Proceedings Book of the 14th ITTF Sports Science Congress & 5th World Racket Sports Congress

Suzhou, May 23rd - 25th 2015

Editors:
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Message from the Editors

Preface

It is a great honour and pleasure for the Editors to issue this Proceedings book of the 14th International Table Tennis Sports Science Congress and 5th World Racket Sports Congress. This Proceedings book contains selected papers from the both congresses.

All four major racket sports belong to the most popular sports in the world. Players range from youth, recreational players to the world-class elite players. Correspondingly, scientific studies on racket sports are increasing. Research in every field of interest has been conducted in separate and individual areas such as physical training, physiology, psychology, medicine, dietetics, physics, engineering. It is envisaged that this Proceedings book of the Congresses will contain papers that will eventually be regarded as a major source of knowledge and material for the advancement of racket sports science. We express our thanks to the International Table Tennis Federation, the Chinese Table Tennis Association, Soochow University, the Organising Committee of the World Table Tennis Championships, the Badminton World Federation, and the World Commission of Sports Science for hosting the 14th International Table Tennis Sports Science Congress and 5th World Racket Sports Congress. The Congress was organized by members of Soochow University, Chinese Table Tennis Association and members of ITTF Sports Science and Medical Committee with the support of International Table Tennis Federation. We are truly grateful to all those people who helped to organize these congresses.

We hope that this and future publications will contribute to the major goal of the racket sports International Federations, that is, to bridge the gap between sports scientists and practitioners in teaching, coaching, training and rehabilitation.

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PART 1
Science papers

The effects of detraining on the technical parameters in young Table Tennis players

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Abstract: The aim of the present study was to evaluate the effects of a 20-day detraining period on the technical parameters in young Table Tennis players. Twenty five (n=25) athletes (15 boys & 10 girls), aged 12±1.8yrs with body mass of 45.9±12.9 kg and stature 1.52 ± 0.1cm participated in the current study. All athletes were right-handed and they were considered as advanced players performed an in season 10-week *Multiball* Table Tennis specific protocol. The *Table Tennis Specific Test Battery* (TTSTB) with the balls launch rate at 80balls/min was applied in order to identify the effects of lack of training on the technical modelling of the Table Tennis players. The technical parameters which were recorded in the study subjects were: Reaction Speed 1, 2 (RS), Displacement Speed 1, 2, 3 (DS), Skill Speed 1, 2 (SS) and Ocular Manual co-ordination (OCM) and they were applied pre-and-post the 20-day detraining period. A *t* test was used to identify the differences in the playing parameters from the initial to final technical evaluation of the TTSTB. Spearman's (ρ) analysis was applied in order to determine whether the testing parameters were significantly correlated. All statistical analyses were carried out with the IBM-SPSS 21.0 for Windows. The results showed that the mean scores of Displacement Speed 1 [$t_{(1, 24)}$ = 2.32, p=0.29] and Displacement Speed 3 [$t_{(1, 24)}$ = -3.01, p=0.06] were significantly decreased after the 20-day detraining. In the amount of the studied subjects, all the mean scores of the TTSTB during the final technical evaluation were recorded lower than the initial but without any significant differences in the technical efficiency of the players. The total scores in the Reaction Speed 1 recorded 9.7±3 successful shots, while the Displacement Speed 3 recorded 10.2±3.4 accurate shots. Spearman's (ρ) correlation analysis reported a statistically significant negative correlation between the DS3 and SS1, (ρ=0.53, DF=25, p<0.01) and a significant interaction between DS3 and OCM, (ρ=0.64, DF=25, p<0.01). In conclusion, the better the playing technique is learned by applying the *Multiball* training method, the longer it will be retained in the developmental age Table Tennis players, even after a 20-day detraining period. However, it should be noted that the above findings mainly regard the technical improvement of the players in the training rather than the evaluation of a match in Table Tennis.

Keywords: table tennis, training, technical efficiency, coordination

1. INTRODUCTION

Racket sports are described as complex sport activities. The non-specified duration of the matches (Sforzo et al., 1995; Thoestensson, 1997), the frequency of the exchanged rallies (Shaver, 1975), the physical abilities as well as the high quality of technical parameters demand from the coaches a multifarious training design for the achievement of the players' highest performance. The intensity, volume, duration as well as the type of the match stimuli or the frequency of their provision are factors in which racket sports coaches have always taken into account.

Table Tennis is a racket sport that requires high level of technical performance (Katsikadelis, Pilianidis & Mantzouranis, 2014). However, apart from the changes that occur in the athletes' physical condition during training, particular attention has also been drawn to the relevant changes that take place after its cessation. Quite early it was noticed that training interruption known as detraining causes negative changes in the athletes' performance, possibly due to the immediate loss of their physical and technical acquisition which were gradually obtained during the training period.

Table 1. Multiball testing data pre (D=0) and post (D=20) the players' detraining period

DAY	D = 0				D = 20			
TEST (shots)	Min	Max	Mean	SD	Min	Max	Mean	SD
RS 1	6	16	9.68	3.01	4	12	8.32	2.19
RS 2	0	2	.76	.779	0	15	1.88	2.90
DS 1	5	19	12.92	4.10	0	16	10.84	3.47
DS 2	5	18	11.84	3.10	6	17	11.88	2.55
DS 3	3	16	10.16	3.41	7	18	11.88	2.45
SS 1	8	20	14.84	3.06	6	19	13.92	3.68
SS 2	5	20	14.12	3.68	8	19	14.04	3.31
OCM	6	15	10.08	2.73	7	15	10.88	2.58

During an annual periodization the detraining (abstention from the training) decreases the athletes' performance and it is directly related to a kind of decline in their physical abilities and physiological adaptations. This decline is also affected by the duration of abstention as well as the trainee's general biological level before the interruption. Additionally, the detraining is also defined by parameters such as the kind of the sports activity, the type of training and the age of the trainees (Wessel, Arant & Olson, 2004). The main negative changes due to detraining are recorded in the muscular strength/power and cardiovascular endurance (Evangelista et al., 2005; Moore et al., 1987; Thorstensson, 1997).

According to our knowledge, there is not any available study in the bibliography which has assessed the effect of the detraining in Table Tennis. Therefore, the aim of this study was to evaluate the effects of a 20-day detraining period on the technical parameters in young Table Tennis players.

2. METHODS

2.1 Sample

Twenty five (n=25) Table Tennis players (15 boys & 10 girls), aged 12±1.8yrs with body mass of 45.9±12.9kg, stature 152±10cm and training experience of 5yrs volunteered to participate in this study. The amount of players was right-handed and they were considered as advanced athletes having competed in National Youth Table Tennis Tournaments with active Ranking List points. The study was performed according to the rules of the Ethics Committee of Democritus University of Thrace.

2.2 Data Collection

The participants performed an in-season 10-week training program by applying the *Multiball* Table Tennis protocol. The descriptive statistics of the *Multiball* target tests are presented in Table 1. The *Table Tennis Specific Test Battery* (TTSTB) with the balls launch rate at 80balls.min^{-1} was applied in order to identify the effects of lack of training on the technical modelling of the Table Tennis players. The descriptive statistics of target tests are presented in Table 1. The technical parameters which were recorded in the study subjects were: Reaction Speed 1/2 (RS), Displacement Speed 1/2/3 (DS), Skill Speed 1/2 (SS) and Ocular Manual co-ordination (OCM) and they were applied pre-and-post the 20-day detraining period.

2.3 Statistical analyses

The data normality was checked by using the Kolmogorov-Smirnov analysis. A *t* test was used to identify the differences in the playing parameters from the initial to the final technical evaluation of the TTSTB. Spearman's (ρ) analysis was applied in order to determine whether the testing parameters were correlated. All statistical analyses were carried out with the IBM-SPSS 21.0 for Windows. The statistical significance was set at $p<0.05$.

3. RESULTS

The results showed that the mean scores of Displacement Speed 1 [$t_{(1, 24)} = 2.32$, p=0.29] and Displacement Speed 3 [$t_{(1, 24)} = -3.01$, $p=0.06$] were significantly decreased after the 20-day detraining period (Table 2). In the amount of the studied subjects, all the mean scores of the TTSTB during the final technical evaluation were recorded lower than the initial but without any significant differences in the technical efficiency of the players. The total scores in the Reaction Speed 1 recorded 9.7±3 successful shots, while the Displacement Speed 3 recorded 10.2±3.4 accurate shots.

Table 2. T-test *Multiball* results pre and post the detraining period

Testing Parameters	t	*p*	Significance
RS1Mid - RS1Fin	1.80	.083	ns.
RS2Mid - RS2Fin	-2.01	.055	ns.
DS1Mid - DS1Fin	2.32	.029	sig.
DS2Mid - DS2Fin	-.049	.961	ns.
DS3Mid - DS3Fin	-3.01	.006	sig.
SS1Mid - SS1Fin	1.19	.243	ns.
SS2Mid - SS2Fin	.12	.899	ns.
OCMMid - OCMFin	-1.86	.074	ns.

Spearman's (ρ) correlation analysis reported a statistically significant negative correlation between the DS3 and SS1, (ρ= 0.53, *DF*=25, p<0.01) and a significant interaction between DS3 and OCM, (ρ=0.64, *DF*=25, p<0.01).

4. DISCUSSION

The main findings of the current study demonstrated that there are no differences of significant importance regarding the performance of the target tests after a 20-day training abstention, although lower performance measurements were recorded. More specifically, a significant difference in the Displacement Speed 1&3 was observed which resulted in a marginal decline in the studied players' performance. The above testing measurements require not only technical competence but also explosive speed and strength, in order for the athlete to meet the requirements of high frequency launcher.

It seems that during the 10-week training program with *Multiball* protocol the players' adaptations regarding the strength and speed physiological parameters were decreased. Similar studies (Shaver, 1975; Sforzo et al., 1995) have pointed out that the greater the improvement in strength and speed during training, the greater the drop in speed after detraining due to the atrophy of the fast-twitch muscle fibres. In addition, the studied young Table Tennis players were possibly affected by the fact that the larger and faster their improvement of the training stimulus, the greater the decrease in their performance during the first weeks of discontinuation (Shima et al., 2002; Tsolakis, Vagenas & Dessypris, 2004).

With reference to the performance decrease as observed in the target test, it should be pointed out that the TTSBT does not evaluate the kinetic characteristics of technical movements. Nevertheless, according to literature, no negative effects on the players' neuromuscular coordination existed after the training interruption (Schmidt & Wrisberg, 2000) even with the passing of years. Yet the effects on the physical abilities are responsible for the general decrease in the players' performance and this ascertainment must be taken into consideration by the coach during the training periodization.

5. CONCLUSION

The short-term planned training abstention does not seem to affect dramatically the technical competence of the young Table Tennis players according to the target test evaluation. Nonetheless, the recorded marginal changes in the participants' performance due to detraining should constitute a crucial factor in the training management. Future studies referring to a short or long abstention time-period from the training stimuli are required for further clarification concerning the effects of detraining on the competitive performance of Table Tennis players.

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The Technical and Tactical Analysis about Japanese Excellent Table Tennis Player Ishikawa Kasumi

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Abstract: This paper uses the literature method, video observation method, three sections of index evaluation method and mathematical statistics of Ishikawa Kasumi's statistical analysis of four games in the world championships and Table Tennis World Cup in 2013-2015. Results show that Ishikawa Kasumi is an excellent athlete with good basic skills and fast speed, serving sideways to attack the soonest being her strong point, but losing more often than not. She is extremely active in receiving and serving balls, and dares to act, and, when receiving the ball, is especially conscious to make an attack. She is most able to win scores in the serve and receive phases and to hold on in the stalemate period, but she is more or less weak in strength and stability.

Keywords: Japan, table tennis, Ishikawa Kasumi, technique analysis

1. INTRODUCTION

Japan's history of table tennis in the international table tennis world is long, and Japanese table tennis teams have made outstanding contributions in the process of historical development. They were brilliant in the international table tennis world by the use of sponge racket and special playing skills. In the 7th World Championships in 1952 ~ 1959, the Japanese unique advanced methods and technology won a total of 24 titles. The 1950s were known to be the golden age of Japan "ping-pong«. Japan was never short of good table tennis players. And now, young Ishikawa Kasumi is not only the hope of Japanese women table tennis, but also the highest level of Japanese women table tennis. Compared to Fukuhara Ai, both being famous when young, Ishikawa Kasumi is more advantageous in age, more comprehensive in technology, and more prominent in expertise. It is believed, with her stability of mature technology, she is bound to have strong impact on China's woman table tennis.

2. THE RESEARCH OBJECT AND RESEARCH METHOD

2.1 The Object of Study

In this paper, the research object, ISHIKAWA Kasumi, is a Japanese table tennis women athlete. On February 23, 1993, with her left-hand long handle racket in rubber, she became the representative of present world's women world table tennis athletes skilled in loop combination of fast-break. Based on statistics made of the video recordings of four important international events (semi and final) from 2013 to

2014, and an analysis of her application of technology and tactics, a study is carried out of the characteristics of her strategy and tactics.

2.2 The Research Methods

2.2.1 Literature and Documents

Relevant literature and documents on table tennis technology and tactics is retrieved from books of reference in the Shanghai Sports Institute library, which includes 96 reference articles, with access to professional magazines and books in the library. By absorbing the past research results, creative ideas are summed up in this article.

2.2.2Video Recordings

By watching the four important games of Ishikawa Kasumi in the international table tennis federation events (world table tennis championships and the table tennis World Cup) in 2013-2014, an analysis is made of her technique features.

2.2.3 Mathematical Statistics

By means of Excel 2007 software, statistics are made of Ishikawa Kasumi's three sections and their usage in her game.

2.2.4 Three Sections of Index Evaluation

This paper adopts the "three sections of index evaluation method" proposed by WU Huanqun (1988), which decomposed the athletes' overall ability into three phases: the serve phase (the first and third board), the receive phase (the second and fourth board) and the stalemate phase (the fifth board and after). It uses the three phase scoring and utility rate to diagnose and assess athletes' technique and ability. Evaluation criteria are shown in table 1.The computation formula is as follows:
Phase scoring rate = {Phase scores÷(Phase scores +Phase losses) } x 100%
Phase utility rate = { (Phase scores +Phase losses)÷(whole scores + whole losses) x 100%

Table 1. Evaluation Standards of Periods in Table Tennis Matches

	serve phase		receive phase		stalemate phase	
	scoring rate%	utility rate%	scoring rate%	utility rate%	scoring rate%	utility rate%
excellent	70		50		55	
Good	65	25-30	40	15-25	50	45-55
Passable	60		30		45	

3. RESULTS AND ANALYSIS

3.1 Analysis of the Characteristics of Ishikawa Kasumi's Technology and Tactics

Ishikawa Kasumi is another biggest threat to Chinese women table tennis players after Fukuhara Ai. Her world ranking 4 in January 2015 was the best of both her own and the Japanese women athletes. Ishikawa Kasumi was very skilled in loop

combination of fast-break and left hand racket holding.

She was superior in making quick attacks during the serve phase and performed the best in the score and utility rates in the receive phase among all the three phases. But she was comparatively weak in strength and stability in the stalemate phase, which results in her inferiority to excellent athletes in the stalemate phase.

3.1.1 An Analysis of Characteristics of Ishikawa Kasumi's Technology and Tactics against Ding Ning

In the 2014 World Cup table tennis women's singles semi-finals, Ishikawa Kasumi was against Chinese player Ding Ning, Ishikawa Kasumi scored 6 to 11, 3 to 11, 11 to 7, 9 to 11, 6 to 11, 7 to 11. With a score of 2 to 4, Ishikawa Kasumi lost to China's Ding, An analysis of Ishikawa Kasumi's tactics against Dings is shown in Table 2.

