., 2005).

In their research, Zhang et. al. (2012) added play practice training to the components of Table Tennis such as the initial serve and strike, as well as Skill-focus instruction (SI). In this case, too, the research findings showed, although other components were measured as well, that training accompanied by guidance and explanations was more effective that training without explanations (Zhang et. al., 2012).

Table tennis is one of the fast ball games branches, and hence, a coach experiences all the elements and nuances of effective training (Sindik, 2013). From the perspective of sport, effective training or an effective game is expressed in the result.

Success depends on the analysis of data about the given object. A Table Tennis player who succeeds in seeing the ball at the right time and the right place is likely to successfully strike back. Timing then is of the utmost significance for the player to transfer motor commands based on information received visually. Additional information obtained visually may also help assess the type of serve and its characteristics. Sergio et. al. (2002) conducted research which showed how the eye-hand coordination is of great significance in Table Tennis. The research findings revealed that competent players followed the ball with their eyes and reached higher achievements than the less competent ones (Sergio et. al., 2002).

Hand-eye coordination is one of the components representing this sport branch directly. Most hand-eye coordination studies have been conducted in laboratory conditions and cannot genuinely testify to

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what happens in a real Table Tennis game (Williams & Davids, 1998). One of the first field research studies examined the players' performance when the coach gave them instructions to keep their eyes on the ball along its trajectory (Pippol & Felurance, 1998). The results showed that players reacted better both in terms of the quality of their strikes and the speed of reaction to balls which reached the middle line of the body rather than to those which went towards the sides.

The field of Table Tennis among individuals with intellectual disabilities has not been sufficiently researched. In the past, individuals with intellectual disabilities who played professional Table tennis could participate in the Paralympics. In 2012, after 12 years without playing, the Olympic Committee approved the return of athletes with intellectual disabilities to the Paralympics, and decided not to limit their participation to the Special Olympics. Classification tests that players have to take to qualify for the Paralympics are measured via numerous parameters, as is the case with all Paralympics participants. Nevertheless, there are other elements such as anxiety, stress or medical problems which might influence the players' state, especially those with intellectual disabilities (Biesen et. al., 2010; Biesen et. al., 2014).

Research conducted by Biesen (2014) focused on individuals with intellectual disabilities who participate in the Paralympics. The research sought to compare the results of technical performance in a game simulation and those of a real game. The findings showed no significant differences between the simulation and a genuine game in most components (Biesen et. al., 2014). To this day, individuals with intellectual disabilities take much longer to learn in general and motor skills in particular. As a rule, it is harder for individuals with intellectual disabilities to learn motor skills than for individuals without intellectual disabilities, and the same is true for reaction time (Porretta & Moore, 1991; Biesen et. al., 2010).

Because the existing tests for examining the motor skills of people with intellectual disabilities are not adapted to their physical and cognitive abilities, we have been adapted this need by these new skills tests.

study on the skills tests was conducted after writing the skills tests and the validity of 11 specialists.

In order to examine the reliability of each measure comprising the test, Alpha Cronbach coefficients were calculated that demonstrated internal consistency between components of each measure.

Ten people participated in the study with moderate intellectual disabilities and motor disabilities aged 30-32.

3. Research aim

To find components of the movement in table tennis to create skill tests designed to test these components.

4. Research question

What components might comprise skills tests for intellectually disabled people in four areas: balance, hand-eye coordination, power regulation and coordination?

5. The Research procedure

In order to answer this question, three stages were undertaken:

a. Examining existing research tools in each one of the chosen four skills. This showed that there are a number of valid tests that examine these skills but they are unsuitable for an intellectually disabled population group. In light of participants' severe impairments, it was recognized that they would not be able to undertake these tests and adapted tools would need to be built.

b. Constructing a test to examine each of the four skills. The skill tests, as can be seen in the methodology chapter that follows, were constructed in such a way that the first two motor actions in each skill were taken from known validated tests. The remainder was chosen according to motor actions linked to these skills, for example in the hand-eye coordination skill test, one of the actions was to throw and catch a ball. The tests were sent to 11 experts in different fields: special education, physical education and table tennis experts for analysis and validation.

c. Internal consistency testing

6. Research Results

The results are presented as follows:

Table 1. Results of reliability analysis of balance measure (N=10)

Reliability Statistics	
Cronbach's Alpha	N of Items
.896	8

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
a1	11.80	12.622	.564	.893
a11	11.50	10.278	.775	.873
a12	12.00	11.556	.760	.877
a13	12.10	11.211	.850	.870
a2	12.00	11.333	.566	.894
a3	12.00	10.667	.565	.902
a4	11.80	10.844	.779	.873
a5	12.00	11.556	.760	.877

The analysis demonstrated a high reliability level across the whole measure ($\alpha = 0.896$). The above table shows that there was no need to remove any component from the general measure.

