PREDICTIVE VALIDITY OF REACTION TIME AND ATTENTION DISTRIBUTION ABILITY ON CHILDREN'S TENNIS SKILLS DEVELOPMENT

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ABSTRACT

This study aimed to assess the children's reaction time and attention distribution ability on their level of tennis skills. The results of the assessment were used to determine the predictive validity of reaction time and attention distribution ability on tennis skills development of children aged 7-10 years. The study found out that the participants' hand coordination performance and numerous committed errors are within acceptable for ages 7 to 10. The participants' ITN scores which are generally slighty below half the maximum score reflect that they already possess the entry skills expected of the tennis players. Gender and age affect selection reaction time while gender, age and use of hand dominance affect ITN scores. Simple reaction time and selection reaction time scores are negatively correlated with Serve and ITN scores. A shorter reaction time index indicates a higher tennis skill level, and the quicker the reaction time, the better the skill level of each tennis sub-sport skill. Enhancing hand coordination is a function of constant practice and creativity in coming up with novel ideas for ensuring coordination of both hands. The study recommends that tennis trainers should focus more on the improvement of the tennis-specific reaction time and selective reaction time as these significant variables that relates with ITN level. Further, tennis trainers should not only pay attention to the use of genetic non-handedness, but also pay attention to the training of non-handy and related coordination. Also, trainers may consider the comprehensive use of the univariate regression equation to roughly estimate the ITN scores of children aged 7-10.

Keywords*: attention distribution ability, children, predictive validity, reaction time, tennis skills development*

INTRODUCTION

Tennis was conceived in France, born in the United Kingdom, and was widely developed and reached its climax in the United States. Tennis is loved by people and is a very fun sporting activity. It is not only a pastime, a way to improve health, but also an artistic pursuit and enjoyment. Compared with the developed countries' tennis in the world, the current situation of Chinese tennis still has a certain gap in terms of talent base, competitive level, and project development environment. Understanding the rules of the project and understanding the professional tennis are still in the process of learning and knowing. In the knowledge stage, the policies, systems, talents, systems, and other factors related to the development of the project have not yet fully adapted to the requirements of the rapid development of the project. At this moment when "opportunities and challenges" coexist, the excavation and training of tennis reserve talents have attracted much attention. Establishing a scientific selection system for tennis players can make coaches get twice the result with half the effort and promote the high-speed, efficient, and sustainable development of competitive tennis.

With the improvement of people's living standards in the country and the recognition of the unique function and value of tennis, tennis has become popular in China. More and more parents let their children join in tennis, which has laid a solid mass foundation for the cultivation of tennis reserve talents in the country. At present, the research on tennis talent selection in China is in the initial stage, empiricism and book worship is still strong.

However, there is a need to use the successful and feasible scientific selection methods of other similar sports for reference in the selection of tennis events. According to the characteristics of tennis events, the tennis training system in the country, must pay attention to the age characteristics of tennis players. Also, they need to scientifically arrange and implement a system of primary selection, re-selection, and selection to ensure proper training of tennis players (Coelho-e-Silva et al. 2022).

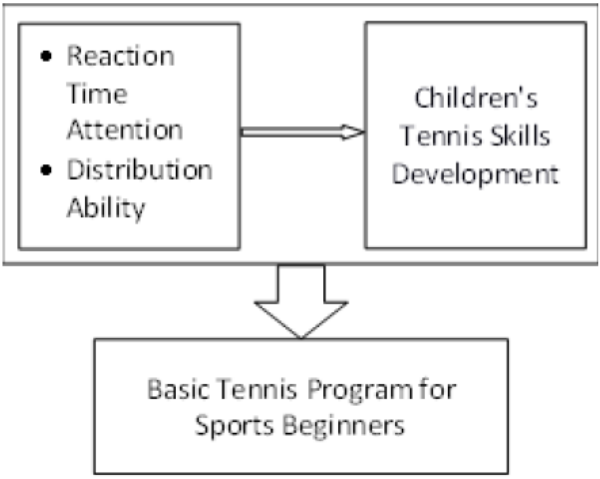
The primary selection method should be simple, the test indicators should be few and precise, and it should be able to reflect the tennis skill level of the initial students scientifically and objectively, providing a scientific basis for future re-selection and selection. In this study, children aged 7-10 years were selected as the research object, and indicators such as reaction time and coordination of both hands were selected to try to study the predictive validity of children's tennis skills development and explore a scientific selection method to provide help for the primary selection of tennis players. The research on the psychological law of children and young people provides the possibility for the evaluation and selection of athletes' psychological abilities of different ages. The advantages of psychological genetic quality and the high starting point formed by good early training provide the possibility for the prediction and selection of athletes' psychological ability (Collins & Cruickshank, 2021).