Table 2. Analysis of ISHIKAWA Kasumi's tactics against Ding Ning

	serve phase		receive phase		stalemate phase	
game	scoring rate%	utility rate%	scoring rate%	utility rate%	scoring rate%	utility rate%
1st	60.0	29.4	66.7	17.6	11.1	52.9
2nd	0	7.1	50.0	14.3	18.2	78.6
3rd	50.0	22.2	50.0	22.2	70.0	55.6
4th	66.7	30.0	37.5	40.0	66.7	30.0
5th	60.0	29.4	33.3	35.3	33.3	16.7
6th	33.3	16.7	42.9	38.9	37.5	44.4
total	54.2	23.1	43.3	28.8	36.0	48.1

Table2 shows, in the first game, Ishikawa Kasumi had the highest scores in the first of the three sections to pick up a steal, at 66.7%, achieving the best standard, followed by the serve phase, also reaching a good level, but in the phase of stalemate she served only 11.1%, and the utility rate was 52.9, which shows that Ishikawa Kasumi, in the stalemate phase, in most cases, belonged to the passive, being repressed in the stalemate phase with the result of losing at 6 to 11.In the second game, Ding won with a score of 11 to 3 by her superiority in speed. Ishikawa Kasumi's score rate in the stalemate phase was 18.2%, and the utility rate as high as 78.6%. Ding Ning, who also specializes in quick action, overwhelmed Ishikawa Kasumi in the stalemate phase, won the second game by a score of 11 to 3. In the third game, Ishikawa Kasumi, though the utility rate in the serving and receiving phases was only 22.2% and the quality of serving and receiving balls improved, still had a failing average score rate of 50%.But by high-quality serving an receiving and counter-attack after receiving, she placed DING directly in a passive position by backhand receiving, creating a positive game opportunity in the later stalemate phase. Though Ding made some adjustments during the suspension at the score of 7 to 5, yet Ishikawa Kasumi's score rate reached 70%, won a game by 11 to 7.In the In the fourth game, both sides were close in scores, Ishikawa Kasumi had a nice score rate of 66.7% and a utility rate of 30% both in the serve and stalemate phases, which contributed to her won another game by 11 to 9.In the fifth game, Ishikawa Kasumi won an advantageous score of 4 to 2 by high- attack in receiving balls, but Ding Ning

quickly caught up and successively exceeded by many-sided serving, and Ishikawa Kasumi failed to serve balls after the score of 6 to 6, resulting in a passive position. The score rate of this game in the receiving and stalemate phases were both at the failing level of 33.3%, which was the chief direct cause for failure. In the sixth game, the contest between the two sides was still in the stalemate phase, but Ishikawa Kasumi had a failing score rate of only 37.5% in the stalemate and she was unable to achieve a superior position in the serve phase, thus the score was 7 to 11, losing to Ding Ning at 2 to 4.

Judging from the scores, Ishikawa Kasumi experienced some ups and downs in the games, with both sides enjoying a high utility rate, which shows that both players were good in their basic skills, in their adaption to each other's playing patterns. But Ishikawa Kasumi failed to achieve a high score rate in the stalemate phase, being in most cases quite passive.

3.1.2 An Analysis of Characteristics of Ishikawa Kasumi's Technology and Tactics against LI Xiaoxia

During the 2014 world championships in Tokyo, in the women finals against LI Xiaoxia, Ishikawa Kasumi was defeated by 0 to 3.

Table 3. Ishikawa Kasumi's tactics against LI Xiaoxia analysis

game	serve phase		receive phase		stalemate phase	
	scoring rate%	utility rate%	scoring rate%	utility rate%	scoring rate%	utility rate%
1st	100	21.1	14.3	36.8	37.5	42.1
2nd	40.0	27.8	20.0	27.8	50.0	44.4
3rd	50.0	11.1	33.3	38.9	44.4	50.0
total	63.6	20.0	21.1	34.5	44.0	45.5

Table 3 shows that Ishikawa Kasumi's score rate in the three games were respectively 100%, 40% and 50%, which shows that the skill of serve-attack was not much used in the second and third games. In the receive phase, of the three games, two were lost, and one barely succeeded, with an excellent utility rate. Ishikawa Kasumi failed to give full play of her advantageous speed. Improper service and reception of balls was the main cause for the later unsatisfactory performance of skills.

3.1.3 An Analysis of Characteristics of ISHIKAWA Kasumi's Technology and Tactics against Wu Yang

Table 4. Ishikawa Kasumi's tactics against Wu Yang analysis

game	serve phase		receive phase		stalemate phase	
	scoring rate%	utility rate%	scoring rate%	utility rate%	scoring rate%	utility rate%
1st	0	18.8	50.0	25.0	33.3	36.3
2nd	33.3	17.6	25.0	47.1	50.0	35.3
3rd	25.0	20.0	100	15.0	38.5	65.0
total	20.0	18.9	46.7	28.3	39.3	52.8

In the Table Tennis Team World Cup finals of 2013, Ishikawa Kasumi lost to Wu Yang with scores of 5 to 11, 6 to 11 and 9 to 11 in the three games. Ishikawa Kasumi failed in the score rate in all the three games in the serve phases, that of the first game being zero. And the utility rate was also low. In the receive phase, Ishikawa Kasumi was excellent in the first and third games. In the stalemate phase, Ishikawa Kasumi's score rate reached only 50% in the second game, and respectively 33.3% and 38.5% in the other two games. As regards her utility rate, it was very high in the first and third games, with the exception of the second game at 35.3%.which was more or less concerned with WU Yang's playing pattern combining chopping and attacking. An analysis of Table 4 reveals that Ishikawa Kasumi was weak in judging the swirling of balls when confronted by chopping players. She was not very stable in the loop skill and unable to deal the high-quality killing stroke.

3.1.4 An Analysis of Characteristics of Ishikawa Kasumi's Technology and Tactics against Pota

In the 2014 Table Tennis World Cup women's singles semi-finals, Ishikawa Kasumi won the third place with a total score of 4 to 3 against the Hungarian player POTA, which was the highest score in her professional life of table tennis singles.

Table 5. Ishikawa Kasumi's tactics against Pota Analysis

game	serve phase		receive phase		stalemate phase	
	scoring rate%	utility rate%	scoring rate%	utility rate%	scoring rate%	utility rate%
1st	66.7	15.0	57.1	35.0	50.0	50.0
2nd	50.0	42.1	33.3	15.8	37.5	42.1
3rd	50.0	23.5	40.0	29.4	25.0	47.1
4th	100	35.7	50.0	42.9	100	21.4
5th	33.3	16.7	42.9	38.9	37.5	44.4
6th	50.0	20.0	71.4	35.0	44.4	45.0
7th	80.0	33.3	100	26.7	50.0	40.0
total	62.5	26.0	56.4	31.7	44.2	42.3

On the whole Ishikawa Kasumi was merely passable in the score rate, excellent in the serve phase, and a failure in the stalemate phase. Generally speaking the

difference between the two sides was note quite wide, but Ishikawa Kasumi made full use of her own special fast speed and Pota's weak point of inflexible steps. And Ishikawa Kasumi was also better than Pota in making on-the-spot adjustments.

4. CONCLUSION AND SUGGESTIONS

4.1 Conclusion

Ishikawa Kasumi has very good basic skills, but when confronted by excellent players she is comparative unstable in her performance, scoring not very high in the serve phase, with quite often losses in serving and fast attacking.

Ishikawa Kasumi is very positive in receiving balls and making quick attacks after receiving, and has high score and utility rates in the receive phase.

Ishikawa Kasumi is strong in holding on and acting fast in the stalemate, but comparatively weak in strength and stability, and tend to make losses as a forehand.

Ishikawa Kasumi cannot judge well the swirling ball of the opposite player's chopping, and her loops are often quite unstable.

4.2 Suggestions

When confronted by world's first-rate players, athletes should have a good mentality, daring to combat, and making full play of their own strong points, but putting more emphasis on training of serving to make quick attacks and keeping stability, thus increasing the variety of serving and swirling patterns.

Training should be increased in the variety of receiving patterns.

Training should be emphasized in strength, especially strength of arms, to promote stability of skills in the stalemate phase.

More exercises should be done by the chopping players in average contests and daily training.

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Measuring preplanned agility using the Aspire Table tennis Agility Test (ATTAT)

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Abstract: The purpose of this study was to determine the reliability and validity of the Aspire Table Tennis Agility Test (ATTAT). The ATTAT was developed from performance analysis data to measure preplanned agility in highly-trained young table tennis athletes (n= 10, 15.0 ± 1.5 y). The ATTAT consisted of a linear step, linear jump, pivot and two lateral movements in sequence at the table and 3 stationary balls were hit by the racket in hand. The mean time take to complete the ATTAT was 3.94 ± 0.75 s. Reliability was measured using a typical error (TE) score from 10 consecutive pairs of trials 3 days apart. The TE score for the test was 3.98% demonstrating that the ATTAT is reliable at the 90% confidence limit. Validity was investigated using a Spearman's rank correlation analysis comparing the ranking of 10 ATTAT scores against an expert coach's perceived ranking of agility (technique of changing direction) in table tennis and a ranking of leg muscle qualities (physical capability) derived from 3 jump tests. Validity was considered high with correlation coefficients of 0.88 and 0.79 for the coach's ranking and leg muscle qualities ranking respectively.

Keywords: table tennis, agility, reliability, validity

1. INTRODUCTION

Agility is a key component of fitness for table tennis athletes who must move quickly in a variety of directions using various footwork techniques. The ability to reliably assess agility is paramount in the development of athletes to track their progress over time. To the author's knowledge there is no literature assessing this important attribute for table tennis athletes in a sport-specific manner. Preplanned agility tests such as the "5-0-5" or "L-run" have been used in other sports (e.g. Gabbett et al., 2008) but do not elicit the movements that might be seen in table tennis.

A test was therefore developed at Aspire Academy based on performance analysis data (Glynn et al., 2014) and is currently used as one of the measures to track the progress of junior table tennis athletes across their development; the "Aspire Table Tennis Agility Test" (ATTAT). The ATTAT focusses on movement skill as opposed to perceptual or decision making factors. The reliability and validity of the ATTAT is yet to be determined. The aim of this study was therefore to determine the reliability (typical error) of the ATTAT and to begin to investigate the validity of the test against an expert coach's perceived agility (technique of changing direction) of the player and his leg muscle qualities (physical capability).

2. METHODS

ATTAT: The ATTAT measured the time taken to complete a set agility course. The athlete had a standard table tennis racket in hand and hit 3 stationary table tennis balls in a set sequence whilst ensuring that the feet or foot passed completely over white tape on the Gerflor surface. The ATTAT was designed to elicit a linear step forwards, a linear jump backwards, a pivot and two lateral movements in opposite directions as these were found to be the most frequent movement types from performance analysis of an elite junior match (Glynn et al., 2014).

Equipment set-up

The equipment was set-up as shown in Fig. 1 for a right-handed athlete performing the ATTAT.

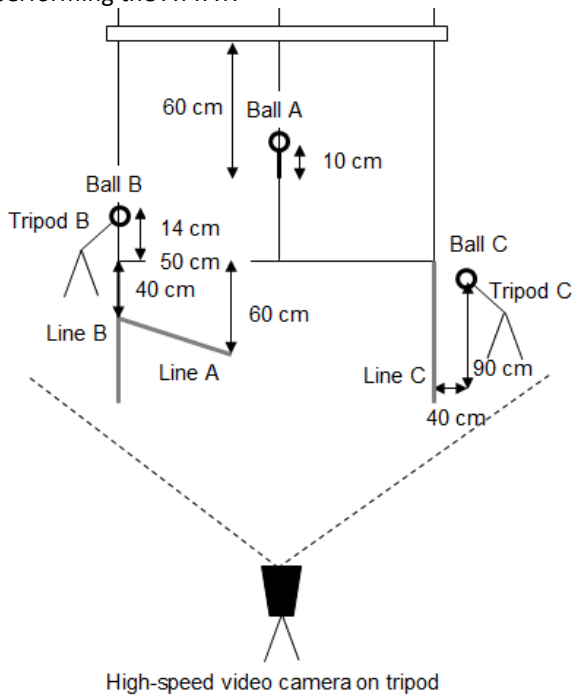

Fig. 1. Equipment set-up for the ATTAT.

For a left-handed athlete the positions of the tripods were the mirror image relative to the long-axis of the table tennis table i.e. tripod B moved to the right side of the table so that the ball was suspended above the corner of the table. Line B became Line C. Distances were to the centre of the ball or the front edge of the tape line (tape 5 cm width). Tripods were modified with plastic tubing attachments for the ball to sit on. The tripod legs were carefully positioned to not interfere with the athlete and the hinge rotation followed the intended direction of the simulated stroke.

ATTAT procedure (for right-handed player)

1. The athlete performed a minimum of 2 trials and started each from a 'service return ready position' with both feet behind but close to Line A (Fig. 2).

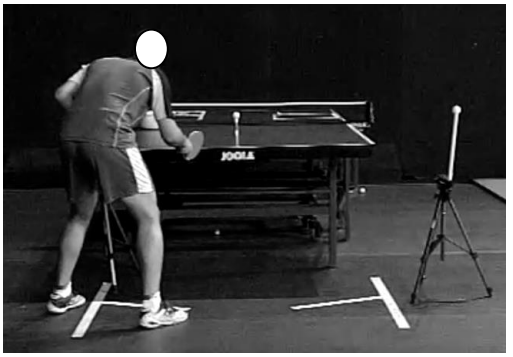

Fig. 2. Ready position to start the ATTAT.

2. A Casio EX-F1 high-speed camera was set to 300 Hz, shutter speed 1/250 and there was ample ambient light for a clear camera image. The camera was set behind and in the middle of the table with the zoom and focus adjusted to have a clear field of view capturing the whole movement volume.

3. It was explained to the athlete that he must complete the trial as quickly as possible whilst maintaining 'proper' technique as defined by an expert coach. Having checked the athlete was in the ready position, the camera operator gave the "READY" command and then started recording. 2-3 s later the camera operator instructed the athlete to "GO".

4. On hearing the "GO" command the athlete made a forward lunge with the right foot to hit Ball A off the plastic tube (as if returning a short serve, Fig. 3). The start of a trial was the first frame where the heel of the right foot was not in contact with the floor (Gerflor) as the athlete initiated a lunge move towards Ball A.

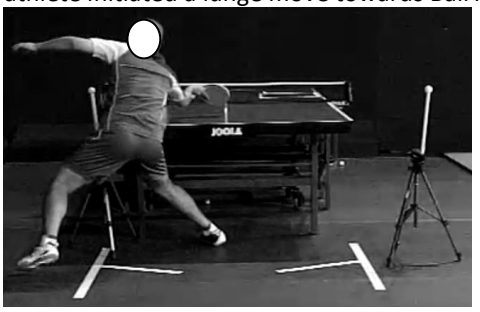

Fig. 3. Forward lunge to hit Ball A.

5. The athlete then jumped backwards and all of both feet had to land behind Line A (resetting position of body relative to the table).

6. Without stopping the athlete made a pivot move to hit Ball B (simulating an attacking forehand drive) perched on the end of plastic tubing connected by a hinge

to Tripod B (Fig. 4). The whole of the right foot had to cross Line B.

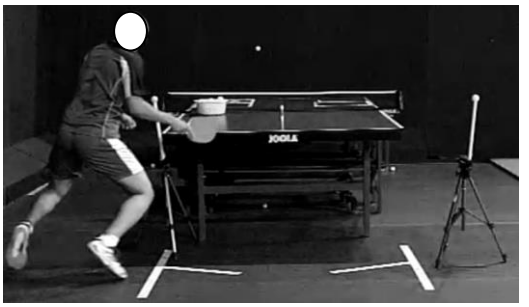

Fig. 4. Pivot move to hit Ball B.

7. The athlete then moved laterally to hit Ball C perched on the end of plastic tubing connected by a hinge to Tripod C. The whole of the right foot had to cross Line C (Fig. 5).

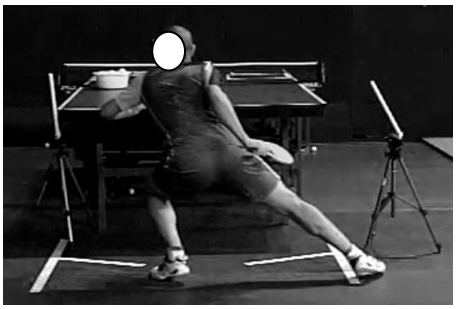

Fig. 5. Right foot had to cross Line C when moving laterally to hit Ball C.

8. Finally the athlete then moved back laterally and crossed Line B. The end of a trial was the first frame when any part of the left foot was in contact with the floor past Line B.

Reliability: Ten male table tennis athletes (n= 10, 15.0 ± 1.5 y) performed the ATTAT in two sessions that were three days apart. Each athlete was familiar with the test. In a session the ATTAT was performed twice (or more if the protocol was breached) and the trial with the fastest time was the ATTAT score taken for further analysis. Reliability was measured using a typical error (TE) score from consecutive pairs of fastest trials (Hopkins, 2000).

