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ORIGINAL ARTICLE

Test-retest reliability of the "table tennis specific battery test" in competitive level young players

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Abstract

The aim of this study was to evaluate the reliability of the Table Tennis Specific Battery Test (TTSBT) in young table tennis players. Sixteen (n=16) boys and fourteen (n=14) girls aged 13.3±0.9yrs performed the battery test twice. The present study, based on the competitive performance level of the players, assessed 4 groups (8 tests) of the TTSBT regarding the playing target skills (Reaction Speed, Displacement Speed, Skill Speed, Ocular-Manual coordination). The Intraclass Correlation Coefficient (ICC) was applied to estimate the coefficients of reliability, while the t-test was used in order to analyze the players' test-retest performance in the TTSBT. From the results it is shown that the overall reliability of the studied TTSBT was high (a=0.85). However, 3 tests were excluded from the testing battery due to their low reliability. In conclusion, the TTSBT is generally a reliable test battery which focuses on the evaluation of the technical skills and the table tennis performance progress of the young players.

Keywords: Table tennis, tests, technique, targets.

Introduction

Table Tennis is a technical racket sport which requires repeated maximal efforts followed by short resting intervals. A number of studies have used the anthropometric profile (lean body mass & forearm/arm girths) as the key point for the performance evaluation of the Table Tennis players (Yuza, Sasaoka, Nishioka, Matsui & Miyashita, 1992; Carrasco, Pradas, Torre, Rapun & Martinez, 2011), while the psychological factors (concentration, anxiety, self-control) and their relation to the players' competitive performance have also been studied (Chen, Chang, Hung & Chen, 2010; Chu et al., 2011). Currently, the prevailing tendency is to evaluate the athletes' playing performance (special movements & type of strokes) during the analysis of the matches (Malagoli, Rocco & Franco, 2011). Additionally, the motor skills assessment and their connections to the playing performance as well as a combination of elements, such as the required movements of the players or their successfully selected strokes, are very important parameters for the evaluation of Table Tennis (Yuza, 1992; Malagoli, Lobietti & Merni, 2007).

Nowadays, the assessment of the competitive performance in the top-level players in Table Tennis has been widely investigated (Chen, 2010; Chu, 2011). For this reason, the use of accurate and reliable methods for the performance evaluation in Table Tennis is very important for the training processes. More specifically, the contemporary playing techniques in Table Tennis are very important not only for the targets precision counting but also for the accurate reflection of the players' strokes

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(Williams, 1998). The Table Tennis Specific Battery Test (TTSBT), as a testing and training tool in motor skills, does not require any highly sophisticated equipment and it may offer valuable information to the coaches about the level of their players' technique. However, the TTSBT has been applied for the talent identification in Table Tennis for more than a decade (Gomes, Amaral, Venture & Agular, 2000) without any reliability study available. Thus, the aim of this study was to evaluate the reliability and the repeatability of four groups of the TTSBT (Reaction Speed, Displacement Speed, Skill Speed, Ocular-Manual co-ordination) by using the counterdrive forehand and the backhand strokes in young competitive level Table Tennis players.

Methods

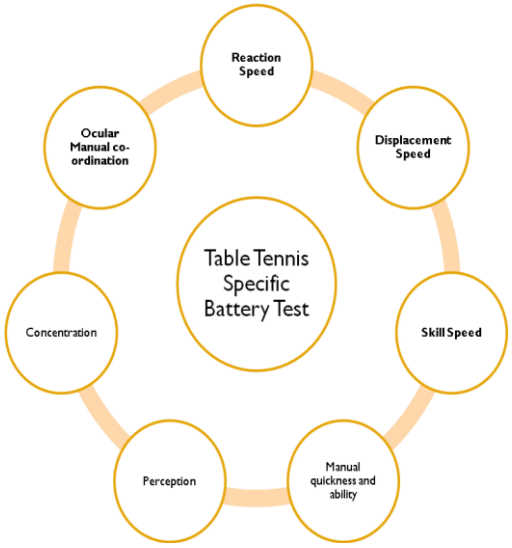
Participants

Thirty (n=30) adolescent table tennis players who were classified in the official Hellenic Table Tennis Federation (H.T.T.F.) Ranking list volunteered to participate in this study. The studied subjects consisted of sixteen (n=16) boys and fourteen (n=14) girls at the age of 13.3±0.9 yrs with training experience of 3 years, exercising in table tennis at least 4 times per-week. Furthermore, none of the adolescent players had ever been tested on the TTSBT since the beginning of this study. The parents were fully informed about the research and they were asked to complete a written information consent prior to the players' participation. The study was performed according to the rules of the Ethics Committee of the Democritus University of Thrace.