Conceptual Framework

This study was based on the following framework:

Figure 1

The conceptual framework



This study was anchored on the given framework. As shown, the students' scores in the reaction time test and distribution ability

tests served as the independent variables. The children's tennis skills development which was obtained from the ITN scores served as the dependent variables in the study. Gender and handedness are considered to have an interaction effect on the children's scores in the tests. The comparative and correlation analysis were further undertaken to determine the interaction effect of the gender and handedness to the children's scores. Further analysis was done to come up with the prediction model for children's tennis scores.

Statement of the Problem

This study aimed to determine the predictive validity of the reaction time and attention distribution ability on children's tennis skills development.

More specifically, the study aimed to answer the following sub-problems:

1. What is the profile of the students in terms of handedness, and use of dominant hands?
2. What are the students' scores in the Simple reaction time test; Selection reaction time test; and Two-handed coordinator test?
3. Is there a significant difference on the students' scores in the simple reaction time test, selection reaction time test and two-handed coordinator test when they are grouped according to profile variables?
4. What are the students' scores in the ITN test?
5. Is there a significant difference on the students' scores in the ITN test when they are grouped according to profile variables?
6. Is there a significant correlation between the students' ITN scores and their scores in the reaction time tests and their scores in the two-handed coordinator test?
7. What is the regression equation that predicts students ITN scores based on their reaction time test and their two-handed coordinator test scores?
8. What basic training program can be offered to tennis sports beginners?

Scope and Limitation

This study is limited to the assessment of the children's reaction time, attention ability and tennis skills. A comparative analysis was also undertaken on these students' variables when they are grouped according to gender, age, and handedness. The children's reaction time and attention ability scores were correlated with their tennis skills, after which, a regression equation was derived to predict students' tennis skills given their reaction time and attention ability scores. The study involved 30 children athletes registered in Nanjing Tennis Management Center as the study participants. The study further aimed to come up with a tennis training program for tennis beginners.

METHODOLOGY

Research Design

This investigation utilized the quantitative research approach as this concerns the assessment of the children's reaction time and attention distribution ability and their tennis skills using the ITN test. This research determined the significant differences, comprehensive test correlation index, established regression equation, and tested the predictive validity of relevant index.

Participants of the Study

The research participants are 30 children athletes registered in Nanjing Tennis Management Center, aged 7-10 years which include 10 female athletes and 20 male athletes.

Instrumentation

The study utilized the checklist to obtain the profile of the participants. The test guide served as basis for the test collaborators to know the precautions in testing for reaction time and attention distribution ability and tennis skills of children. The test quide and the scoring were used which was adopted from, the ITN Test standard used in China (International Tennis Federation, n.d.).

Data Gathering Procedure

To obtain the data needed for the investigation, the following procedures were undertaken by the researchers.

The researchers asked permission from the principal of Nanjing Tennis Sports School for the conduct of the study. Informed consent from the participants' parents was sought to ensure that the study conformed with the ethical norms of research.

Conduct of the Pretest. The research tested the reaction time and attention distribution ability of children who have not been trained in tennis to obtain the original data.

Conduct of the Tennis Skill ITN Test. The researchers determined the following scores based on the test's procedure: GS depth scores; volley depth scores; GS accuracy scores; serve scores; and mobility scores.

Data Analysis

The data obtained were analyzed by using the following data analysis tools:

Frequency and percentage distribution, mean, t-test for independent samples, analysis of variance, Pearson product moment correlation coefficient and regression analysis.

RESULTS AND DISCUSSION

Participants' Profile

Majority of the participants are right-handed and seldom use their dominant hands in playing tennis. This result is supported by the study of London (1990) which states that proportionately more athletes are left-handed. Grouios et al. (2002) also stated that there is higher than expected numbers of left-handed athletes in certain sports. This finding is supported by Stöckel & Weigelt (2012) which

stated that professional players use their non-dominant hand more as a strategy to their opponents who are using their dominant hand.