Validity: The same ten table tennis athletes from the reliability study were ranked by an expert coach in terms of perceived agility (technique of changing direction) in table tennis and a ranking of leg muscle qualities (physical capability). The coach had been training the athletes full-time (15 hours/week for 2.5 ± 0.6 y) and his rankings were entered prior to the first session to avoid any bias. Leg muscle

qualities were ranked from the average ranking of three tests: max load from a 3RM inclined depth 90-degree leg press (strength); jump height from a counter-movement jump (power); and reactive strength index from a 30 cm drop jump onto a force plate (reactive strength). Leg muscle qualities test battery was performed the day after the first session. The ATTAT scores from the first session of the reliability study were ranked and compared against the coach's ranking and the leg muscle qualities ranking using a Spearman's rank correlation analysis in Excel.

Athlete heights and arm span were measured in the same week as the ATTAT sessions using a stadiometer and arm span chart respectively. The ATTAT score was compared against both these anthropometric variables using a Pearson's correlation analysis in Excel.

3. RESULTS

The ATTAT score and TE score for the ATTAT are presented in Table 1.

Table 1. ATTAT score and TE.

ATTAT score (s)	TE (s)	% TE
3.94 ± 0.75	0.15	3.98

The ATTAT ranking from the first trial, the coach's rankings, the leg muscle qualities rankings and the corresponding Spearman's rank correlation coefficients are shown in Table 2.

Table 2. Athlete's ATTAT ranking, Coach's ranking, Leg muscle qualities ranking and Spearman's rank correlation coefficients.

Player	ATTAT ranking	Coach's ranking	Leg muscle qualities ranking
A	1	1	1
B	2	4	5
C	3	3	3
D	4	6	6
E	5	2	2
F	6	5	4
G	7	7	9
H	8	9	8
I	9	8	7
J	10	10	10
Spearman's rank correlation coefficient compared to ATTAT		**0.88**	**0.79**

Athlete heights and arm span were 166.1 ± 14.1 cm and 169.2 ± 15.3 cm respectively. The Pearson's correlation analysis showed correlation coefficients of 0.43 and 0.38 for height and arm span compared to the ATTAT score.

4. DISCUSSION

Reliability

The TE score of 3.98% demonstrates that this test is reliable at the 90% confidence limit. The TE scores of the "5-0-5" and "L-run" agility tests are 1.90% and 2.80% respectively (Gabbett et al., 2008). Considering the increased complexity of the ATTAT to reflect the sport-specific movements, the TE score compares favourably. Since agility is composed of many factors including technique (Sheppard and Young, 2006), the inclusion of several technical elements in the ATTAT including use of the upper-body to mimic strokes has likely reduced the reliability compared to the aforementioned tests.

Validity

The Spearman's rank correlation analysis showed a high correlation coefficient between the ATTAT and the coach's perceived ranking of agility. The coach was ranking the athletes based on his expertise of what technique should look like to change direction quickly and move between strokes. More in-depth biomechanical analysis using 3D kinematic data would enable further validation of the ATTAT against athlete technical ability.

The Spearman's rank correlation analysis showed a high correlation coefficient between the ATTAT and the muscle leg qualities ranking. This study therefore confirms the importance of a strength and conditioning programme in junior table tennis.

Practical application

The Pearson's correlation analysis showed that within the cohort we studied, the taller athlete with greater arm span does not necessarily have an advantage during the ATTAT. Smaller players have no choice but to move, and so may develop good footwork from regular training. Smaller players can also negate some of the reach disadvantage by moving their limbs (of lower inertia) faster whilst a lower centre of mass of the body can enable faster starts (http://www.tabletenniscoach ing.com /node/53).

If using the ATTAT to compare between athletes then the coach should be aware of the anthropometric differences to help inform his/her opinion. Similarly, for athletes in adolescence, changes in individual ATTAT scores should be viewed in the context of their maturation status (calculated from anthropometric variables) and this would require further investigation.

The ATTAT could be used to improve the agility of a table tennis athlete by analysing the high-speed video. For example, Player E (Table 2) was ranked 2nd by both the coach and the battery of tests to determine leg muscle qualities. However, he was effectively ranked 5th by the ATTAT which suggests there is potential to modify factors such as foot placement or posture which are technical components of agility (Sheppard and Young, 2006).

5. CONCLUSION

This study showed the ATTAT to be a reliable and valid way to measure preplanned agility in junior table tennis athletes. Further comparisons with larger subject numbers of higher technical and physical ability could further strengthen the validity of the ATTAT. The authors suggest that coaches use the numerical data they acquire to infer if successful modifications (based on analysing the high-speed video) to movement technique have been made.

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Exploring the temporal and spatial characteristics of the stroke performances in the semi-final of the man's singles in 2015 table tennis world team cup

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Abstract: Table tennis is a sport of fast pace. Many points are determined within the first 4 strokes. Therefore, the performances of the first 4 strokes of a rally have become the focus of the game analyses. Most of the table tennis research investigated the type of strokes used and the effectiveness of the early phase of the rallies while little attention has been paid to the temporal and spatial characteristics of each stroke. The purpose of this study was to examine the performance of the stroke time and the range of landing location in table tennis competitions. Two singles matches were selected from the man's semi-finals (Chinese Taipei vs. China) of the 2015 Table Tennis World Team Cup. The notational analysis was used on the basis of the video playback. The results showed that the mean flying time of the ball for the serving strokes was longer than that of all the other strokes. One player showed a significantly shorter flying time and a wide range of landing location for the second stroke than those of all the other strokes and the other players. This indicates the planned attacking tactics of the return strokes. In conclusion, the temporal and spatial characteristics of the table tennis performance provide useful information to understand the tactics used by the players and can be used in training and coaching education. Future studies will extend the application of the temporal and spatial analysis to different levels of players.

Keywords: table tennis, temporal, spatial, notational analysis

1. INTRODUCTION

Table tennis is a sport of fast pace. The total rally time for an 11-point game is usually around eighty seconds (Prad, Martínez, Rapún, Bataller, Castellar & Carrasco, 2011), and many points are determined on the first four strokes. Therefore, the performances of the first 2 strokes from both of the serving (1st & 3rd stroke) and the returning (2nd & 4th stroke) sides have become the focus of the analyses of the game compare to the performances of the rest of the rallies.

Wu and Li (1989) proposed the "three-phase evaluation theory" to assess the usage and scoring rates on the first 2 strokes from the serving and the returning sides compare to the rest of the rallies in the table tennis matches. Proponents of the "three-phase evaluation theory" have also developed a formula to evaluate the effectiveness of techniques based on the relationship between the scoring rate and

usage rate (Zhang, Liu, Hu, & Liu, 2014). Although these researchers claimed to analyse the data in the "three phases", the analyses only involved two phases which include the early phase (1st & 3rd strokes or 2nd & 4th strokes) and the late phase (the rest of strokes in a rally) for each player.

Most of the table tennis research investigated the type of strokes, footwork (Malagoli Lanzoni, Di Michele & Merni, 2014), and the effectiveness of different phases for each player (Zhang, Liu, Hu, & Liu, 2013). Little attention has been paid to the tempo of each stroke and the distribution of the locations of the ball-landings for each player for the table tennis match analyses. The tempo of a stroke may be reflected by the fly time of the ball on each stroke while the SD of the distance to the centre of all landing locations may represent the distribution of the ball-landing locations. Shorter fly time of the ball may put pressure on the opponent for the return and a greater distribution of the ball-landing locations may imply an unpredictable stroke location for return (Wu Xiao & Escobar Vargas, 2007). Therefore, the purpose of this study was to examine the tempo and the ball-landing distribution of each stroke in table tennis competitions.

2. METHODS

2.1 Match samples

Two singles matches were selected from the man's semi-finals (Chinese Taipei vs. China) of the 2015 Table Tennis World Team Cup. There were three games in each match. The video recordings of the matches used in this research were downloaded from the "YouTube" website on the Internet (https://www.youtube.com/watch?v=8bWWK6YKMqM).

2.2 Data recording

The time of the ball-bat contact (ST), the time of the ball-landing on the table (LT), the location of the ball-landing on the table (LP), and the result of each stroke were registered using the Simi Scout Master software (SIMI Reality Motion Systems GmbH, Munich, Germany). Figure 1 shows a screen shot of the Simi Scout Master during the data acquisition. The Mathematica 7.0 (Wolfram Research, Champaign, IL) was used to process all the data.

2.3 Data analyses

For the tempo of the strokes, two measures were analysed. The fly time of the ball was determined from the ST to LT for each stroke. The stroke time was defined as the time between two successive LTs. For the landing distribution, the SD of the distance to the centre of all landing locations for the specific stroke (i.e., the 1st stroke, the 2nd stroke, the 3rd stroke, the 4th stroke, and the rest of the rally) was calculated. In addition, the distribution of the scores and the misses in the early phase and the late phase for each game and each player were also calculated.

The fly time of the ball, the stroke time, and the landing distribution were averaged over a game, and the non-parametric Mann-Whitney U test was used to compare the performance of the opposing players of a match. The descriptive

statistic was used to examine the distribution of the scores and misses in the early and late phases.

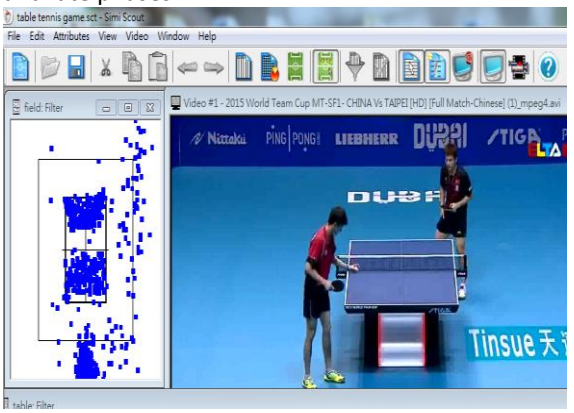

Fig. 1. A screen shot of the Simi Scout Master during the data acquisition.

3. RESULTS

3.1 The scores and misses determined in the first 4 strokes vs. in the later strokes

The results show that the percentage of the rally results that were determined in the early phase was over 50 % for the Chinese Taipei players of both matches. However, the scoring rate was higher for the Chinese players especially for the first match (see Figure 2). The higher scoring rate was maintained over the late phase for the Chinese players of both matches (See Figure 3).

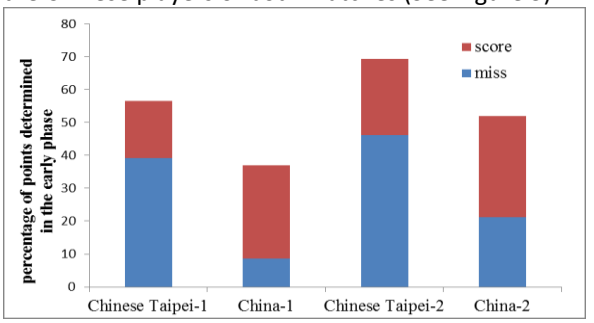

Fig. 2. The average percentage of points determined in the early phase over the 3 games. China-1 and Chinese Taipei-1 represent the first match; China-2 and Chinese Taipei-2 represent the second match.

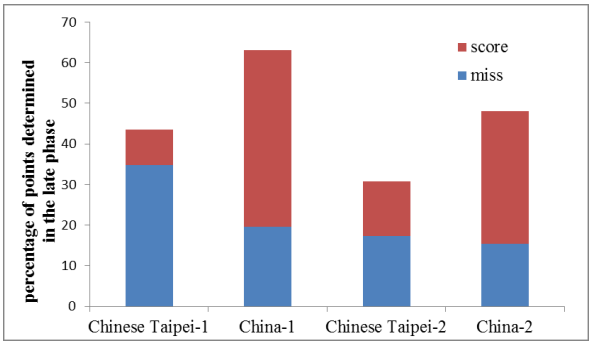

Fig. 3. The average percentage of points determined in the late phase over the 3 games. China-1 and Chinese Taipei-1 represent the results from the first match; China-2 and Chinese Taipei-2 represent the results from the second match.

3.2 Flying time of the ball

The results showed that the mean flying time of the ball was longer for the serving stroke than that of all the other strokes. In the first match (*Fig. 4*), the flying time of the 2nd stoke had significant player effect ($Z=1.964$, $p<.05$). The Chinese player had shorter flying time than the player of the Chinese Taipei. For the 3rd stroke, however, the significant player effect ($Z=1.993$, $p<.05$) showed a reverse trend: the Chinese player had longer flying time than the player of the Chinese Taipei. There was no significant player effect found in the second match (*Fig. 5*).

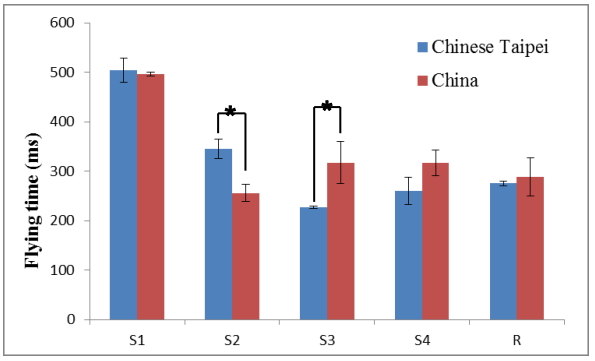

Fig. 4. The means and standard deviations of the flying time of the ball for each stroke in the first match.

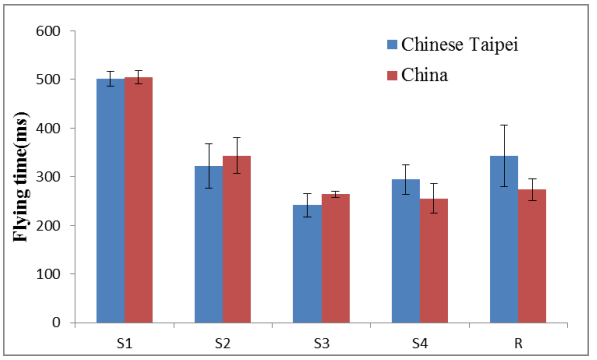

Fig. 5. The means and standard deviations of the flying time of the ball for each stroke in the second match.

3.3 Stroke time of the ball.

In the first match (*Fig. 6*), the player effect was significant for the second stroke (S2) and the 3rd stroke (S3). The Chinese player had a shorter stroke time than the player of the Chinese Taipei (Z=1.964, p<.05), but for the strokes time of S3, the Chinese player was longer than the player of the Chinese Taipei (Z=1.964, p<.05).

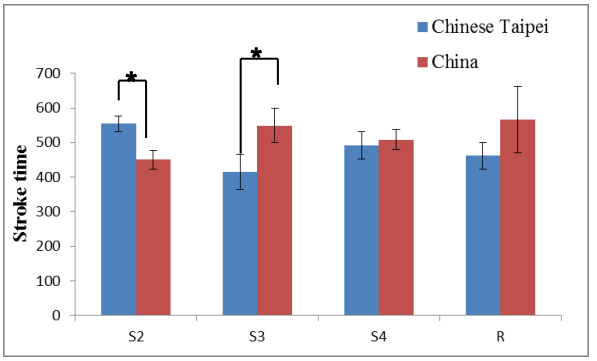

Fig. 6. The means and standard deviations of the stroke time over 3 games in the first match.

In the second match (*Fig. 7*), the player effect was only found significant on 4th stroke (Z=1.964, p<.05). The Chinese player had shorter stroke time than the player of the Chinese Taipei.

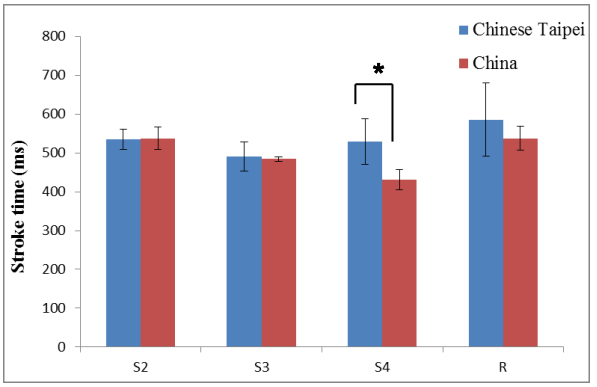

Fig. 7. The means and standard deviations of the stroke time over 3 games in the second match.

