

Psychomotor Abilities As A Prediction Indicator Of High-Level Performance In Tennis.

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Abstract : Detecting future high level performance is important in various sports . Psychomotor abilities constitute the foundation of physical giftedness . The aim of this study was to identify the most important psychomotor abilities that may lead to highest level of performance in tennis . High qualified tennis coaches were asked to make an educated guess about the most important two psychomotor abilities which cannot be modified by practice or experience . According to the result of this questionnaire, Manual dexterity and Finger dexterity abilities were tested . A total of 32 tennis players (n=32) age ranged from 22 to 24 years old (mean 23.4 years old, SD = 0.9) were selected . Subjects divided into two groups depending on the international tennis federation ranking of players, group (A) were 12 professional tennis players (6 males , 6 females) who were top 200 on the international ranking, group (B) were 20 professional tennis players (8 males , 12 females) who were over the rank 800 . Standard apparatus (Complete minnesota manual dexterity & O'connor tweezer dexterity) were used in this study to assess selected psychomotor abilities. The result showed that there was a significant difference ($p<0.05$) between the two groups . So it can be concluded that Manual dexterity and Finger dexterity play a vital role as a prediction indicator of high-level performance in tennis.

Key words: Psychomotor abilities, Manual dexterity, Finger dexterity, Talent identification

Introduction

“Is my son going to be a talented tennis player ?”. This is a common question directed to coaches especially in a high costed sport like tennis . Most coaches could not answer this question because there is no criteria in which they could detect future high level performance . Talent identification is searching for players who possess attributes to be future elite athletes and perhaps they are not as skillful yet .

Many scientific researches aimed to achieve talent identification of tennis players , Adrian alexandru mosoi (16) conducted on the assumption that the position in the national rank is influenced by mental and motor skills . He also discussed (17) relationship between the psychomotor factors and the position in the national rank , the result conclusion that junior players with highly psychomotor skills also occupied a high position in national rank. Schluga Filho et al (21) have determined the motor and morphological of amateur tennis players from 11 to 15 years old. Filipčič et al (5) deduced the importance of several motor abilities for competitive successfulness in tennis for different age categories . Brouwers et al (2) have studied the relationship between the international competition performances of young tennis players and later success , they concluded that performances at international youth competitions may be used in talent identification in tennis.

Away from tennis, Pawel et al (11) have evaluated the ability of selected psychomotor handball goalkeepers with a high level of sports , he find that handball goalkeepers indicate a high level of simple reaction time and reaction time with choice . Krzednowek et al (18) have evaluated selected psychomotor abilities of handball players depending on the competition class , they stressed the importance of: simple reaction time test, choice reaction time test, hand-eye coordination test and

spatial anticipation . Bhupinder (24) have assessed the relationship psychomotor abilities (hand-eye coordination, balance, and reaction time) in relation to selected sport skills in volleyball , the results indicated that the psychomotor abilities significantly influence the performance of Serve, setting and reception in volleyball players . The results of Jackson et al (7) studies demonstrated that mental competence, overall performance and general skills emerged as the strongest predictors.

From the previous, scientific research demonstrated that prediction of future success is based on abilities . so initially , it is important to define **ability** and its difference from **talent** and **gift** .

Francoys Gagne indicated that gifts are outstanding natural abilities , where as talent appears when these abilities are efficiently used with certain activity . Any person could not be talented without first being gifted . Natural abilities are treated as the constituent elements of talent . for instance, the skills of a young pianist derive from general perceptual and motor abilities , among them hand coordination, finger dexterity, auditory discrimination, visual memory, and rhythm (25).

Richard A. Schmidt & Timothy D. Lee defined ability as the following “ an ability is a fundamental characteristic of different individuals that tends to underlie particular skills ; ability is largely inherited genetically and is not modifiable by practice” (22:151) or experience (22:152) . We are born with some abilities and they remain with us . A performer with natural speed will retain that ability throughout his life and be able to use it when required .