Students' Scores in the Reaction Test

Table 1

Descriptive Characteristics of the Participants' Scores in the Simple Reaction Time Test

Test	Gender	Lowest Score	Highest Score	Mean	SD
Simple Reaction Time	Male	0.22	0.46	0.31	0.07
	Female	0.23	0.35	0.29	0.04
Selection Reaction Time	Male	0.72	1.32	0.96	0.16
	Female	0.70	0.82	0.28	0.04
Two-Handed Coordination	Male	57.90	111.38	73.33	17.04
	Female	37.64	101.77	63.74	17.74

The means show that the female group has a faster simple and selection reaction time than the male group. Some studies have shown that in almost all age groups, the average reaction time of men is slightly faster than that of women. Some people think that the muscle contraction time of men and women are the same, and the difference in reaction time comes from the time difference between stimulation and muscle contraction.

In the two-hand coordination test, the male group has a higher score than the female in the two-handed coordination test which indicates that male participants have a better two-hand coordination test performance than female participants.

In the Selection Reaction Time and Two-Handed Coordination tests, male participants have committed more errors than the female participants.

Comparative Analysis of the Students' Reaction Test Across Profile Groups

Table 2

Inferential Test Analysis on the Students' Reaction Test Across Groups

Tests	Gender		Age		Handedness		Use of Dominant Hands	
	CV	PV	CV	PV	CV	PV	CV	PV
Simple Reaction Test	1.55	0.22	0.91	0.45	0.06	0.80	0.02	0.89
Selection Reaction Time Test	5.70	0.02*	5.96	0.00*	0.03	0.87	1.88	0.18
Two-Handed Coordination Test	0.56	0.46	0.28	0.84	0.23	0.64	0.019	0.89

The test results reveal that there is no significant difference on the participants' scores in the Simple Reaction Test, and Two-Handed Coordination Test when they are grouped according to gender, age, handedness, and use of dominant hands.

On the other hand, the Selection Reaction Time Test results for the male and female participants significantly differ. Based on the means, male have higher score than female in the Selection Reaction Time Test. For this test, a low score means a better performance. Thus, it can be deduced that female has better performance than male in their simple reaction response. For the Selection Reaction Time Test, based on the means, the younger group has higher score than the rest of the group. In this test, a low score indicates a better performance. Hence, it can be deduced that for children of this age, the Selection Reaction Time of the older is better than that of the younger group. Also, the result show that there is no significant variation on the participants' scores in the different tests when they are grouped based on handedness. This suggests that whether a person is left or right-handed or whether they use their dominant hands or not, their scores do not vary; and in the Simple Reaction Test, Selection Reaction Time Test, and Two-Handed Coordination Test, the results do not vary

significantly. This further indicates that no matter which hand is used to hold the beat, the reaction time and attention of children aged 7 to 10 years old allocating capacity is at the same level. This further indicates that whether the participants use their dominant hand, their reaction time and attention are at the same level. In general, the results show that there is no statistically significant difference between frequent and infrequent use of the non-dominant hand in the tests.

Students' Score in the ITN test and their ITN Level

Table 3

Descriptive Characteristics of the Participants' Scores in the ITN Test

Gender	Descriptive Statistics	GS Depth Scores Max. Score: 90	GS accuracy scores Max. Score: 84	Serve scores Max. Score: 108	Mobility scores Max. Score: 76
Male	Highest Score	43	37	46	26
	Lowest Score	7	8	12	12
	Mean	19.05	21.05	24.35	19.90
	SD	8.77	7.98	10.88	3.82
Female	Highest Score	48	39	44	32
	Lowest Score	12	10	12	15
	Mean	31.10	27.80	34.30	23.60
	SD	10.12	7.64	10.14	6.05

Ground Stroke Depth Scores

The GS Depth Assessment, the male score is almost half of the target while the female score is slightly more than half of the maximum score of 90. This means that female participants have better performance in doing "10 alternate forehand and backhand ground strokes" than male participants.

Groundstroke Accuracy Assessment

The GS Accuracy score of both male and female participants are

slightly below half of the maximum score of 84. This means that female participants have higher GSA accuracy scores than the male group. This means that female participants have better performance in doing "6 alternate forehand and backhand down the line & 6 alternate forehand and backhand cross court activities" than male participants.