3.4 Landing distribution

For the 1st match, although the second stroke (S2) from the Chinese player seemed to show a large range of landing locations, no significant player effect was found (see *Fig. 8*). For the 2nd match, the player effect was found significant for the landing distribution of the service (S1) ($Z=1.964$, $p<.05$). The player of the Chinese Taipei had greater range of landing locations than the Chinese plyer (see *Fig. 9*).

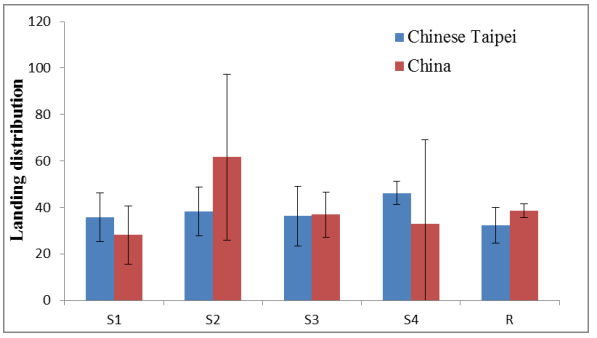

Fig. 8. The means and standard deviations of the landing distribution of the ball over 3 games in the first match.

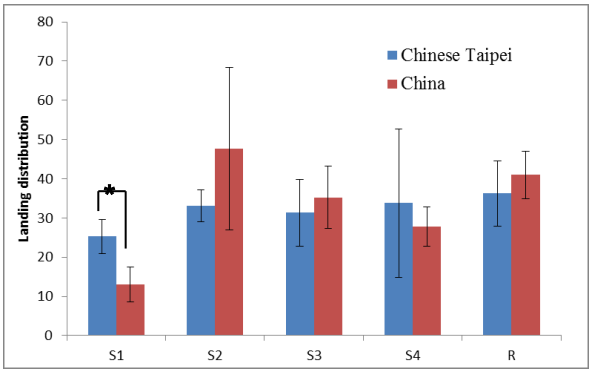

Fig. 9. The means and standard deviations of the landing distribution of the ball over 3 games in the second match.

4. DISCUSSION

In the first match, the Chinese Taipei player had over 50% rally results determined in the early phase (the first to the fourth strokes) but only scored a few. The Chinese player had higher scoring rate in the early phase for the first match. This player had significantly shorter fly time and stroke time for the service-return strokes compared to his opponent, and this might be one of the reasons to have higher score rate in the early phase. In the second match, the Chinese player had significantly shorter stroke time for the 4th stroke, and that might be one of the reasons to cause a higher scoring rate for the late phase.

For the distribution of the landing locations, the Chinese players seemed to have a greater range of distribution for the service-return strokes, but due to a large variability among the 3 games for both matches, no significant differences between players were observed. In the second match, the distribution of the landing location for the service stroke was significantly greater for the player of the Chinese Taipei than the Chinese player (see Figure 10), this might be the reason that the Chinese player performed the shorter stroke at the 4th stroke instead of the service-return stroke.

Based on the analyses of the 2 matches, we observed that the Chinese players tended to have a faster tempo on the service-return strokes or the 4th strokes to put the pressure on the opponents in order to score. On the other hand, when the landing locations of the serves were widely distributed, it was more difficult for the opponent to perform a short return stroke.

The current study demonstrated that the temporal and spatial characteristics of the table tennis performance derived from the notational analysis provide useful information to understand the strategies and tactics used by the players and can be used in training and coaching education. Future studies will extend the application of the temporal and spatial analysis to different levels of players.

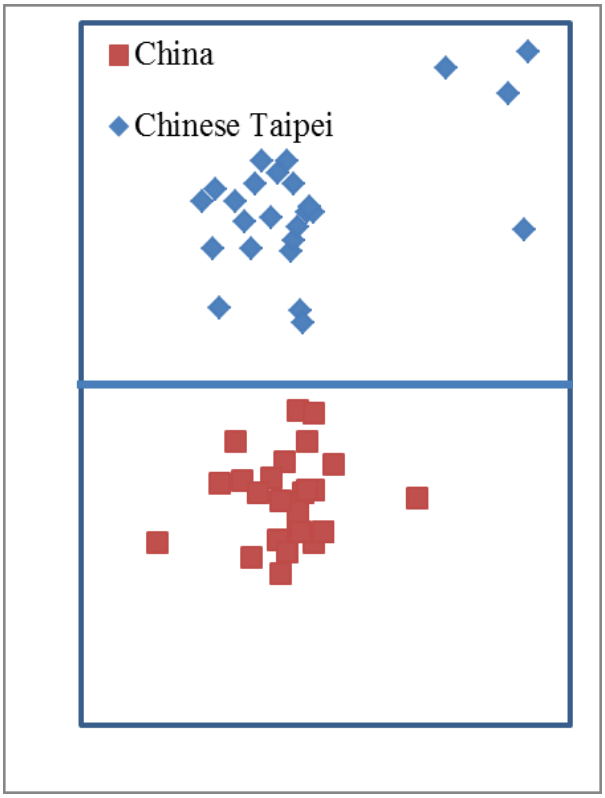

Fig. 10. The landing distribution of the services in the second match.

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Physical and Physiological Fitness of Badminton Collegiate Athletes

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Abstract: Numerous studies have assessed athlete's physical characteristics and fitness because of their significant importance in competitive sports such as badminton. This study investigated physical and physiological fitness characteristics of badminton athletes. Eighteen collegiate badminton athletes (female=10, male=8) in one university in the Philippines participated in the study. Basic anthropometric, physical fitness and physiological variables were measured namely, height, weight, waist, hip, medicine ball power throw, flexibility (sit and reach), blood pressure, heart rate and VO2max (multi-stage shuttle test). Results showed that while male badminton athletes were taller, heavier, stronger and fitter, they were less flexible than their female counterparts. On the other hand, other physical characteristics (BMI, waist, hip, WHR) and physiological variables (heart rate, systolic and diastolic pressures) did not show any differences between males and females. This study reveals physical and physiological profiles of badminton collegiate players and provides relevant information about the current status of Filipino male and female athletes concerning these variables. The results also confirm and expand previous data about gender differences in sports particularly in badminton.

Keywords: arterial blood pressure, heart rate, badminton athletes, Filipino, fitness performance

1. INTRODUCTION

Badminton is considered the fastest, exceptionally challenging and exhausting racket sport in the world (Liddle, Murphy, & Bleakley, 1996; Nageswaran, 2013). It is a sport that frequently combines moderate to high intensities of long and short rallies (Jeyaraman, 2012; Liddle et al., 1996) and players need to defend or attack the shuttlecock by reaching and lunging their arms and legs and performing powerful strokes as quickly and consistently as possible. Hence, players who would like to have that competitive advantage to be successful in the sport must possess great amount of cardiovascular and muscular endurance and strength, power, agility, speed and flexibility. Although studies about physical and fitness performance characteristics about badminton exist in the literature (Phomsoupha & Laffaye, 2014; Rahmawati, Budiharjo, & Ashizawa, 2007; Revan, et al., 2007; Campos et al., 2009; Nande, Mudafale, & Vali, 2009; Ramos-Alvarez, Campos, & Portes, 2013), information about this topic are rare in the Philippines except for one study that only analysed anthropometric measurements (Kim, Cruz, & Kim, 2013). Hence, the purpose of the study was to analyse physical and physiological fitness parameters of Filipino

badminton collegiate athletes and compare these dependent variables between males and females. Assessing Filipino badminton players' physiological and fitness performance variables would provide baseline reference for coaches and sports researchers that would assist them in identifying athletes' strengths and weaknesses and thereby make the appropriate training program according to the demands of the sport and each athlete's needs.

2. METHODS

Participants

Eighteen collegiate badminton athletes (female=10, male=8) were selected in one university in the Philippines and gave their consent to participate in the study. Age ranges from 16-22 years old. Playing experience in competitive badminton ranges from 3-8 years. All procedures were performed according to the Declaration of Helsinki for human experiments.

Measurements

Basic anthropometric variables including height weight, waist, and hip were measured using a wall-mounted wooden stadiometer, digital TANITA scale, and anthropometric tape for the latter two body sites respectively. Measurements followed the International Standards for Anthropometric Assessment (ISAK) protocol (Stewart et al., 2011). BMI was calculated from height and weight whereas WHR was computed using waist and hip measurements.

To determine athletes' physical fitness profile, the following tests were administered: the seated medicine ball throw (Topendsports, 2016) to measure upper body strength and power, the sit and reach test (Cooper Institute for Aerobics Research, 1994) to determine lower body and hamstrings flexibility, and the multistage 20-m shuttle run test (Leger & Gadoury 1989) to obtain maximal oxygen uptake. Whereas blood pressure and heart rate data were recorded using a portable digital blood pressure machine (Beurer BM-20 DE147040787, Germany) after athletes rested for 5 minutes on the bench.

Analysis

One-way ANOVA was used to assess differences of the dependent variables between genders. Statistical significance level was set to $p<0.05$ and effect sizes were also used to express the extent of differences between groups.

3. RESULTS

Table 1. Descriptive characteristics of athletes by gender

Variable	Female		Male		Partial Eta^2
	Mean	SD	Mean	SD	
Height (cm)	1.55	0.063	1.66	0.065	0.45*
Weight (kg)	53.54	7.15	64.61	9.72	0.33*
BMI	22.08	2.21	23.19	1.97	0.07
Waist (cm)	74.42	6.18	76.82	5.99	0.04
Hip (cm)	88.60	5.61	92.17	5.21	0.11
WHR	0.84	0.05	0.83	0.03	0.01

* $p<0.05$

Table 2. Physical and physiological fitness of athletes by gender

Variable	Female		Male		Partial Eta^2
	Mean	SD	Mean	SD	
RHR (bpm)	78.60	17.74	78.12	9.28	0.00
SBP (mmHg)	109.20	8.10	111.62	10.58	0.02
DBP (mmHg)	57.10	2.96	59.75	8.03	0.06
SMBT (cm)	28.52	4.08	45.09	7.27	0.70*
S&R (cm)	56.75	10.52	46.62	7.48	0.25*
VO_2max (ml/kg/min-1)	34.51	5.20	46.38	3.08	0.67*

*RHR=resting heart rate; SBP=systolic blood pressure; DBP=diastolic blood pressure; SMBT=seated medicine ball throw; S&R=sit and reach; $p<0.05$

4. DISCUSSION

The study aimed to analyse physical and physiological fitness parameters of Filipino badminton collegiate athletes and compare these dependent variables between males and females. Based on the anthropometric results, significant differences were evident in terms of height and weight between gender showing male athletes being taller and heavier than females. Results were also consistent with previous studies (Nande et al., 2009; Kim et al., 2013) except for the BMI scores. Prior studies showed BMI scores of males were higher than females while no statistical difference was found in the current study which could be related to the almost similar height of males against the females that consequently affected the calculated BMI value of the male players.

Physical fitness results showed significant differences between genders. Male athletes had higher aerobic capacity and muscular strength and power than their counterparts. On the contrary, female athletes were more flexible than male badminton players. Mixed results were found between previous findings and the current study in terms of aerobic endurance and flexibility. Studies of Heller (2010) and Lieshout & Lombard (2003) found junior players' VO2max scores were higher for males but the study of Abdullahi (2011) found that Nigerian male racket players were more flexible than their female counterparts.

Physiological fitness results showed no significant differences between Filipino male and female athletes' resting heart rates, systolic blood pressures, and diastolic blood pressures. Previous studies did not measure athletes' baseline heart rate and thus no comparison can be made from badminton players. However, studies about heart rate sex differences showed that females have higher heart rates than males (Ellis et al. 2013) while varied results were found for systolic and diastolic blood pressure measurements. These differences were attributed to age and ethnic background. Nonetheless, physiological markers of Filipino players fall within the normal population range.

Overall, differences and similarities of Filipino athletes' physical and physiological differences in terms of gender would be attributed to their higher level of physical activity due to training and innate characteristics such as hormones and genetics.

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Effect of Reaction time of University Table Tennis Players on Different Velocities and Directions

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Abstract: The purpose of this study was to discuss the effect of the reaction time on velocities, ball coming directions to intercollegiate players. The subjects were table tennis school team players from National Kaohsiung University of Hospitality and Tourism, male 13, female 7, total 20 persons in the aggregate of 20 people. Subjects' average age 21.9 ± 2 years, length of playing table tennis 10.1 ±3 year. To investigate the effect of the winging back reaction time from velocities (independent variable A) and ball coming direction (independent variable B) to the subjects by taking the imitation of real games serving from real players. Analyse by 2-way ANOVA, the result shows that: 1.Velocities to swing back reaction time had a significant pact. 2. Ball coming direction to receiving reaction time had a significant pact. 3. Velocities and ball coming direction to receiving back reaction time did not exert an influence of interaction. The study concluded: Different velocities and directions were a main effect individual receive and confront faster velocity and ball directions from left result faster reaction time.

Keywords: table tennis training, stimulus response, total response time

1. INTRODUCTION

Hsieh (2006) pointed out that table tennis originated in the UK, and was invented by James Gibb in 1881. In 1890, the sport was re-named as Ping-Pong due to the sound the ball created on the table. Table tennis is also a sport in which the ball moves rather fast from one end to another. Aside from their brilliant skills, table tennis players have outstanding reaction time (RT) and movement time (MT). In real table tennis game, the accurate judgment of the ball direction and the fast reaction to strike back are the key to victory.

The reaction time refers to the time ranging from the emergence of stimuli to the start of reaction (Magill, 1993), and is the main indictor for measuring human beings processing time (Martnium, 1976).

Table tennis is a sport that requires many fast-moving skills, featuring (1) the urgency of time, and (2) the complexity of stimuli (Wen & Lin, 1998). Open sports filled with constant changes such as table tennis often challenge players with unpredictable changes, which require players to react fast so as to deal with uncertain space and location changes (Wu & Hung, 2006). Chen (1995) pointed out that in a short-period, fast-speed sport, the time ranging from stimuli to reaction is

rather short, which signals that the emergence of stimuli promptly triggers the start of reaction, and the time is often measured by millisecond. Therefore, in this sort of fast-speed sport, players' reaction time plays a key role. In the game of table tennis, players have to adopt different speed, rhythm, direction, and strength; also, they have to move as fast as can be while starting up, stopping, and changing strike direction, so as to gain the upper hand in intense offense and defence. Therefore, reaction time plays a key role in speed. In actual sport, reaction time can be put into two categories: (1) prediction of sudden stimuli, and perform regular reaction, which is called simple reaction time, as exemplified by swimming context and track and field, in which contestants start off upon hearing the gunshot; (2) complex reaction time, which refers to performing irregular and different reactions according to different stimuli, as exemplified by sports that require players to determine their next moves based upon the direction of ball, such as table tennis, baseball, basketball, tennis, badminton. In terms of the effect on agility, it is obviously that complex reaction time outweighs simple reaction time, especially in table tennis, in which players have to first judge the speed, direction, and revolving of ball, then react differently. Therefore, the training on reaction time in table tennis seems to be more complex than that of other sports (Feng & Chung, 2007). Schmidt (1988) pointed out that between the input of stimuli and output of reaction, an individual has to undergo three stages: stimuli-identification, response-selection, and response-programming. And the individual's reaction time serves as the basis of quantification.

Phycologist Singer (1980) pointed out that all sports have to go through the interaction between "consciousness process", "cognition process", and "action process " before taking shape, so as to translate skill performances into a meaningful, integrated, and effective behaviour. For example, prior to performing serve and receive, players have to, based upon the information received by their senses, determine their possible hit direction and timing (consciousness process) by judging their opponents' eyes, swing direction, start move, anchor foot, and location of direction foot. Then, players have to, based upon their skills, anticipation, and reaction, determine their movement (cognition process) and make fast judgments and decisions. The process is completed through the transmission and reaction of the nerve system, which collaborates with all parts of the body and coordination skills to perform the striking-back skill (action process).

Schmidt (1988) explained how individuals, between stimuli and reaction, perform information process and control reaction process, through motor control. The reaction time refers to the time an individual needs to perform information process and control reaction process between stimuli and reaction, meaning the time spent for performing stimuli confirmation, selection of reaction, and reaction process. In a table tennis game in which the ball travels rather fast, the key to victory often lies in the reaction of players. This further stresses the importance of reaction time, in that it is a speed performance of the integration of nerve and muscle. The less reaction time is spent, the higher the adaptability and resiliency of a table tennis player (Hoyle & Holt, 1983). Chin (2010) pointed out that reaction time is also often used as an indicator to evaluate an individual's performance. And through the measurement

of reaction time, it could be used as reference for selecting sport talents. Therefore, reaction time could be used as a principle for drafting players or setting future goals.