Ability is typically regarded as having been either genetically determined or developed during growth and maturation (15) . Henry (1968) decided that abilities are specific , unique , Innate and can be improved by practice but only to a limited extent (14:22). Every person possesses a unique set of innate abilities that can influence the level of performance which can be achieved (23) . We can say that someone has great ability in a particular activity (14:24) dependent on whether he or she possesses the necessary underlying abilities (9)(4) . Thus, one person has the necessary abilities to become a gymnast, while another may possess the abilities necessary to become a good rugby player (14:8) .

By referring to scientific resources, it has been found that there are different classifications of human abilities . One of them is Fleishman’s taxonomy of human performance . Fleishman & Reilly (6) developed a comprehensive set of human abilities grouped into four domains : cognitive , psychomotor , physical and sensory . The paradigm of abilities developed by Fleishman seems to constitute a very heuristic chart likely to corroborate the judgment of coaches in detecting future talents (1) .

Many studies established that psychomotor abilities play a significant role in performance of various sports (Hughes et al. , Kioumourtzoglou et al. , Shim et al. , Gabett and Benton) (3) . Tan (2006) explained that the word “psycho” refers to the mind , and the word “motor” to the physiological body (26) . Psychomotor abilities can be defined as the process of interaction between the perceptual system , the brain and body (8) .

According to Fleishman and colleagues, psychomotor abilities are divided into three categories (fine manipulative , control movement , reaction time and speed) which are refined to ten abilities (Table 1) : control precision, multilimb coordination, response orientation, rate control, arm-hand steadiness, manual dexterity, finger dexterity, reaction time, wrist-finger speed, and speed-of-limb movement

Table 1. Psychomotor abilities (Fleishman and Reily 1992).

Categories of psychomotor abilities	Ability	Description
Fine manipulative	Arm-hand steadiness	The ability to keep your hand and arm steady while moving your arm or while holding your arm and hand in one position.
	Manual dexterity	The ability to make skillful arm-hand movements to manipulate objects under speeded conditions.
	Finger dexterity	The ability to make skillful , controlled movements of small objects.
Control movement	Control precision	Highly controlled arm/hand and leg movements.
	Multilimb coordination	The ability to coordinate two or more limbs simultaneously.
	Response orientation	The ability to make rapid directional discrimination and orientation of movement patterns under highly speeded conditions.
	Rate control	The ability to adjustment movements relative to changes of a moving object or scene.
Reaction time and speed	Reaction time	The ability to quickly respond to a stimulus.
	Wrist-finger speed	The ability to make fast, simple, repeated movements of the fingers, hands, and wrists.
	Speed-of-limb movement	The ability to quickly move the arms and legs , it does not include accuracy , careful control or coordination of movement.

In this study I'll identify only psychomotor abilities , so the present study aimed to identify the most important psychomotor abilities that may lead to highest level of performance then it could assist in establishing objective test battery to identify tennis player's profile .

• Method

Subjects : Two groups were selected , the first group (A) were 12 professional tennis players (6 males , 6 females) who were top 200 on the international tennis federation ranking. The second group (B) were 20 professional tennis players (8 males , 12 females) who were over the rank 800 on the international tennis federation ranking . All subjects came from different countries , the age ranged from 22to24 years old (mean 23.4 ± 0.9) . They agreed to participate in this study after knowing the aim and the procedures . All subjects didn't do any surgeries or had recent injury in the dominant arm .

Procedure : According to the aim of this study , the researcher has used the following steps:

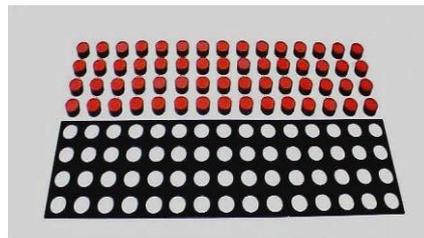
1. *Psychomotor abilities selection* : Made by highly qualified tennis coaches - Coaching High Performance Players Course (Level 3) - with at least 20 years of experience . Coaches were asked to make an educated guess based on their experience about the most important two initiate psychomotor abilities and which can not be modified by practice or experience. The questionnaire included psychomotor abilities identified from Fleishman's taxonomy with description of each ability (table 1).
 2. *The result of questionnaire*: Two psychomotor abilities were finally selected as a most important for tennis skills (Manual dexterity and Finger dexterity)
 3. *Psychomotor abilities assessment* : Standard apparatus were used in this study to assess psychomotor abilities . The tests are mentioned below (Table 2)
- Tests results for all subjects (groups A & B) were recorded , calculated , and analysis using (SPSS).