Serve Assessment

For the Serve Test, the scores of both male and female participants are slightly below half of the maximum score of 108. This suggests that male participants have higher serve scores than the female group. This means that male participants have better performance in doing "3 serves for the designated areas" than female participants.

Mobility Assessment

Female participants have higher mobility scores than the male group. This means that female participants take a shorter time to pick up five tennis balls and return them individually to a specified zone than male participants.

Table 4

Frequency and Percentage Distribution of ITN Level of the Participants

ITN Level	Male		Female	
	Frequency	Percentage	Frequency	Percentage
Level 10	13	65.0	1	10.0
Level 9	7	35.0	1	10.0
Level 8			7	70.0
Level 7	1	5.26	1	10.0
Total	**20**	**100**	**10**	**100**

As shown from the ITN test scores and grades, female participants are better than male participants, which indicates that women's tennis skills are better than men's in children aged 7-10. This may be due to the analysis, that at this age, girls grow faster than boys, and girl's are more intelligent than boys.

Comparative Analysis of the Students' ITN Test Results When

Grouped According to Profile Variables

Table 5

Inferential Test Reslts on the Students' ITN Scores

Tests	Gender		Age		Handedness		Use of Dominant Hands	
	CV	PV	CV	PV	CV	PV	CV	PV
GS Depth Scores	11.38	0.00*	8.41	0.00*	0.28	0.60	2.48	0.13
Selection Reaction Time Test	4.90	0.04*	7.93	0.00*	0.01	0.91	7.52	0.01*
Two-Handed Coordination Test	5.82	0.02*	12.51	0.00*	0.16	0.69	5.71	0.02*
GS Accuracy Scores	4.22	0.049*	17.71	0.00*	0.07	0.80	0.20	0.66
ITN Level	21.884a	0.00*	34.445a	0.00*	1.301a	0.73	8.76	0.03*

Note: **significant*

The data reveal that there is a significant difference on the participants' scores in the different ITN sub-tests when they are grouped according to gender and age. More specifically, the females can perform the test better than the male. In summary, female participants demonstrate a higher level of tennis skills than the male participants. Among age groups, 10 years old athletes attained the highest score in the GS Depth Assessment and Mobility Test and nine years old athletes scored the highest in the GS Accuracy and Serve Test. Seven-year old athletes consistently got the lowest rating in all ITN sub-tests. This result indicates that older athletes are more skillful in tennis than younger group. The older (9 or 10 years old) athletes are more skillful in tennis than the younger group (7 or 8 years old).

Participants' level of tennis skills particularly on those GS Accuracy and Serve scores is dependent on the use of dominant hands. This further reveals that those who use their dominant hands are more skillful than those who are not using their dominant hands

in making six alternate forehand and backhand down the line and six alternate and backhand cross court (GS Accuracy), and in making 12 serves (Serve Test). This result indicates that the use of dominant hands yields better tennis skills. The tennis skill level of participants who frequently use their non-dominant hands is higher than those who seldom use dominant.

Also, the table reveals that handedness and the use of dominant hands do not affect ITN sub-test skills. This implies that handedness does not affect ITN levels. In other words, ITN ratings achieved by the participants are at the same level whether the racket is held with the left or right hand.

Correlational Analysis on the Students' Test and ITN

Table 6

Correlational Analysis on the Students' Test and ITN Scores

Reaction Test	Variables	GS Depth Scores	GS accuracy scores	Serve scores	Mobility scores	ITN Scores
Simple Reaction Test	Pearson Correlation	-0.246	-0.265	-0.477**	-0.297	-0.381*
	Sig. (2-tailed)	0.190	0.157	0.008	0.111	0.038
	Decision	Accept Ho	Accept Ho	Reject Ho	Accept Ho	Reject Ho
Selection Reaction Time Test	Pearson Correlation	-0.476**	-0.609**	-0.731**	-0.438*	-0.667**
	Sig. (2-tailed)	0.008	0.000	0.000	0.016	0.000
	Decision	Reject Ho	Reject Ho	Reject Ho	Reject Ho	Reject Ho
Two-Handed Coordination Test	Pearson Correlation	-0.224	-0.120	-0.165	-0.110	-0.193
	Sig. (2-tailed)	0.233	0.529	0.383	0.563	0.307
	Decision	Accept Ho	Accept Ho	Accept Ho	Accept Ho	Accept Ho

Note: Correlation coefficient: *P<0.05, **p<0.01

Simple Reaction Test and ITN Test Results

Participant's simple reaction test score is not significantly correlated with his or her GS Depth Scores, GS Accuracy Scores, and Mobility Scores. On the contrary, the participant's simple reaction test score is significantly correlated with his/her Serve Scores, and ITN Scores.