Magill (1993) pointed out that reaction time refers to the period that ranges from the emergence of stimuli to the start of reaction. Weiss (1965) used electromyography (EMG) to test reaction time. RT refers to the period ranging from the emergence of stimuli to the start of reaction, excluding the reaction itself, and stressing the period prior to the start of reaction. MT, on the other hand, refers to the period ranging from the emergence of stimuli to the completion of reaction.

Yet, so far, researches on reaction time are mostly classical researches on the stimuli on fingers. In the sport field, researches are done through virtual reality; however, in biological nerve system, information senses and the emergence of action affect each other. Therefore, these mechanisms should not be separated while conducting research (Michaels & Carello, 1981). Only by connecting conscience and action in real environment can we observe sensory transfer (Davids, Button, & Bennett, 2008), which is the change of reaction time, thereby creating ecological validity in applying this in training or contest. Foreign scholars often use the reaction to button after visual stimuli to manipulate the experiment, while domestic scholars started to use "virtual or real sport scenario" to design experiment and study.

Kuan (2013) pointed out that RT has long been used as an indicator to evaluate individual skill performance under the following situations: (1) speculating the time needed for preparing a move; (2) recognizing the environmental and background information an individual uses to perform a move; (3) evaluating an individual's anticipation of a given move and ability of recognizing when to start the move. The reaction time would be affected by different external stimuli. There were a handful of researches that discussed how environmental constraints such as illumination intensity and temperature, task constraints such as ball speed and difficulty of work affect reaction time, through manipulation. This study aims to simulate actual game scenario and discuss the effect of different ball speed and ball direction have on the reaction time of college table tennis players, hoping to better understand the level of college table tennis players and provide science-based references to coaches while selecting talents.

2. RESEARCH METHOD

1. Research subjects

The research subjects of this study are 20 college table tennis players which consist of 13 males, 7 females, totalling 20 people. The average age is 21.9±2 years old, and the average career length is 10.1±3 years.

2. Research Instruments:

(1) Hardware equipment: 1 table tennis table (Chanson CS-6290) for experiment; 2 backhand rackets (Donic); 2 triaxial accelerometers (Silicon Designs 2210-200); 1 digital analogy adapter (National Instruments, NI-USB-6211); 1 power supplier (Gwinstek GPS-4303); 1 infrared ray signal receiver (self-produced); 1 sound wave detector; 1 laptop.

(2) Software equipment: software equipment package LabVIEW 2009 (Laboratory Virtual Instrument Workbench) virtual control drive program and SPSS12.0.

(3) Design of Experiment:

- Independent variable: (A) ball speed of factor (fast：0.49±0.18；slow：0.87±0.13); (B) different ball direction of factor (left, right).
- Dependent variable: RT (the moment the demonstrator serves to the moment the receiver moves).

3. Research Procedure

Set up experiment scene. Explain to participants the purpose, procedure, and content of this experiment. Ask participants to sign the agreement for the experiment. Stick the triaxial accelerometers on the racket and table to be used by participants, sound wave detector on the server's racket to ensure the integrity of signal and to gather the signal of the retraction of racket created by the server. A set of accelerometers (±5g) are stick on the rackets to gather the timing parameter of the moment the ball receiver moves the racket and the e moment the ball touches the surface of the racket. The server (once a player on the national team) stood at the general serving position, and served the ball to warm up participants. Five serves were used as proper practice. In the official experiment, each participant received 10 fast balls, 10 slow balls.

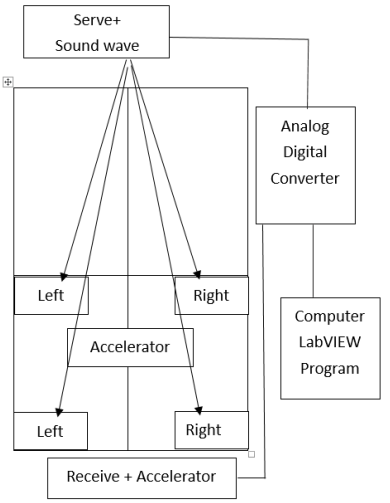

Fig. 1. Experiment Scene Layout

4. Information processing and analysis

This experiment collected all information through LabVIEW, and conducted analysis of the data required by this study, which is later used for statistical analysis. Through statistical analysis software with SPSS 12.0 version, the study conducted 2-way ANOVA on dependent samples. In the case that the interaction proves to be telling, then conducted the test on simple main effect, so as to verify its differences. The telling standards of each statistical test in this study are allα=.05.

3. RESULTS

Table 1 shows the reaction time of striking-back movement required for different ball speed and ball direction: average time for fast balls coming from the left: 0.42 second; average time for fast balls coming from the right 0.56 second; average time for slow balls coming from the left: 0.85 second; average time for slow balls coming from the right 0.89 second

Table 1. Summary of the average number and standard deviation of the reaction time of striking-back movement while facing different ball speeds and ball directions (unit: second)

	Fast		Slow	
	Left	Right	Left	Right
M	0.42	0.56	0.85	0.89
SD	0.19	0.15	0.13	0.14

After the mixed 2-way ANOVA, Table 2 is the summary of the 2-way ANOVA on the effect different ball speeds and ball direction have on the reaction time of striking-back movement. The results showed that: (1) different ball speeds' (A) factor reached telling standard (F =138.24, p<.05), which means different ball speeds have tellingly different effects on reaction time, and fast balls require less time than slow ones; (2) the (B) factor of ball coming from different directions also reached telling standard (F =11.12, p<.05), which means different ball speeds have tellingly different effects on reaction time of striking-back movement, and balls coming from the left require less time than those coming from the right; (3) (A) factor of balls with different speeds and (B) factor of balls from different directions did not reach telling standard (F =2.44, p>.05), which means different ball speeds and different ball directions do not interact with the reaction time of striking-back movement. This also suggests that, fast balls have a more telling effect on the reaction time of striking-back movement than slow ones, and the reaction time required for the striking-back movement for balls coming from the left require less time than those coming from the right. Therefore, it can be inferred that ball speed and ball direction are the main reasons that affect an individual's serving and receiving. Also, an individual needs less time to deal with fast balls and balls coming from the left

Table 2. Summary of the 2-way ANOVA of the reaction time of striking-back movement while facing different ball speeds and ball directions

Source	SS	Df	MS	F	Post-comparison
S	0.69	19	0.04		
A(different ball speed)	2.86	1	2.86	138.24*	slow＞fast
S*A	0.39	19	0.02		
B(different ball direction)	0.17	1	0.17	11.12*	right＞left
S*B	0.28	19	0.02		
A*B	0.05	1	0.05	2.44	
S*A*B	0.40	19	0.02		
All	4.84	79			

*p<.05

4. CONCLUSION

Therefore, modern table tennis competitions are all composed of fast and sudden moves as the ball travels from one end of the table to another (Thornas, R. B., 2000/2004), Corbin & Lindsey (1994) thought agility is the reaction ability to accelerate, move backward, move vertically and horizontally at a given action and direction. Therefore, in table tennis, speed and agility are often completed within a very short period of time. Speed is one of the keys in exercising, and is shown by the form of dynamics, which is represented by the ratio of distance and time. This includes three elements: reaction time, frequency of unit time movement, and speed of movement within a fixed distance (Lin, 1986).

The results of his study show that different ball speed and ball direction have tellingly different effect on the reaction time of stroke, which correlates with Tu (2008)'s study on the effect of different ball speed and illumination intensity have on college students' reaction time and movement of interception, in which the author pointed out that ball speed is one of the factors that affect reaction time. Liu (2001) studied the visual stimuli and body movement of 30 college football players as subjects, who received virtual image that created penalty kicks from different directions. The participants wore displayers on their heads and stood upon Kistler force plate. After watching the direction of the penalty kicks on the display, they move towards right or left. The players spent less RT while facing fast balls than slow ones; balls coming from the right (0.698s) produced less RT than those coming from the left (0.792s), yet no telling difference was shown. This shows that ball speed affects RT. Tsai (2001) studied the interception movement of primary school football players, and found that fast balls affect the players' reaction time. Cheng (2011) used 6 junior high school female students as subjects to study the reaction time and movement time of junior high school female volley players while catching and smashing the ball, and found that ball speed affects reaction time most. According to the "memory drum" theory proposed by Henry & Roger (1960), after a period of practice, movement would transform into nerve coordination mode and is stored in the memory drum. While external stimuli appear, individuals would call their learned movement skills from the memory drum, which is completed unconsciously. Whenever an individual needs it, this unconscious mechanism would send movement memory to lead required nerve impulsion, which is transferred to proper muscles to perform the needed skills (Pan et al., 2001). Judging from this, college players create memory after a long period of training. And based on this theory, it is known that providing different ball speeds and directions in training is conductive to the improvement of players' reaction during training. In table tennis, fast judgment, fast reaction, quick start, fast arm swing, fast movement, and fast change of reaction and direction are required to grasp every critical timing and win (Ping Pong Edition and Translation Division, 1982)

In addition, the results pointed out that among different ball speeds, fast balls have a more telling effect on the reaction time of striking-back than slow ones, which correlates with the study of Chung (2008), in which 22 PE majors were used as study subjects to discuss the effect of two kinds of ball speed have on the reaction

time of forehand interception and movement time in table tennis. In this study, it was found that players' reaction time while dealing with fast balls (249.6 millisecond) is shorter than that of slow -speeded balls (478.5 millisecond). Chien (2008) used 37 primary school soft tennis players as subjects to study how interception movement affects players' reaction time and movement time while they face different ball speeds. The results showed that players' reaction time while dealing with fast balls (386.61 millisecond) is shorter than that of slow -speeded balls (563.43millisecond). Chen (2009) studied the influence of different ball velocities and colours on the reaction time and movement time for baseball catching, and found that players' reaction time for fast balls (608 millisecond) is shorter than that of slow -speeded balls (782 millisecond).Wang (2009) studied the influence of illuminations and ball velocities on the movement for table tennis, and found that players' reaction time for fast balls (268.6 millisecond) is shorter than that of slow -speeded balls (363.3 millisecond). Liu (2002) discussed the reaction time of college players by using different ball speeds and ball directions created by virtual scenes, with a view to measuring the reaction time of female college volley ball players. The results showed that different ball speeds have tellingly different effects on overall reaction time; ball coming with fast speed would generate faster reaction. Also, Kuan (2013) used 10 college students specializing in soft tennis to study the effect different ball speeds and ball directions have on college soft tennis players' forehand stroke and reaction time, and found that ball speed would affect reaction time. This study resonates with the study results above on the effect of ball speed on RT, showing that ball speed is the main reason that affects reaction time. Yet, the study on ball direction suggested otherwise. The results showed that different ball directions have little effect on RT, which is different from that of this study. This result also correlates with the invariant features proposed by Schmidt (1988), signalling that a set of unique features for restricting general movement procedure does not change with the changes of the movement to be completed.

The results of this study are as follows: ball speed and direction affect an individual's reaction time of serving most. Also, while facing ball with fast speed and from the left, players would generate shorter reaction time. Based on the conclusions above, the study suggests that (1) different ball speeds have telling effects on reaction time; therefore, in general training, trainers are advised to use different ball speed to improve players' reaction time, so as to upgrade their level and achieve better performance. (2) future study: this study merely targeted college table tennis players. It is advised that future studies include primary school players, or professional table tennis players to lift the level of experiment participants, with a view to constituting consistency and achieving integrated results in professional table tennis training.

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A comparison of chosen health indicators determined during routine medical examinations between table tennis, badminton and squash players

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Abstract: In this article, the main goal is comparison of chosen health indicators determined during routine medical examinations between table tennis, badminton and squash players. These routine medical examinations are particularly important to determine current health status of the athletes, to provide information about risk factors and still unknown critical congenital dysfunctions at the individual players. But the main purpose of these routine medical examinations is to determine lately developed dysfunctions, influenced by regular growth and development, but also with exhaustive trainings. These dysfunctions could cause sudden deaths, or appearance of chronically diseases or injuries. In this study, we have used the data from Polyclinic for Occupational Health and Sport, from male athletes (66 badminton, 143 squash and 235 table tennis players), and then female athletes (5 badminton, 127 squash and 81 table tennis players), stratified by gender and by four age groups. Collected data included height, body mass, body mass index, blood pressure (diastolic and systolic), heart rate, vital capacity of the lungs, haemoglobin, haematocrit, leukocytes, thrombocytes, ECG and speed of sedimentation. The results of Kruskal Wallis and Chi-square tests indicated very small number of differences among table tennis, badminton and squash players in chosen indicators, mainly in height, body mass and body mass index in certain age groups. The results are described in terms of desirable morphological characteristics, as well as in terms of specific functional capacities and motor abilities, for each sport (badminton, squash and table tennis). The main shortcomings are relatively small number of participants in certain age groups and generally small number of badminton players in females.

Keywords: age groups, functional capacities, morphological characteristics, racket sports

1. INTRODUCTION

Sports performance is based on a complex and intricate diversity of variables, which include physical (general and specific conditions), psychological (personality and motivation) and body (body morphology, anthropometry and body composition)

factors [1]. The identification of athlete's morphological characteristics and functional capacities in a sport contributes to his/her success and enables to spot differences among athletes in different sport modalities, which is of great interest for athletes and sport coaches, as well as for scientists [2,3]. A limited number of studies in the literature has investigated physical and physiological characteristics in racket sports, such as badminton, squash and table tennis [4-6].

Badminton was included as an Olympic sport in 1992 and it is a sport modality, which requires both aerobic and anaerobic energy systems. Badminton athletes must have great physical capacity, especially speed and aerobic strength and power [4,7]. Similarly, studies conducted on squash players indicate that aerobic fitness is highly important in players of various standards [8-11], but to date, only a few studies on squash have reported physiologic variables other than laboratory-based assessments of aerobic pathway [12-14]. Table tennis is a sport, which demands excellent fitness at high levels of play - players require aerobic stamina, agility, strength, speed and precision. It is also a technical sport, requiring good motor coordination, the development of sophisticated racquet movements and adequate anthropometrical requirement and biomechanical development [15]. Although table tennis has a century long tradition, the relatively small number of research studies in this area limits the scientific information about specific procedures, physiological profiles, and characteristics of this sport [15]. All the conducted studies indicate that the physical requirements of all three racquet sports (badminton, squash and table tennis) demand efficiency in a number of fitness components [1].

Different studies based on anthropometry have concluded that the morphological characteristics of athletes successful in a specific sport are biased in comparison with non-athletes, among type of sports, among levels within sports and between genders [16]. Athletes succeeding in certain sports have distinctive body shapes that differ according to the demands of the type of sports and competitive level and the differences in the size, shape and form of the players play a significant role in the athlete's success. In this respect, it is clear that the anthropometric measurements are highly important in selecting individual athletes to involve in specific sports activities based on their physical capabilities, which then serves as an indicator for future athletic achievements [17].

The purpose of this study was to evaluate the morphological characteristics and functional capacities of Croatian male and female badminton, squash and table tennis players based on data collected from athlete's routine medical examinations. The first goal was to determine the differences in chosen health indicators, determined during routine medical examinations. Then, we have determined the profiles of male and female badminton, squash and table tennis players based on chosen morphological and medical variables.

2. SAMPLE AND METHODS

The data from the Polyclinic for Occupational Health and Sport have been used in this study, including both male athletes (66 badminton, 143 squash and 235 table tennis players), and female athletes (5 badminton, 127 squash and 81 table tennis

players), stratified by gender and by four age groups. Collected data included height, body mass, body mass index, blood pressure (diastolic and systolic), heart rate, vital capacity of the lungs, haemoglobin, haematocrit, leukocytes, thrombocytes, ECG and speed of sedimentation.

The Kruskal Wallis (for quantitative variables) and Chi-square (for nominal variables) tests were used to identify the potential differences among table tennis, badminton and squash players in the chosen morphological and health indicators. K-means, i.e. non-hierarchical clustering method is applied using quantitative (ratio-type) (morphological and health-related) variables only. Initial cluster centres are automatically determined, while two-cluster solution is estimated most suitable. After clustering, individual cases are classified in relation to the type of sport (squash, badminton and table tennis), with respect to the abovementioned quantitative variables, only for age group 17-30 (adults), separately for male and female athletes. All analyses were performed using SPSS 20.0.