Table 2. Tests identified

Ability	Test apparatus	Developed by	Type of tasks	Type of results
Manual dexterity	Complete minnesota manual dexterity	Lafayette instrument Model 32023A	Two-hand turning and placing test	Number of seconds for four trails , timed with a stopwatch
Finger dexterity	O'connor tweezer dexterity	Lafayette instrument Model 32022	Pins inserted to board using tweezer	Time to completion

Apparatus and testing :

Complete Minnesota Manual Dexterity test : It is a standardized test for determining eye-hand coordination and arm-hand dexterity skills (12) . It has a high four-trial reliability of 0.97 . The testing kit consists of a plastic collapsible board with 60 holes (3.9 cm in diameter and 0.5 cm deep) and 60 cylindrical blocks (3.7 cm in diameter and 1.9 cm high), (Figure 1). The complete MMDT Manual (Model 32023A) incorporates five subtests: the Placing test, the Turning test, the Displacing test, the One-hand Turning and Placing test, and the Two-hand Turning and Placing test. In this study we used Two-hand turning and placing test only . Subjects were instructed to complete all trials as fast as they could using their dominant hand and in standing posture . Every subjects have four trials (highly recommended to test score reliability) , the total number of seconds to complete each trial are added together to obtain a raw score , then converting raw score to a scaled value (stanine score in this study) using the charts . Row score is the same for men and women in minnesota manual dexterity test .

**Figure 1. Complete minnesota manual dexterity .**

O'Connor Tweezer Dexterity test : It is a standardized assessment of hand-eye coordination as well as fine motor control (10)(13) , so it measures the ability to perform skillful arm and hand movements and it has been a well validated, reliable test of dexterity (20) .

This test consists of a board having 100 holes (arranged in 10 rows of 10 holes , roughly 1/16 of an inch) and a cup that holds 100 pins (metal pins is 1 inch long and 1/16 of an inch in diameter) (Figure 2). The participant was asked to insert all 100 pins into the holes using tweezers as fast as possible , with the dominant hand. The score is the time needed to insert all the pins into the holes for only one trail . Each participant was allowed to fill only the top 10 holes of the board for practice, to minimize any learning effect. The time by seconds to complete the trial are converting raw score to a scaled value (standard score in this study) . Men's row score in O'Connor Tweezer Dexterity test is the different for women's row score .



Figure 2. O'Connor Tweezer Dexterity.

Standardization:

To standardize the tests: 1-The bench used was raised to a comfortable height, as chosen by the subjects . 2-Between the tests , the subjects were allowed to refresh themselves by rest for 5 mins at least . 3-Subjects were allowed to practice to become acclimated to both the test and the testing environment. 4-Avoid any vigorous exercise in the 24 h prior to tests. 5-Testing was conducted between 9am–11am, and at least 90 minutes after breakfast .

• Results:

Minnesota test:

The result of the study shows that group A performed very well in Minnesota test . The data presented in (Table 3) indicate that mean stanine score was ($9\pm 0,000$) for group (A) , and was (7.65 ± 0.671) for group (B) .

Table 3. Group Statistics (Minnesota test)

Group	N	Mean(stanine score) \pm SD.
A	12	9.00 \pm 0,000
B	20	7.65 \pm 0,671

Group A (Top 200 rank), Group B (Over the rank 800), N=number of players

Data in (Table 4) present differences between two groups (A) & (B) in Minnesota test . The Levene's test for equality of variances showed that there is no equal variance between two groups. The table further showed the t-test for equality of means between the two groups , the test showed that there is significant difference ($p<0.05$) between the mean of (A) group and (B) group .