This further implies that one's performance in the Simple Reaction Test can predict his/her performance in the Serve and ITN scores. Noteworthy is the negative value of the correlation coefficient which indicates an inverse relationship between the two correlated variables. This result implies that the higher is one's score in the Simple Reaction Time Test, the lower is their level of Tennis skills. Also, simple reaction time is closely related to speed quality and sensitivity quality, so it will also affect service quality to a certain extent. Serve skills are more difficult than baseline hitting skills.

Selection Reaction Time Test and ITN Test Results

Participants' simple reaction test score is significantly correlated with their ITN sub-tests scores.

This indicates that choice response time had a strong relationship on the ITN scores. This means that participant's performance in the Simple Reaction Test can predict his/her GS Depth, GS Accuracy, Serve, Mobility and ITN scores. This further implies that one's performance in the Simple Reaction Test can predict his/her tennis skills. The obtained negative coefficients indicate that the paired variables are inversely related. This further implies that the shorter the response time, the higher is one's scores in the four ITN sub-tests. Conversely, the higher is one's score in the Simple Reaction Time test, the lower is their level of skills in tennis.

Two-Handed Coordination Test and ITN Test Results

This means that the participants' performance in the Two-Handed Coordination Test is not significantly correlated with their ITN

level and ITN sub-tests scores.

Equation of Regression Line

The regression equation for the significantly correlated variables are as follows:

a.1 Simple Reaction Time Test and Serve Scores
y = -90.40x + 54.98

a.2 Simple Reaction Time Test and ITN Scores
y = -192.7x + 152.8

b.1 Selection Reaction Time Test Scores and GS Depth Scores
y = -0.001x + 23.28

b.2 Selection Reaction Time Test Scores and GS Accuracy Scores
y = -0.000x + 22.82

b.3 Selection Reaction Time Test Scores and Serve Scores
y = -0.000x + 22.82

b.4 Selection Reaction Time Test Scores and Mobility Scores
y = -5E-06x + 21.03

b.5 Selection Reaction Time Test Scores and ITN Scores
y = -0.005x + 92.53

This equation can be utilized to predict the ITN score and ITN sub-skills. This prediction equation may be used in the selection of Tennis athletes for school level, national and international level Tennis competitions.

Basic Training Program for Tennis Sports Beginner

Based on the results of the investigation, a Basic Training Program for Tennis Sports Beginners is conceptualized. This program includes sets of activities that will enhance the athletes' reaction time and hand

coordination as well as their ITN level.

CONCLUSION

Based on the findings of the study, the following conclusion is arrived at:

The participants' hand coordination performance and numerous committed errors are acceptable for ages 7 to 10. Enhancing hand coordination is a function of constant practice and creativity to ensure coordination of both hands. The participants' ITN scores which are generally slightly below half the maximum score reflect that the participants already possess the entry skills expected of the tennis players. Gender and age affect selection reaction time. Gender, age, and use of hand dominance affect ITN scores. Simple Reaction Time and Selection Reaction Time scores are negatively correlated with Serve and ITN scores. A shorter reaction time index indicates a higher tennis skill level, the quicker the reaction time, the better the skill level of each tennis sub-sport skill.

RECOMMENDATIONS

Based on the findings and conclusion, the following recommendations are derived:

1. The findings of the research should be disseminated to maximize the results.
2. Tennis trainers should focus more on the improvement of the tennis-specific reaction time and selective reaction time as these significantly relate with ITN level.
3. Tennis Trainers should not only pay attention to the use of genetic non-handedness, but also pay attention to the training of non-handy and related coordination.
4. Trainers may consider the comprehensive use of the univariate regression equation to roughly estimate the ITN scores of children aged 7-10.
5. The researchers may consider evaluating the effectiveness of the Tennis Training Program after its implementation.

6. Future researchers may consider the conduct of relevant research that address the limitations of this study and to include other related variables associated with Tennis skills.

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