Table 1. Sample stratification according to sport, age and gender.

Age group	Males			Females		
	Table Tennis	Badminton	Squash	Table Tennis	Badminton	Squash
7-13	80	9	58	33	0	37
13-15	39	10	29	4	2	37
15-17	29	6	13	11	2	20
17-30	79	2	43	28	1	21
>30	8	39	0	5	0	12
Total	235	66	143	81	5	127

3. RESULTS AND DISCUSSION

Very small number of statistically significant differences among table tennis, badminton and squash players in chosen health indicators is revealed, using Kruskal Wallis and Chi-square tests (Table 2, Table 3 and Table 4). Main differences are found in morphological variables, such as: male squash players have highest means, while table tennis players have lowest means in body mass index (BMI), height and body mass (age 7-13); female squash players have highest means, while table tennis players have lowest means in body mass (age 7-13), age 17-30 and age >30); female squash players have highest means, while table tennis players have lowest means in height (age <30). Finally, only one difference is found in medical variables: in males, table tennis players have highest haemoglobin, while squash player have the lowest, in age group 13-15. The results of the K-means cluster analysis for the badminton, squash and table tennis players, using chosen morphological and medical variables are presented in Table 5.

In relative numbers, relatively more squash players are grouped in the first cluster, while something more table tennis players are grouped in the second cluster.

In spite of the fact that findings revealed in this study support general expectations, coming from previous research, the differences among the athletes in

three different racket sports are found only in morphological variables. Of course, incomplete data for all variables and relatively small amount of data about badminton and (especially) squash players should be the main reasons for obtaining such results. However, motor, morphological, technical, tactical, psychological and functional requirements of certain racquet sports are quite different [15]. The results lead to clear conclusions that the most distinctive characteristics, which can be a base for the decision about choosing the sport in which the athletes will engage in, are their morphological features. All these three sports show distinctive body shapes, adjusted to the demands of certain type of sports. Instead the fact that badminton, and especially squash, have more requests in terms of aerobic functional capacities, these differences are not found in our sample(s). Consistent differences are found in body height (and consequently sometimes in positively linked body mass), which is more desirable in badminton, as compared with table tennis. However, the highest values of means in height and body mass are found in squash players across the age groups. One reasonable explanation could lead us to a hypothesis that squash players are mostly recreational, who want to reduce their body mass. The advantage of this research is studying the representative samples of athletes, in fact all athletes, which were included in routine medical examinations, in two consecutive years (2011 and 2012) in the Clinic for Sports and Occupational Medicine of the Zagreb Sports Association. Thus, the possibility of generalization of these findings is good, but the main shortcomings arise from the fact that subsamples of athletes are quite small-sized (when stratified by gender and age groups), and especially for squash and badminton. Moreover, the data about competitive levels [18-20], play styles [17], specific psychological profiles, or other relevant variables, were not collected. Important shortcoming arise from the feature of routine medical examinations, which are really "routine", very often superficial, without collecting all data for all the variables for each athlete. Particularly, the data about haemoglobin, thrombocyte and speed of sedimentation are particularly deficient. In future research, the main directions are collecting more data in general, the data about competitive levels, play styles, specific psychological profiles, and/or obtaining more precise data from medical and anthropometric examinations. Practical implications are mainly diagnostically, but also selection-directed.

Namely, researchers could identify the individuals who are disturbing from "ideal" profiles in morphological variables, but also in their functional capacities and health status. This information could be used in better defining training process, as well as for preventive purposes.

Table 2. Descriptive statistics for the data provided by routine medical examinations for male and female table tennis players, according to their age group

Table tennis												
Age group	7-13		13-15		15-17		17-30		>30			
	M	F	M	F	M	F	M	F	M	F		
height (cm)	**144.33±10.9**	151.48±9.35	164.89±8.96	159.37±3.09	177.56±10.50	167.95±4.96	174.18±10.57	167.64±4.09	179.43±6.78	**159.10±6.88**		
body mass (kg)	**38.85±10.80**	43.90±9.54	56.08±15.55	51.62±7.58	65.65±9.79	64.31±4.83	67.14±9.81	**60.85±6.55**	91.37±16.54	**60.80±9.50**		
blood pressure diastolic (mm Hg)	62.34±7.22	65.00±7.96	66.19±8.81	59.00±0.00	66.53±8.79	63.16±10.98	71.69±8.16	67.71±8.38	76.66±10.40	80.25±9.32		
blood pressure systolic (mm Hg)	99.11±11.02	101.66±8.72	107.76±12.18	93.00±0.00	114.53±16.43	102.16±10.79	116.42±11.39	106.07±12.52	125.00±5.00	129.75±12.31		
heart rate (beats/ min)	80.50±13.29	81.35±18.99	74.78±13.60	73.66±20.50	71.00±16.49	78.18±15.25	69.03±13.67	65.92±9.85	60.12±6.77	63.00±19.46		
vital capacity of the lungs (ml)	-	-	3.30±0.55	-	3.54±0.00	4.46±0.53	12.34±19.28	3.00±0.00	-	-		
hemoglobin (g/L)	97.75±65.45	129.40±7.09	**140.33±9.50**	129.00±0.00	147.33±7.43	-	136.28±40.41	114.66±43.71	104.50±69.76	133.00±0.00		
thrombocytes (µL)	215.75±151.86	271.80±68.19	220.66±81.56	354.00±0.00	213.00±29.84	-	195.92±70.13	213.88±93.70	165.00±114.81	256.00±0.00		
sedimentation rate (mm/h)	7.25±5.43	9.40±4.56	5.25±3.10	5.00±0.00	2.87±1.64	-	3.66±2.20	7.11±5.62	7.00±5.29	10.00±0.00		
BMI (kg/m^2)	**18.40±3.38**	18.95±2.73	20.45±4.17	20.28±2.67	20.74±1.89	22.78±1.01	22.16±2.88	21.70±2.64	28.34±4.84	24.08±3.76		

Legend: Bold= values of means, where statistical significant differences are found at p<0.05; M=males; F=females.

Table 3. Descriptive statistics for the data provided by routine medical examinations for male and female squash players, according to their age group

Squash											
Age group	7-13		13-15		15-17		17-30		>30	
	M	F	M	F	M	F	M	F	M	F
height (cm)	**150.39±8.64**	148.59±10.86	168.46±7.67	165.33±6.34	179.23±5.53	169.97±5.85	176.17±6.45	171.73±6.86	-	**169.75±4.31**
body mass (kg)	**44.51±10.01**	40.09±9.91	57.50±8.83	58.28±10.11	68.34±5.90	64.50±4.02	70.06±7.27	**68.21±5.01**	-	**70.45±7.27**
blood pressure diastolic (mm Hg)	63.37±6.69	64.75±10.57	67.45±7.54	68.41±7.56	70.71±6.72	69.83±3.18	68.83±6.54	71.75±4.71	-	77.62±12.22
blood pressure systolic (mm Hg)	100.45±9.47	101.68±12.57	107.90±10.33	111.47±9.46	115.85±12.25	116.14±10.13	116.66±9.67	110.87±8.18	-	117.50±18.94
heart rate (beats/ min)	77.05±14.94	83.27±11.54	74.57±10.09	72.54±13.40	72.25±9.60	70.64±13.43	63.65±9.30	66.52±9.83	-	67.50±14.24
vital capacity of the lungs (ml)	-	-	-	3.75±0.34	5.29±0.75	4.21±0.16	5.12±0.52	3.26±0.00	-	
hemoglobin (g/L)	109.33±53.61	131.75±5.43	**137.00±3.36**	134.08±7.50	96.66±83.73	103.80±58.55	109.75±68.18	130.00±9.94	-	131.33±5.03
thrombocytes (µL)	206.85±106.49	281.25±36.86	283.75±54.08	253.08±65.91	144.00±124.80	193.20±113.71	174.00±113.31	254.00±56.98	-	241.66±24.00
sedimentation rate (mm/h)	6.11±4.35	6.00±2.94	4.5±1.00	6.33±3.33	1.33±1.15	5.20±3.42	3.12±2.94	7.00±3.80	-	11.33±7.50
BMI (kg/m^2)	**19.49±3.04**	17.90±2.21	20.20±2.53	21.25±3.16	21.29±1.86	22.36±1.65	22.55±1.80	23.25±2.68	-	24.42±2.01

Legend: Bold= values of means, where statistical significant differences are found at p<0.05; M=males; F=females.

Table 4. Descriptive statistics for the data provided by routine medical examinations for male and female badminton players, according to their age group

Badminton												
Age group	7-13		13-15		15-17		17-30		>30	
	M	F	M	F	M	F	M	F	M	F
height (cm)	**152.05±4.15**	-	164.60±5.62	165.50±0.70	181.91±5.60	165.75±1.06	183.00±7.07	166.00±0.00	179.82±6.88	-
body mass (kg)	**47.00±6.24**	-	55.15±5.78	54.50±9.19	67.25±11.05	63.75±3.18	70.00±1.41	65.00±0.00	83.37±11.24	-
blood pressure diastolic (mm Hg)	61.33±3.72	-	69.50±5.80	66.50±16.26	70.50±2.12	70.00±0.00	61.00±0.00	0.00±0.00	79.94±10.12	-
blood pressure systolic (mm Hg)	98.50±5.31	-	104.50±8.22	95.50±7.77	101.00±11.31	110.00±0.00	106.00±0.00	0.00±0.000	130.00±12.86	-
heart rate (beats/ min)	82.66±10.51	-	80.40±20.39	66.00±4.24	80.16±17.18	78.50±2.12	61.50±4.94	74.00±0.00	64.91±11.08	-
vital capacity of the lungs (ml)	-	-	3.59±0.01	2.06±0.00	4.90±0.21	4.12±0.00	5.81±0.00	3.7±0.00	-	-
hemoglobin (g/L)	128.00±8.88	-	**129.66±5.68**	117.50±2.12	133.00±0.00	121.00±0.00	148.50±7.77	121.00±0.00	142.71±6.56	-
thrombocytes (µL)	274.33±46.49	-	255.16±47.78	252.00±49.49	240.00±0.00	315.00±0.00	325.50±13.43	401.00±0.00	221.85±47.77	-
sedimentation rate (mm/h)	7.00±2.00	-	6.00±2.68	11.50±0.70	4.00±0.00	7.00±0.00	5.00±0.00	15.00±0.00	6.35±3.87	-
BMI (kg/m^2)	**20.37±3.00**	-	20.35±1.86	19.91±3.52	20.24±2.45	23.19±0.86	20.93±1.19	23.58±0.00	25.74±2.75	-

Legend: Bold= values of means, where statistical significant differences are found at p<0.05; M=males; F=females.

Table 5. Results of the K-means cluster analysis for the badminton, squash and table tennis players, using chosen morphological and medical variables

Males - Age group 17-30			Females - Age group 17-30		
Variables	1	2	variables	1	2
height (cm)	**179.83**	173.97	Height	**169.46**	168.55
body mass (kg)	**82.92**	65.75	body mass (kg)	**67.42**	58.00
BMI (kg/m^2)	**25.68**	21.77	BMI (kg/m^2)	**23.60**	20.47
heart rate (beats/ min)	65.83	**67.72**	heart rate (beats/ min)	**68.17**	67.00
blood pressure diastolic (mm Hg)	**134.17**	113.98	blood pressure diastolic (mm Hg)	**115.42**	98.70
blood pressure systolic (mm Hg)	**72.83**	70.20	blood pressure systolic (mm Hg)	**71.92**	65.90
difference between b. pressures (mm Hg)	**61.33**	43.78	difference between b. pressures (mm Hg)	**43.50**	32.80
No. of cases in cluster	6	46	No. of cases in cluster	12	10
Badminton	0	1	Badminton	0	0
Squash	3	15	Squash	6	2
Table tennis	3	30	Table tennis	6	8

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Analysis about Table Tennis Extracurricular Activities in Ordinary Universities in Beijing

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Abstract: Table tennis, as the national game, enjoys a widespread mass base in China, especially when the Chinese government is paying more and more attention to physical education. However, the current situation is not so optimistic in ordinary universities in Beijing. Although table tennis has been listed in extracurricular activities or elective courses, the effects are not as good as we expected. In order to further learn about the situation, I have done a lot of surveys about the motivation of students to choose table tennis, how often they play table tennis, what table tennis activities they participate in, and their opinions about universities opening table tennis as extracurricular activities. According to the results of the survey, I have analysed the current situation and the causes behind that. Some students may have an interest in table tennis, but they cannot learn it well, because table tennis requires elaborate skills and hard training, which is exactly what students are short of. In addition, students seem to have more and more academic pressure and social activities these days, so they cannot devote more time to one sport like table tennis. On the other hand, teacher force is not strong enough and universities don't have efficient management for table tennis teaching. In this paper, I also try to put forward some solutions to the problem based on the survey. More interesting games and competitions should be actively organized to arouse the students' interest in participation in the sport, as well as enhance the awareness of physical exercise. Schools should enrich the forms of extracurricular activities, and increase the number of activities to establish a better platform for students. I hope that this paper can be a reference for table tennis teaching in ordinary universities.

Keywords: ordinary universities, table tennis extracurricular activities, Beijing

1. INTRODUCTION

Table Tennis has been a universally popular sport with a long history. Table tennis has developed into a sport with rich content, superb skills, fierce confrontation and full of wisdom and passion[5]. China is well known to be very strong in this sport on the international competition stage. As we all know, China's table tennis athletes have superb technique and fiery passion. They repeatedly win countless international competitions. We can say that their sport techniques are better than other countries. Additionally, table tennis is also very popular among the Chinese people. The competitiveness and fascination of the sport attract people of all ages. The progress of social civilization and the changes to modern lifestyle has transformed the meaning of table tennis to a new level. It slowly becomes part of

China's society and culture[4]. Yet students' participation in table tennis is not high in universities. The participation of young students is vital in promoting China's future sports development. Active promotion of table tennis helps stimulate the growth of China's table tennis and sports in universities. The development of the sport cannot only rely on classroom teaching, so we should increase after school training activities, hold more competitions and implement the extension of classroom teaching[2]. Through the investigation and study of the current situation of table tennis as extracurricular activities in 9 colleges and universities in Beijing, this study aims to explore the existing problems and causes, and accordingly put forward relevant suggestions and expectations of the China's table tennis in universities.

2. RESEARCH OBJECTS AND METHODS

2.1 Research Objects

The current situation of table tennis as an extracurricular activity in Beijing.

2.2 Research Methods

2.2.1 Literature

Using "Table tennis extracurricular activities" and "University" as key words, I researched through the CNKI, Renmin University library and others. I mainly focused on research regarding the integration method of table tennis clubs in and out of class, China's physical education reform and development, and development of students' fitness in table tennis activities. I consulted more than 30 articles and 10 books about the current situation of table tennis in Universities in order to lay a solid theoretical basis for this study.

2.2.2 Questionnaire Survey

From the 82 Universities in Beijing that offered the table tennis elective course, a total of 9 universities were chosen at random in order to survey and analyse the data of table tennis extracurricular activities. The universities surveyed included: Tsinghua University, Peking University, China University of Political Science and Law, Renmin University of China, China Agricultural University, Beijing University of Posts and Telecommunications, Beijing Jiaotong University, Beijing Institute of Technology and Beijing University of Technology. In the course of the investigation, a total of 585 student questionnaires were issued and 550 were returned. The questionnaire recovery rate was 94%. Within those received, 532 were valid questionnaires, meaning 97% of questionnaires received were valid and effective. 27 questionnaires were issued to teachers and 25 of them were returned. The recovery rate for these were 93%. Within these, only 92% (23 questionnaires) were valid. 9 questionnaires were issued to experts and 9 were returned. Additionally, all 9 of the questionnaires were valid. The reliability and validity of the questionnaire meet the requirements of the investigation method and the research needs.

2.2.3 Mathematical Statistics Methods

The survey data was arranged and processed using Microsoft Excel and the Spss13.0 statistical software in order to generate related results and charts.

2.2.4 Logic Analysis Method

The paper uses before synthesis, summing up, generalization and arrangement of the literature and questionnaire results in order to have a better grasp on the basic situation of table tennis in universities.