Testing Description

The Table Tennis Specific Battery Test (TTSBT) was firstly presented in 2000 and it consists of six (6) groups of targets and one (1) mental test in order to evaluate the athletes' playing performance (Figure 1). The battery test was constructed in order to detect accurately the talents in Table Tennis, analyzing the playing parameters of: Reaction speed, displacement speed, skill speed, manual quickness & ability, ocular-manual coordination, perception and concentration (Gomes, Amaral, Venture & Agular, 2000).

Figure 1. Schematic representation of the groups of tests of the Table Tennis Specific Battery Test (TTSBT)



The evaluation of the players' performance is associated with an achieved score which is increased every time the player sends the ball to the targets. According to the creators of the TTSBT, the classification of the players' performance ranged from "Weak" to "Excellent". Regarding the age and the playing level of the studied athletes, the four (4) out of the six (6) evaluated groups of the TTSBT in the present study were: a) reaction time I & II, b) displacement speed I, II & III, c) skill speed I & II, d) ocular-manual coordination.

The TTSBT manual described the groups of tests as follow:

a) Reaction Speed Test I & II: the balls are thrown in high speed (60-70 balls/min) to different areas of the table tennis table and the player has to perform forehand or backhand topspins. The number of balls that touch the table during the 15s is considered successful (RS I) and the amount of balls that touch in special marks on the table are considered successful too (RS II).

b) Displacement Speed I, II & III: the balls are thrown in high speed (80 balls/min) to the sideways of the table (DS I) and the player should perform alternately forehand and backhand topspins. After a 30s break, one ball is thrown to the right and two to the left side of the table (DS II). The player has to perform repeatedly a forehand topspin, a backhand topspin and a forehand topspin with pivot. In the last test (DS III), after a 30s break the examiner sends one short ball to the right, one long ball to the right, one short ball to the left, one long ball to the left in a regular way. The player must repeatedly perform a forehand flip, a forehand topspin, a backhand flip and a backhand topspin and the number of balls that touch the table during the 15s is considered successful.

c) Skill Speed I & II: the balls are thrown in a fast tempo (80-100/min) to the right side of the player. After a 30s break, the balls are thrown to the left side of the

table. The player performs forehand (Skill Speed I) and backhand topspins (Skill Speed II) and the amount of balls that touch the special marks on the table is considered successful.

d) Ocular-Manual Coordination: the player stands in a distance of approximately 1m from the table. The balls are thrown (low-top) over the table to the side of the player who must hit the balls with the racket without allowing them to fall in the ground. The amount of balls that the player hits (15) is considered successful. The players were evaluated twice by the same examiner and with the same testing protocol (return the balls in fast tempos) in a time period of 15 days. Instead of top-spins, the counterdrive forehand and backhand strokes were used due to the limitations in the playing technique of the adolescent players. Prior to each testing session the players did a standard warm-up of an approximate duration of 15min. The specific warm-up consisted of 2 minute forehand and backhand counterdrive strokes which were similar to the strokes used in the daily warm-up before the usual training of the players. Then the test was demonstrated to the studied players and the examiner explained the type of strokes and footsteps that the players had to make. Immediately after the oral instructions to the subjects, the tests started with the ball throwing by using the table tennis robot. However, in the "Displacement Speed III" test which was not technically supported by the robot, the balls were thrown to the players manually with the use of multiball. Between the testing groups there were rest intervals according to the TTSBT guidelines. The research data was evaluated separately for each player, while all testing efforts were recorder by a digital camera and analyzed by the same experienced researcher. The total duration of the measurements was 10-15min for each subject and the test-retest procedure took place in the same Sport Hall in Patras, Greece.

Equipment

The data was recorded by Sony: HDR-GW77V Handycam HD and Sony DCR-PC330E, while the digital timer was set per 15s. The specific research equipment was as followed: Table Tennis Robot with Adjustable Frequency Launcher and Angles Drop AMDT / Y & TV-989 which had been constructed to use the Stag 418-3 Star White balls. The Table Tennis Table was the Stag 1000DX, ITTF approved. Each studied player used his/her personal equipment with the racket evaluator type Butterfly VSG21-4000-FL off with rubbers Joola Express 40-001.

Statistical Analysis

The data normality was checked by using the Kolmogorov-Smirnov method, while the normal distributions of the variables were confirmed by the probability P-P plots. The Intraclass Correlation Coefficient (ICC) was applied to estimate the reliability in all TTSBT testing variables by using an absolute agreement definition type. The correlated control t (paired samples t-test) was used in order to analyze the research data between initial and final measurements of the TTSBT. The graphical method of Bland-Altman plot was applied to determine whether any statistical bias existed (Bland & Altman, 1986). Descriptive statistics as well as the ICC and t-test were made with the use of SPSS-PASW statistical software version 18.0 for Windows,

(*SPSS, Inc., Chicago, IL*). The Bland-Altman plots were computed by using the MedCalc ver. 12.1.1 for Windows, (*MedCalc Software, Broekstraat 52, Mariakerke, Belgium*). The level of statistical significance was set at p=.05.