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Table 2. Results of consistency reliability of hand-eye coordination measure (N=10)

Reliability Statistics				
Cronbach's Alpha			N of Items	
.829			7	
Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
b1	10.80	7.067	.337	.864
b21	10.60	6.489	.649	.793
b22	11.20	6.400	.725	.779
b23	11.70	7.122	.671	.794
b3	11.80	7.067	.712	.789
b4	11.50	7.833	.452	.824
b5	11.60	7.156	.676	.794

The analysis demonstrated a high reliability level across the whole measure (α = 0.829). The above table shows that there was no need to remove any component from the general measure.

Table 3. Results of reliability analysis of power regulation measure (N=10)

Reliability Statistics				
Cronbach's Alpha			N of Items	
.803			10	
Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
c1	12.80	6.844	.564	.778
c21	12.30	8.011	.441	.790
c22	12.90	7.211	.409	.808
c23	13.30	6.678	.664	.760
c3	13.30	7.122	.790	.748
c4	13.10	7.211	.753	.752
c51	13.60	8.489	.531	.786
c52	13.70	9.567	.000	.813
c53	13.70	9.567	.000	.813
c54	13.60	8.489	.531	.786

The analysis demonstrated a high reliability level across the whole measure (α = 0.803). The above table shows that there was no need to remove any component from the general measure.

Table 4. Results of reliability analysis of coordination measure (N=10)

Reliability Statistics				
Cronbach's Alpha			N of Items	
.815			5	
Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
d1	6.10	4.100	.364	.838
d2	6.30	2.233	.713	.769
d3	6.20	2.622	.803	.712
d4	6.60	3.156	.678	.761
d5	6.80	3.511	.619	.785

The analysis demonstrated a high reliability level across the whole measure ($\alpha = 0.815$). The table above shows that there was no need to remove any component from the general measure.

Table 5. Distribution of results of balance measure (N=10)

Components	Low	Medium	High	Total
Balance reactions – Paratrooper reflex*	20%	80%	0	100%
Symmetry (2 sides)	20%	50%	30%	100%
Powerful	40%	60%	0	100%
Responsiveness	50%	50%	0	100%
Transfer of weight from one foot to another 5 times in a row*	50%	40%	10%	100%
Standing on one leg for half a minute*	60%	20%	20%	100%
In game – cross steps across the table from side to side	30%	60%	10%	100%
In game - stop and hit the ball after leg movement	40%	60%	0	100%

Distributions show that balance abilities were generally low. In most components, none of the subjects achieved a high level and in three of them, only a small percentage achieved a high level.

Table 6. Distribution of results of hand eye coordination measure (N=10)

Components	Low	Medium	High	Total
Eye tracking* - following pencil or flashlight Sequence traceability – Crossing the center line	20%	20%	60%	100%
Catch ball from 2 meters with two hands				
Football	10%	20%	70%	100%

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Tennis ball	20%	60%	20%	100%
Paddles ball	50%	50%	0	100%
In game – Right Serve	60%	40%	0	100%
In game - Thump the ball correctly when the player is in static mode	30%	70%	0	100%
In game - Thump the ball correctly when the player is in dynamic mode	40%	60%	0	100%

Distributions shows that hand eye coordination abilities were low. The football catching measure was especially high. 70% of participants demonstrated a high level of ability catching a large ball.

Table 7. Distribution of results of power regulation measure (N=10)

Component	Low	Medium	High	Total
Throwing one type of ball to same target from different distances*	30%	50%	20%	100%
Throw different size balls to same target*				
Football	0	60%	40%	100%
Tennis ball	40%	40%	20%	100%
Table tennis ball	70%	20%	10%	100%
In game - hit the ball across the net, the opponent's court	60%	40%	0	100%
In game – hit next to the net	40%	60%	0	100%
In game - bat on ball:				
Hit	90%	10%	0	100%
Spin	100%	0	0	100%
Chop	90%	0	0	100%
Serve	100%	10%	0	100%

Distributions show that power regulation abilities are very low. One can discern that the majority of athletes are at a low level in most components, particularly those connected with the game itself such as serve and the like.

Table 8. Distributions of results of coordination measure (N=10)

Components	Low	Medium	High	Total
Motor pattern design includes two steps* (e.g. throw a ball and catch it)	10%	90%	0	100%
Dribbling while walking at least 3 times in a row*	50%	30%	20%	100%

Gambol at least 4 times in a row*	30%	60%	10%	100%
In game – hit the ball while moving legs	60%	40%	0	100%
In game - change position depending on body position of the opponent's hit and ball positions	80%	20%	0	100%

Distributions show that coordination abilities were low. Most athletes demonstrated a low or medium level of ability. Most showed a medium level of simple motor pattern planning skills of 2 steps as seen in the first component.

In summary, distributions of the test results prior to the program show that, in general, subjects' abilities were very low in all four measures.

7. Conclusion

The study results led to the conclusion that the tests constructed were suitable for intellectually disabled people and valid for the research field and that a test that mixes components from existing tests with movement components from the game itself, provides a greater internal consistency.

A further conclusion that arose from the study stage was that the four chosen skills were indeed part of many skills connected to this branch of sport, but were indeed basics of the game and the most significant skills.

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