3. RESULTS AND ANALYSIS

3.1 Investigation and Analysis of the reasons why students chose table tennis as an extracurricular activity

An analysis of students' motivation to participate in table tennis elective course shows that the majority of students chose the course due to the interest in the sport (shown in Table 1). 419 students chose this reason, accounting for 78.60% of the total number. This shows that the interests of students are an important factor for students who chose this course. 58 students, accounting for 10.9%, chose "following others" as their main reason. 6.40% of the total (34 students) took this course mainly to get credits. 22 students (4.10%) had other reasons for choosing this course. From the reasons students gave, it can be seen that the sport itself attracts a majority of students. Universities should make use of this to stimulate students' motivation to join in the sport. As for students who haven't shown an interest in table tennis, universities may as well emphasize the credits, which students value most. Furthermore, universities can optimize table tennis course by organizing various activities, such as quiz show, fun games, competitions, and so on. In this way, those who chose the course due to other reasons might gradually fall in love with table tennis.

Table 1. Investigation of students' reasons to choose table tennis course in universities

	To gain credits	Interested in the sport	Following others	Other
Amount	34	419	58	22
%	6.4	78.6	10.9	4.10

3.2 Investigation and Analysis of the students' situation in participating in table tennis in their spare time (shown in Table 2)

Results show that a total of 178 students (33.5%) don't touch table tennis in their spare time. 42.5% say they have participated once while 15% twice. 48 students (9%) have participated 3 times or more. If we add up students who don't play and those who play only once, the percentage will reach up to 76%. This shows that the participation rate of table tennis is relatively low among the students in universities in Beijing. The low proportion of students who do table tennis activities in their

spare time is mainly due to the heavy academic burden and busy social practices for extracurricular activities. Some universities also attach little importance to this course, thus lacking organized competitions and various activities. Additionally, only 24% of students participate in table tennis activities twice or more in their spare time. The ratio is relatively low. However, this varies from university to university, for example, a total of 52.5% and 38.3% of students participate in table tennis activities twice or more in Beijing Institute of Technology and Jiaotong University respectively. Their proportions are far higher compared to other universities. This difference comes from relative importance and policies, sport atmosphere and culture, teachers and equipment between universities. This reflects that table tennis can be appealing and vigorous among university students. In a word, universities have the responsibility and capacity to develop table tennis to a new stage as long as they have a positive attitude and take effective measures.

Table 2. Weekly participation of students for table tennis activities in their free time

	0		once		twice		3 times and more	
	Amount	%	Amount	%	Amount	%	Amount	%
Peking University	13	23.20	26	46.4	11	19.60	6	10.70
Beijing University of Technology	29	64.40	11	24.4	2	4.40	3	6.70
Beijing Institute of Technology	5	8.20	24	39.3	18	29.50	14	23.00
Beijing University of Posts and Telecommunications	38	61.30	21	33.9	2	3.20	1	1.60
Jiaotong University	8	13.30	29	48.3	12	20.00	11	18.30
Tsinghua University	27	40.90	32	48.5	3	4.50	4	6.10
China Agricultural University	20	36.40	27	49.1	7	12.70	1	1.80
Renmin University	17	25.00	32	47.1	12	17.60	7	10.30
China University of Political Science and Law	21	35.60	24	40.7	13	22.00	1	1.70
Total	178	33.50	226	42.5	80	15.00	48	9.00

3.3 Investigation and analysis of the current situation of table tennis activities in universities

I. According to the survey, the main forms of table tennis extracurricular activities are table tennis clubs (17.50%), organized competitions (14.30%) and activities organized by some associations or students themselves (1.6%). This is shown in Table 3. From this point, there are a variety of forms for table tennis activities outside the class. Compared with table tennis activities performed in class or during team training, 33.40% of table tennis activities take place outside the class. That is to say, table tennis extracurricular activities only take up a third of all table tennis activities. Students do not accept guidance or education on the sport actively, and it is hard to promote the idea of "lifelong sports"[3]. In order to achieve "lifelong sports", one must have extensive time, diversity of content, organization autonomy and characteristics lasting for life[1]. Table 3 shows that the number of university organizing events outside the class is relatively small. There is no effective combination of table tennis activities between inside and outside the class. Thus

students are unable to put what they learn in practice, which may affect students' persistence and participation in the sport. The reason for this might be due to the difference in the universities' policies, promotion and atmosphere of the sport.

Table 3. Analysis of forms of table tennis activities in universities in Beijing

	Amount	%
Compulsory Course	12	19.00
Optional Course	20	31.70
University Team Training	10	15.90
Table Tennis Club	11	17.50
Table Tennis Competition	9	14.30
Others (Associations etc.)	1	1.60

II. According to the results obtained from the survey, 5 universities organize competitions once a year. 3 universities organize competitions twice a year while only Beijing Institute of Technology organizes competitions three times a year. This is shown in Table 4. From the investigation about students' participation in table tennis activities each week, we can see that the number of organized competitions directly affects students' degree of concern to the sport. It also directly impacts the popularity and development of table tennis activities in universities. In light of this situation, competitions not only improve students' table tennis skills, but also motivates students to participate in extracurricular training, and creates a sporting atmosphere on campus. Competition can popularize table tennis in universities as well as help to motivate students to play table tennis.

Table 4. Number of competitions organized by universities annually

University	Organized competitions (per year)
Peking University	1
Beijing University of Technology	2
Jiaotong University	1
Beijing Institute of Technology	3
Beijing University of Posts and Telecommunications	1
Tsinghua University	2
China Agricultural University	1
Renmin University	2
China University of Political Science and Law	1

III. According to the survey results regarding students' opinions on whether table tennis events should be organized in and out of class (shown in Table 5), 75.60% of students believe universities should organize competitions. 24.10% believe it doesn't matter while 0.30% believe universities shouldn't organize table tennis competitions. Thus, it can be seen that most students are eager to participate in or watch competitions. This reflects that, to a certain extent, students hope to increase the

number of competitions. It also shows that students have a positive attitude regarding participating in table tennis extracurricular activities.

Table 5. Analysis on whether students believe universities should organize table tennis competitions

	Yes		Does not Matter		No	
	Amount	%	Amount	%	Amount	%
Peking University	37	66.10	19	33.90	0	0
Beijing University of Technology	32	71.10	13	28.90	0	0
Beijing Institute of Technology	41	67.20	20	32.80	0	0
Beijing University of Posts and Telecommunications	48	77.40	13	21.00	1	1.60
Jiaotong University	43	70.50	17	27.90	1	1.60
Tsinghua University	53	80.30	13	19.70	0	0
China Agricultural University	45	83.30	9	16.70	0	0
Renmin University	55	80.90	13	19.10	0	0
China University of Political Science and Law	48	81.40	11	18.60	0	0
Total	402	75.60	128	24.10	2	0.30

IV. According to the results from the teacher questionnaires (shown in Table 6), 67% of teachers believe the current development situation of their university for the table tennis course is average. 24% believe the development situation of the university's table tennis course is good. Only 9% of teachers are very satisfied with their university's development situation for the course. This is greatly related to different policies and managements of universities. If universities don't have supporting policies, don't attach importance to this course, lack funding, lack the effective plans and schemes, they will not be able to form a good sporting atmosphere for table tennis course. In the surroundings, students' interest in table tennis will be greatly weakened. Consequently, table tennis will be very hard to blossom in these universities.

Table 6. Teacher's evaluation of table tennis activities in universities

	Very Good	Good	Average	Total
Amount	2	6	15	23
%	9	24	67	100

4. CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

I. College students have high interest in table tennis, but due to academic pressure, social activities and other reasons, students do not have enough time to participate in table tennis extracurricular activities. As a result,

university students don't play table tennis so often in their daily life, resulting in the low participation of the sport.

II. Most of the students hold a positive attitude to table tennis competitions. However, there are not so many competitions for them to join in, which is bad for the popularity of table tennis among university students. More students should be encouraged to do the sport, and more competitions should be held. Unfortunately, nowadays there is lack of thorough guidance and systematic arrangement in terms of table tennis course. Universities should pay attention to that if they want to spread the sport.

III. Although there are many organizations of table tennis outside the universities, universities don't set up table tennis organizations or clubs. Consequently, organizations for table tennis as an extracurricular activity are relatively low. This is one of the main reasons for the undesirable situation of table tennis in universities. Universities should support more table tennis to be established so as to create more opportunities for students.

IV. The overall development situation of table tennis activities in universities is not very ideal, nor is the implementation of table tennis extracurricular activities. There are many reasons in school and social levels, including lack of supporting policies and effective management. Universities should try to get more financial support for the project of table tennis, and at the same time provide qualified teachers and equipment.

4.2 Recommendations

I. Universities should further stimulate and maintain students' interest while motivating students to practice more. In order to increase the awareness of table tennis activities, universities should have a unified plan, strengthen the development of teaching staff, mobilize the departments at all levels to increase the investment in sporting facilities, make sport venues more open to the public and encourage the promotion of providing convenient and secure facilities[6].

II. Universities should see competitions as a breakthrough point. Increasing the number of competitions can lead to the development of table tennis extracurricular activities. Meanwhile, universities should also pay attention to the setup of the competitions. Competitions should be arranged in accordance with the students' level and interest in the game. This is aimed to encourage more students to participate. For example, teachers can encourage students to join the university team if they have a certain level of skill in the sport and thus organize more team competitions. However, for students who are interested in the sport but lack the skill, teachers can encourage them to communicate with the members of the university team. Competitions can even be organized between students and the university team members. In this way students can improve quickly through the exchange. Additionally, teachers can try to get more students to join in table tennis by organizing fun games.

III. Table tennis extracurricular activities can not only help students build up their bodies and enrich their school life, but also provide a new platform for them to show themselves and make friends. According to "Sunshine Sports", universities are required to introduce more forms of extracurricular activities and set up more platforms in order to attract participation from students with different levels. For example, more table tennis clubs should be established, and table tennis competitions should be added in school sports meets. Universities can organize competitions for their students and encourage them to watch high level matches. There will always a way out, so as long as we work hard based on the real situation, the table tennis extracurricular activities will for sure have a bright future in universities.

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Analysis of the characteristics of competitive Padel

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Abstract: The aim of this study was to determine and compare temporal and notational structures during competition in both, female and male elite padel players. A total of 30 players (14 male and 16 female) participated in the study. 15 simulated padel matches (8 women's and 7 men's) were recorded and saved in a hard disk for posterior analysis. Temporal structure and game actions (i.e. match duration, real time played, rally time, rest times and number of rally shots) were analysed. Significant differences (p<0.05) were found in different temporal game actions (real time played, rally time and rest times). Temporal and game structure showed significant differences (p<0.05) between female and male elite padel players.

Keywords: padel, temporal structure, rallies, shots, gender

1. INTRODUCTION

In recent years, racket sports have been widely investigated especially in terms of internal performance variables (e.g. hormonal response and lactate levels) and external performance variables (e.g. temporal structure and distances during competition). These variables allow coaches and physiologist to define specific profiles to enhance player's performance.

External variables like temporal structure have been recently investigated in many racket sports such as badminton, squash, tennis or table tennis (Cabello & González, 2003; Faude et al., 2007; Fernández et al., 2007; Fernández et al., 2006; Girard et al., 2007; Hornery et al., 2007; O'Donoghue & Liddle, 1998; Pradas et al., 2014). Executed techniques (Cabello & González, 2003; Faude et al., 2007; Fernández et al., 2007). The number of strokes during competition (Fernández et al., 2007; Hornery et al., 2007), the number and type of movements (Fernández, et al., 2007; Hornery et al., 2007), or the covered distance (Fernández et al., 2006; Hornery et al., 2007; Pradas et al., 2013; Vučković et al., 2004) have been also investigated.

However, scientific literature about padel temporal structure is limited (Castellar et al., 2014; Olmos, 2013; Pradas et al., 2014; Ramón, 2012; Sánchez, 2014). These papers offer an approximation to game parameters in padel. However, sample size and players level usually appear as a limiting factor.

The aim of this study was to determine and compare the temporal and notational structures of padel during competition evaluating both female (FEPP) and male elite

padel players (MEPP).

2. MATERIAL AND METHODS

Thirty padel players, 14 males (age: 28±8.1) and 16 females (age: 29.8±3.7) participated in the study. General subjects data are summarized in Table 1.

Subjects were informed about the nature of the study providing written informed consent for their participation.

Table 1. Subjects general mean (±SD) data.

	Men	Women
Age (years)	28±8.1	29.82±3.7
Weight (kg)	78.2±8.5	60.4±4.5
Height (cm)	178.3±4.5	166.7±5.2
BMI (kg/m^2)	24.6±2.0	21.7±1.2

In order to analyse the physiologic response during competition, simulated competitions (SC) were developed. SC were performed in an outdoor padel field with 43±4.2% humidity and 22.5±.8º C. SC were using the official rules applied in Pro Tour performed competitions (i.e. 3 sets with tie break). Before SC a 15min warm-up was performed (5min general exercises and 10min specific padel exercises).

SC were recorded using video cameras (Sony HDR-XR350, Japan) positioned 4m over the field through telescopic devices (Manfrotto, Italy) (Fig. 1).

Fig. 1. Video recording set-up during simulated competition

Each camera was set 6m far from the field and parallel to the field bottom line. All SC were recorded in a hard disc for posterior analysis. An ad-hoc software tool was developed to analyse technical and temporal variables (Fig. 2).

Fig. 2. Tool developed for technical and temporal analysis

Two trained observers analysed SC using the software Match Vision Studio© v 3.0 (Castellano, Perea & Alday, 2005) and following an observational protocol previously established. All data were recorded in an Excel sheet for further analysis. Statistical analysis was conducted using SPSS software version 20 (SPSS Inc., Chicago, IL, USA).

If the tested variables were normally distributed (K–S normality test) a T-Student was performed, if not, a Mann-Whitney U-test was used. Differences were considered statistically significant when $p < 0.05$ before the Bonferroni correction.

3. RESULTS

The temporal variables analysed are summarized in Table 1.

Table 2. Temporal variables

Total game time	TT
Real game time	TR
Total time off	TP
Off time between rallies	TPT
Total off time between rest periods	TPJ
Workout density (TR-TP relationship)	DT

Values recorded for EMPP and EFPP are shown in Figure 3 and Table 3. We highlighted 41% of game time and a 51% off time in EMPP. A 45% game time and 55% off time was recorded for by EFPP.

Rally frequency for EFPP and EMPP are depicted in Figure 4 and 5 respectively.

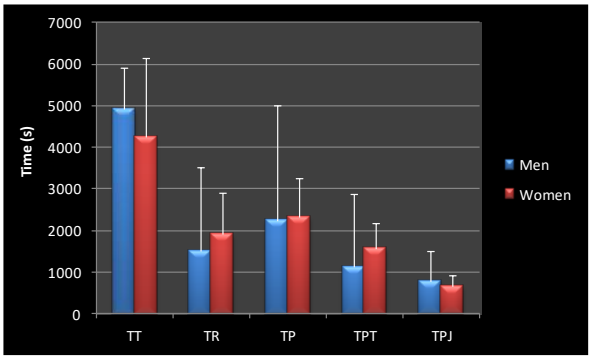

Fig.3. Temporal game structure

Table 3. Game Temporal structure

Temporal structure (s)	Men	Women
TT	4760±1074.7	4243.2±1894.2
TR	1934.2±519.08	1859.1±977.3
TP	2825.7±647.03	2329.1±915.6
TPT	1724.5±507.5	1550.3±631.5
TPJ	771.7±190.2	654.04±270,5
Rally TR	11.7±16.6	13.03±14.5
TP between rallies	9.8±5.57	11.04±9.17

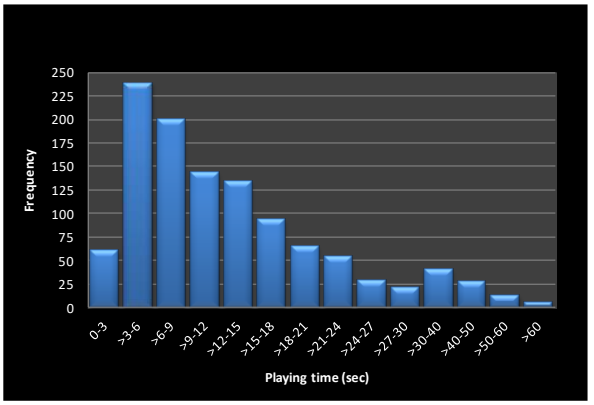

Fig. 4. Elite female padel players rally time durations

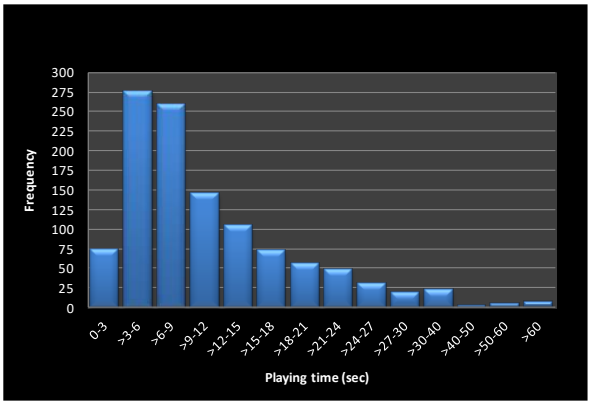

Fig. 5. Elite male padel players rally durations

Rally durations ranged between >3 and >6 sec for both men and women. Mean rallies duration was 11.7±16.6 sec for EMPP and 13.2±14.9 sec for EFPP. During rallies, off time periods density was 0.8 for both men and women.