Results

The ICC overall absolute agreement of the assessing parameters of the Table Tennis Specific Battery Test (TTSBT) was high (8 items; a=.85). More specifically, the Cronbach's *a* revealed that the testing variables of the Skill Speed I Forehand (a=.83) and the Skill Speed II Backhand (a=.86) have high correlation of coefficients. In addition, the parameters Reaction Speed (a=.71), Displacement Speed I (a=.69) and Displacement Speed III (a=.55) presented moderate coefficients of reliability. Finally, the testing variables of the Reaction Speed II (a=.07), the Displacement Speed II (a=.01) and the Ocular-Manual coordination (a=.18) recorded low coefficients of repeatability. The ICC Cronbach'*a* for each pair of the TTSBT parameters is illustrated in the table 1.

Table 1. The ICC reliability analysis of the TTSBT test-retest measurements

Tests	**Cronbach' *a***
Reaction Speed I	.71
Reaction Speed II	.07
Displacement Speed I	.69
Displacement Speed II	.01
Displacement Speed III	.55
Skill Speed I	.83
Skill Speed II	.86
Ocular-Manual coordination	.18

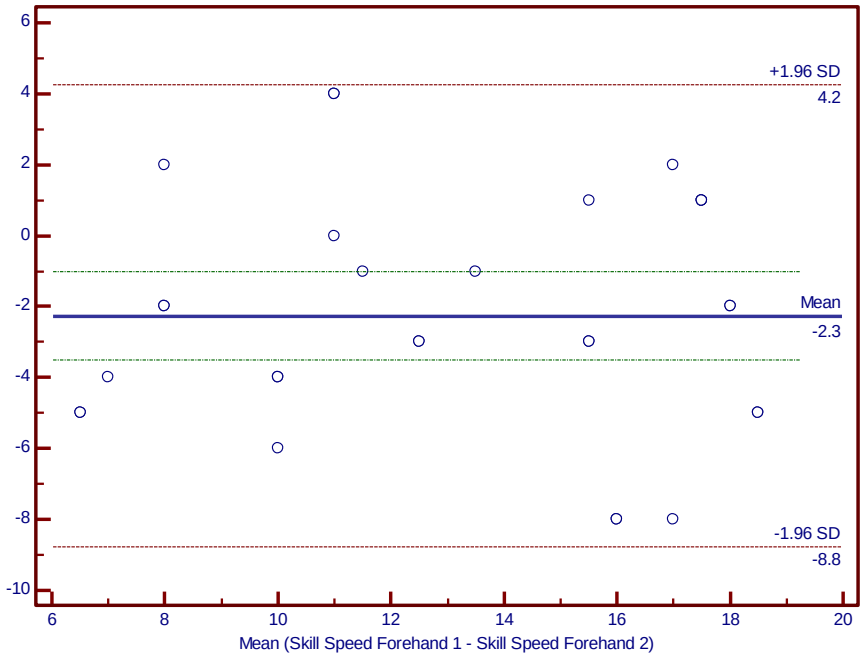
The obtained results from the t-test ranged from -4.97 (Skill Speed II) to 0.44 (Reaction Speed II). Similarly with the ICC analysis, the high reliable TTSBT testing parameters presented high repeatability. More specifically, in the variables of the Reaction Speed II $t_{(29)}$=0.44, p>.05, the Displacement Speed I $t_{(29)}$=-0.26, p=.05, the Displacement Speed II $t_{(29)}$=-0.33, p>.05 and the Displacement Speed III $t_{(29)}$=-1.64, p>.05 no significant differences were reported in the performance of the studied young players. The t-test analysis regarding the players' testing performance in the TTSBT is presented in the table 2.

Table 2. Paired samples t-test of the player's performance in the TTSBT.

Tests	Description	t-values	Significance
Reaction Speed I	Free1 - Free2	-4.61	.001
Reaction Speed II	Target1 – Target2	.44	n.s
Displacement Speed I	Dis1/1 - Dis1/2	-.26	n.s
Displacement Speed II	Dis2/1 - Dis2/2	-.33	n.s
Displacement Speed III	Dis3/1 - Dis3/2	-1.64	n.s
Skill Speed I	Skil11/1 - Skil1/2	-3.74	.01
Skill Speed II	Skil2/1 - Skil2/2	-4.97	.001
Ocular-Manual coordination	Ocular1 – Ocular2	-3.08	.004

In addition, the accuracy of the Table Tennis Specific Battery Test (TTSBT) as a reproducible method for the evaluation of the player's performance must be primarily based on the confirmation of the proposed testing battery reliability. The Bland-Altman plot evaluated the TTSBT test-retest bias in absolute terms. Schematically the above method indicates that in both testing trails the mean difference of the most reliable parameter of the "Skill Speed I forehand" was strongly correlated, confirming that any systematic error does not exist. The Bland-Altman plot for the Skill Speed I forehand of the TTSBT is shown in figure 2.