Table 4. Differences between two groups (A) & (B) in Minnesota test

F-test		T-test			
F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
45.148	0.001	6.925	30	0.001*	1.350

The result of the study shows that group A performed very well in O'Connor test . The data presented in (Table 5) indicate that mean standard score was (7.5 ± 0.000) for men and women for group (A) . And was (6.625 ± 0.2315) men , (6.708 ± 0.3343) women for group (B).

Table 5. Group Statistics (O'Connor test)

Group	N		Mean \pm SD.	
	Men	Women	Men	Women
A	6	6	7.500 \pm 0.00	7.500 \pm 0,00
B	8	12	6.625 \pm 0.231	6.708 \pm 0,3343

Group A (Top 200 rank), Group B (Over the rank 800), N=number of players. Data in (Table 6) present differences between two groups (A) & (B) in O'Connor test . The Levene's test for equality of variances showed that there is no equal

variance between two groups (A) & (B) for both men & women . The table further showed the t-test for equality of means between the two groups , the test showed that there is significant difference ($p<0.05$) between the mean of (A) group and (B) group for both men & women.

Table 6. Differences between two groups (A) & (B) in O'Connor test

	F-test		T-test			
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Men	15.429	0.002	9.165	12	0.001*	0.8750
Women	16.285	0.001	5.713	16	0.000*	0.7917

* significant difference ($p<0.05$) between the mean of (A) group and (B) group for men and women

• Discussion

The current talent identification researches of tennis sport are far from being finished, so there is no accepted model till now . In order to achieve talent identification model, screening and scientific tests of human abilities are required . The key to talent identification is selecting the performance outcome which can be measured .

Earlier studies referred to the necessity to gain insight to the aspects which influence tennis performance . The results of physical fitness predict current performance not future performance , so further researches are being required to ascertain which characteristics -other than physical fitness- that are associated to succeed in elite performance .

Present study traces the most important psychomotor abilities indispensable for tennis high-level performance , that may lead to assist in establishing tennis player's profile . Manual dexterity and Finger dexterity were selected by coaches as the most important innate psychomotor abilities which can not be modified by practice or experience .

Our results indicated the importance of Manual dexterity and Finger dexterity in tennis performance . The results of Minnesota and O'Connor tests shows that top players (top 200 on the international tennis federation ranking) performed very well in both manual and finger dexterity abilities . And to confirm the importance of these two abilities , a comparison was made between tests result of top players with tests result of lower players (over the rank 800 on the international tennis federation ranking) , the comparison reported substantial differences regarding two abilities between top and lower international ranking players , which ascertains the importance of manual and finger dexterity abilities in high tennis performance . So we can assume that manual and finger dexterity abilities can differentiate between tennis players .

According to Richard & Timothy, ability is largely inherited genetically and is not modifiable by practice or experience (22:151-152) , so we can assume that early signs can be used to predict future success . From the previous, manual and finger dexterity abilities could be used in identifying young tennis players . But what is the age of appearance and maturity for these abilities and when we can decide if the player has or not ?

Some scientific resources (19) refer that abilities typically develops during the ages of (1 through 7 years) . On the other hand , the researches indicated that natural abilities as aptitudes stabilize around (age 14), that make certain tasks or activities easy to complete . Unierzyski (2003) maintains that at the age of 14 would be better predictors of future success in tennis . (2:464)

This study is a step to determine a description of the abilities that are responsible of high performance in tennis . More researches are required to provide the relation between other abilities and elite tennis players performance in order to establish specific tennis player's profile .

• **Conclusion**

It was concluded that, manual dexterity and finger dexterity abilities are the most important psychomotor abilities that may lead to highest level of performance in tennis, then it could assist in establishing objective test battery to identify tennis player's profile .

• **Limitations/Future Directions**

- limitations of sample size .

In need to studying all human abilities (cognitive, psychomotor, physical and sensory) to establish tennis player's profile .

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