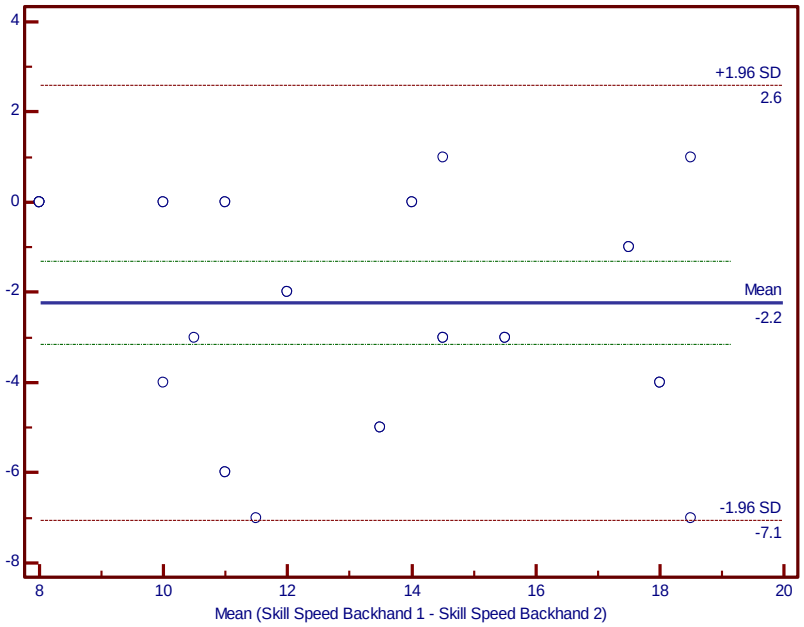
Figure 2. Difference of the two testing trials against the mean Skill Speed I forehand of the TTSBT.



Moreover, the reliability of the TTSBT for the estimation of the players' performance in Table Tennis was also based on the assessment of the agreement level of the variable "Skill Speed II backhand". The Bland-Altman graphical method which was used for the identification of reproducibility of the high reliable parameter "Skill Speed II backhand" showed that the mean difference of this variable in absolute

terms was located far from the zero-bias line. This finding increases the magnitude of the reliability of the above testing parameters. The Bland-Altman plot for the Skill Speed II backhand of the TTSBT is illustrated in Figure 3.

Figure 3. Difference of the two testing trials against the mean Skill Speed II backhand of the TTSBT.



Discussion

Sport-specific tests are important for the talent identification because they are applied under competitive conditions and can simulate the athletes' peak performance (Muller, Benko, Raschner & Schwameder, 2000). The field test batteries which evaluate the overall athletes' performance in competitions can provide a more accurate reflection of their natural behavior and a feedback for the sport scientists (Williams & Davids, 1998). In racket sports, the researchers have developed a number of field tests which accurately evaluate the optimal athletes' performance in relation to their playing techniques in a match. The International Tennis Federation has recently presented the "Battery of Test for Prediction and Evaluation of Tennis players" which consisted of 11 testing items. The above test assesses similar parameters (i.e. agility, sport specific drills, balance and reaction speed) with the TTSBT, especially in target testing with forehand and backhand strokes and it has already been reported as a reliable and accurate test battery for the tennis players (Strecker, Foster & Pascoe, 2011).

In addition, the present study examined the reliability of the TTSBT which can be used to support the work of the coaches for the talent identification in Table Tennis. For this reason and like other relevant studies, the less reliable tests must be excluded from the TTSBT (Smekal, et al., 2000; Hopkins, Schabort & Hawley, 2001;

Girard, Chevalier, Leveque, Micallef & Millet, 2006). It must be also noted that the "Reaction Speed II, the Displacement Speed II and the Ocular-manual coordination" tests with the low reliability which were excluded from the TTSBT were technically difficult to perform by the young Table Tennis players. The high speed balls throwing by the examiner, especially in different table tennis table areas, simulates match conditions of players with outstanding technique and this fact interprets the low reliability of the above tests of the TTSBT in young players. For this reason it is recommended that the coaches must use the forehand and backhand counterdrive instead of topspins in young competitive level players.

Conclusion

In summary, this is the first study which presented that the Table Tennis Specific Battery Test is a reliable and reproducible field test that could be applied for the talent identification and training evaluation. However, it is technically justifiable for the low reliability tests to be excluded from the TTSBT because they are not trainable and cannot meet the demands of young Table Tennis players. Future research should be carried out in order to evaluate the elite and non-elite performers and it should focus on the technical strokes for the establishment of the TTSBT as a scientific tool for the players' training progress in Table Tennis.

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