The game techniques recorded during SC are reported in Table 4.

Table 4. Number of strokes for each technique

Strokes	Men	Women
Total	1247.28±367.82	1308.5±731.12
Total without service	1042.28±322.36	1156.5±680.09
Total forehand side	634.28±200.43	694.75±440.46
Total backhand side	406.86±112.72	452.38±235.2
Forehand	174.43±39.8	188.38±99.38
Backhand	170.29±28.11	143.5±63.97
Volley	300.14±150.88	260±117.72
Lob	194.71±75.64	304.13±205.38
Smash 'bandeja'	119.43±51.29	123.88±105.12
Smash	113.57±45.77	124±66.34
Drop shot	2.14±1.55	1.25±1.39
Other	0.86±1.73	0.13±0.33

Shot technique percentages are shown in Figure 6 and 7. Forehand service is the most used by all participants, independently from the gender.

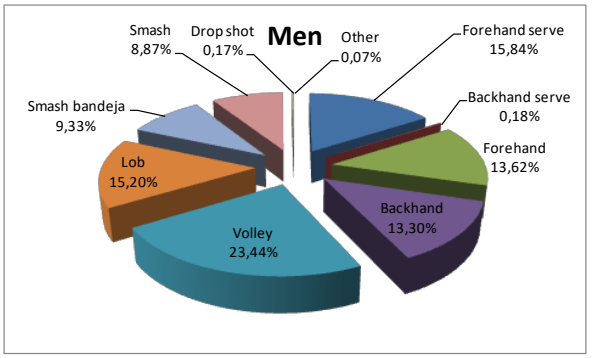

Fig. 6. Techniques used by elite men padel players

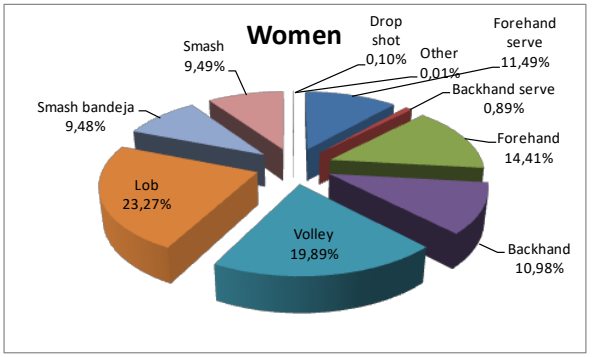

Fig. 7. Techniques used by elite female padel players

EMPP played more rallies (205±49.75) than EFPP (163.63±44.23), however no significant differences were found. EFPP recorded a higher number of strokes per rally (p<0.001), per game (p<0.001) and per set (p<0.04).

4. DISCUSSION

The knowledge of temporal parameters during padel competition may be useful to understand performance and technical needs (O'Donoghue, & Liddle, 1998). Rally duration may be a useful recovery-fatigue indicator during competition in padel. Other authors used the same approach in other racket sports (Cabello et al., 2004).

Mean duration of rallies are higher than those obtained in table tennis (Pradas et al., 2012), badminton (Cabello & González, 2003) squash (Salmoni et al., 1991) and tennis (Fernández et al., 2007) both for men and women.

Stroke preference techniques are relevant in padel as well as in table tennis showed similar values in terms of techniques preferences (forehand vs backhand) (Pradas, et al., 2015). The total number of shots performed per rally, set and match is higher than those recorded in other racket sports such as badminton (Cabello & González, 2003; Faude et al., 2007), tennis (Fernández et al., 2006), table tennis (Pradas et al., 2013) and squash (Montpetit, 1990).

5. CONCLUSIONS

Padel temporal structure is characterized by short and intense rally durations. Game time prevails over off time.

EMPP performed short and faster rallies than EFPP. EFPP performed slower rallies and a higher number of strokes per rally.

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An Analysis of U.S. Table Tennis Clubs

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Abstract: As the primary instrument promoting table tennis in the United States, the club system is largely responsible for the future of the sport. Currently there are 264 clubs registered with USA Table Tennis (USATT). However, the scarce and scattered nature of club data hinders our ability to understand the current state of U.S. table tennis clubs. With the strong support of the USATT, we conducted a comprehensive club survey covering business, facility, and other details in order to understand how current clubs operate and make meaningful observations from the data. Based on the 63 complete survey responses we've received so far, the average club is a 20-year-old non-profit entity that gets its revenue primarily from tournament hosting, walk-in players, and membership fees. This average club operates a mean of 20 hours per week with a median of only 8 hours. This limited schedule hinders access to the sport for the general public. Also, formal coaching and youth programs are only available at 51% and 38% of clubs, respectively, with other programs having similarly low adoption rates. The lack of these programs limits club promotion and shows a lack of investment in the future of the sport. The data showed a dramatic distinction in many club metrics depending on factors such as the presence of employees. For example, clubs with employees operate an average of 42 hours per week and 93% offer formal coaching and junior programs. Purely volunteer-run clubs operate only 14 hours per week, 37% offer formal coaching, and 21% offer junior programs. The lack of professional staff to promote and manage club business limits the revenue-generating activities clubs can provide. This analysis revealed hidden meaning in the data and improved our understanding of U.S. table tennis clubs.

Keywords: United States, table tennis club, club management, survey

1. INTRODUCTION

1.1 Table Tennis in the United States

According to First Coach News (2014), "table tennis as one of the twelve sports that US hasn't had an Olympic medal and do not have a strong local following or commercial interest". In the Board of Directors Meeting Minutes of USATT (2014a), USATT received very limited funding from United States Olympic Committee (USOC) in 2013. Unlike other popular international sports, table tennis in the United States is both nowhere and everywhere at once. In the article written by Morais, B. (2012), he stated "Table tennis may be the only Olympic sport that's played concurrently in frat parties and nursing homes. That it is a sport at all, and an event fit for the Olympics, comes as some surprise to those of us who grew up knowing the game as ping-pong." His popular image of the sport as a casual game makes a serious treatment of

the sport an uphill battle. Comparing the other popular sports, table tennis is not in the official sport list on school system. National Federation of State High School Associations (NFHS) and National Collegiate Athletic Association (NCAA), the governing bodies of most American high school and college sporting activities, omit table tennis entirely. Collegiate Table Tennis does have the National College Table Tennis Association (NCTTA) but the funding and public exposure pales in comparison to other sports. Also, there is not TV broadcasting about table tennis tournament for people to watch. Few community centers provide table tennis tables and big fitness centers such as the YMCA and Lifetime Fitness skip over table tennis in most or all of their locations.

1.2 Table Tennis Clubs in the United States

Given the limited ways the average American can be exposed to table tennis, the USATT club system carries the foremost responsibility for the sport. Unlike other countries where there's a professional sport schools, table tennis clubs in the US is the only place to train and produce professional table tennis athletes. According to the Board of Directors Meeting Minutes of USATT (2014b), "The CEO stated that there was a 2.7% increase in membership in 2014 (i.e., 231 members) as compared to last year. The greatest increase was in the junior category. There were 264 clubs registered this year, a decrease of 30 clubs". Around 10% of clubs are closed or not registered with USATT, and it means public has less resources to play table tennis. While this change presents a mixed message, US table tennis clubs are still the primary means by which the sport is promoted to the rest of the country. Instead, table tennis clubs form the backbone of American table tennis promotion and are largely responsible for the future of the sport. Moreover, table tennis clubs are the main place for the general public and amateur players to access the sport.

1.3 No Study and Comprehensive Data of Table Tennis Clubs

Our research found no existing study about table tennis clubs in United States. Club data from the USATT website only includes name, address, website, operation hours and contact. There is no way to know the operating situation of clubs, so it is difficult to gain insight into the overall situation and challenges they face. The data our research collected and subsequent analysis revealed hidden details and improved our understanding of U.S. table tennis clubs.

2. METHODS

2.1 Design

An online questionnaire was designed for this study with the goal of collecting information about the operational situation of as many US table tennis clubs as possible. The questionnaire was distributed via USATT emails, Butterfly Equipment Dealer emails, and personal contacts of the participants. The survey questions covered basic business attributes, growth data, employment/volunteer details, facility attributes, club services, and club revenue sources.

2.2 Respondents

Ultimately, 63 clubs completed the survey, including 16 for-profit clubs, 34 non-profit clubs and 13 informal clubs. This included the 264 USATT-affiliated clubs as well as any others willing to participate. Almost all surveys were completed in December of 2014 but results continued to come in sporadically until February 12th, 2015.

2.3 Data Analysis

To evaluate the data for relevant table tennis club operation insights, respondents' survey data was organized both by general business type and whether the club had employees or not. Once separated, the various measured attributes were shown using simple totals, percentages, and averages where appropriate.

3. RESUTLS AND DISCUSSION

3.1 Analysis of Table Tennis Clubs as Businesses

Non-profits were the most common type and also had been operating the longest on average. The for-profit clubs and the clubs with employees were the two youngest groups on average.

As shown in Table 1, basic club business attributes were very different among the subgroups. Since only 25.40% of clubs are for-profit, one interpretation is that table tennis is not an attractive business in the United States. Alternatively, the market may exist but it could be that not enough people know how or care to run an effective table tennis business. The survey data provided evidence of both of these viewpoints.

The clubs with employees were the only group that always had its own website. "Small businesses believe websites make their business look more credible and are critical for success" (*Perspectives from Global Small Business*, 2013, p.3). The fact that some clubs did not have websites can be interpreted as a sign that they do not have the resources or motivation to run their operations as effectively as possible.

While table tennis is not a popular sport in the United States, many clubs appear to be able to maintain their existence over the long term. Almost 70% of clubs have been running over 5 years, and the average age is about 20 years. There is no data on the failure rate of table tennis clubs but the average longevity of current clubs shows that table tennis can find a dedicated following in a variety of areas. On the other hand, the average age of for-profit clubs is around 11 years, which is much younger than the other two club types. This could mean that for-profit businesses fail more frequently but it can also mean tennis clubs have become a more profitable business in the last decade.

Table 1. Basic Attributes by Business Type

Attribute	Overall	For-Profit	Non-profit	Informal	With Employees	No Employees
Clubs Per Business Type	63	16	34	13	15	48
Business Types Percentage	100.00%	25.40%	53.97%	20.63%	23.81%	76.19%
Percentage with Website	80.95%	81.25%	82.35%	76.92%	100.00%	75.00%
Percent of Clubs Older than 5 Years (<2010)	69.84%	43.75%	79.41%	76.92%	53.33%	53.33%
Average Age of Club (years)	20.24	11.38	25.91	16.31	10.07	23.42

3.2 Facility Operation Analysis

While some outliers exist, Table 2 shows that, the average club tends to only have one facility and all business types average between 7 and 10 tables per facility. When combined with the operation schedule results in Table 3 and location type results in Table 4, a picture forms showing that the different business types provide very different levels of table tennis availability for their communities.

As shown in Table 2, there were 9 clubs that had multiple facilities. From a deeper look at these cases, it was found that almost all of these clubs moved from place to place on different days/hours of the week. This was due to having venue limitations in whatever recreational center, school, or other low/no cost facility they were using and the organization opted to use more than one facility for their club as a way to expand.

Without counting special programs, the most basic benefit provided by a table tennis club is in the playing resources available to the public. That is to say table availability per unit time is a strongly limiting factor in the ability of a club to promote table tennis. With the mean tables per facility being only 8.85 and the mean open hours being about 20.88 per week overall, the average club provides about 184.79 table-hours per week for its community. When this concept is applied by business type, we find that the for-profit, non-profit, and informal groups provide 388.43, 157.03, and 39.76 table-hours respectively in any given week. This dramatically differentiates the base potential of each business type. However, a similar disparity is seen with clubs with and without employees regardless of business type. This suggests that business type is not the only important criteria for providing high levels of service.

Table 4 shows the distribution of table tennis facilities according to whether they share space with another entity. Overall, only 28.57% of clubs had fully dedicated facilities. The for-profit clubs and clubs with employees were significantly above average in this respect and as a result were able to stay open longer. Since the vast majority of non-profit and informal clubs shared space with other groups, they had fewer hours of operation. There was a trade-off to this as survey respondents often commented that they used these shared facilities because they were low/no cost. Dedicated facilities must typically be paid for through the club's own revenues and place a higher burden on the business.

Table 2. Facility Statistics by Business Type

Facility Statistics	Overall	For-Profit	Non-profit	Informal	With Employees	No Employees
Total Clubs	63	16	34	13	15	48
Total Facilities	74	19	42	13	18	56
Mean Tables per Facility	8.85	9.47	9.1	7.15	9.89	8.52
Median Tables per Facility	8	8	8	6	9	8
Mean Facilities per Club	1.19	1.25	1.24	1	1.2	1.19
Median Facilities per Club	1	1	1	1	1	1
Clubs with Multiple Facilities	9	2	7	0	2	7

Table 3. Club Operation Details by Business Type

Open Hours/Days Per Week	Overall	For-Profit	Non-profit	Informal	With Employees	No Employees
Mean Open Hours Per Week	20.88	41	17.27	5.56	41.73	14.36
Median Open Hours Per Week	8	48	9	6	40	7
Mean Table-Hours Per Week	184.79	388.43	157.03	39.76	395.56	122.31
Mean Open Days Per Week	3.429	5.125	3.235	1.846	5.4	2.813
Median Open Days Per Week	3	7	3	2	6	2

Table 4. Club Location Types by Business Type

Club Location Types (%)	Overall	For-Profit	Non-profit	Informal	With Employees	No Employees
Community or Recreational Center	42.86%	18.75%	52.94%	46.15%	13.33%	52.08%
School	14.29%	6.25%	20.59%	7.69%	6.67%	16.67%
Church	4.76%	0.00%	0.00%	23.08%	0.00%	6.25%
Fully Dedicated Facility	28.57%	68.75%	17.65%	7.69%	73.33%	14.58%
Other Business	9.52%	6.25%	8.82%	15.38%	6.67%	10.42%

3.3 Service Analysis

Going beyond simply providing tables, the special services provided by clubs can further increase public engagement in table tennis. As shown in Table 5, the different club categories varied strongly in their ability to offer services to their communities. Again, the informal clubs offered the lowest levels of service overall.

Tournaments were the most popularly offered club service by far. They are also notable as the only option where all club categories did not deviate much from the 84.13% overall level. Several survey respondents indicated that it was also a strong source of revenue. This makes sense as tournament fees typically far exceed what the same number of players would pay for simple play time on any given day.

Only 50.79% of clubs have paid coaches and offer training programs. Coaching plays an important role for a club and the sport as a whole. According to Sport Coaching in the 21st Century (2012) “Coaches play a central role in promoting sport participation and enhancing the performance of athletes and teams.” Coaches are subject matter experts on table tennis that help connect a local community to the overall world of the sport. This general lack of coaching resources may be another reason why table tennis is not strong in The United States.

Possibly more alarming than the coaching situation, only 38.10% of clubs have junior programs. The lack of attention in junior programs may be one of the strongest

reasons that USA Table Tennis is still at a low competition level in world. Juniors are the next generation sources of elite athletes, fans, promoters, and even policy makers. Paying attention to the junior programs is one of the most underrepresented priorities for promoting table tennis in The United States.

Table 5. Club Service Details by Business Type

Club Services	Overall	For-Profit	Non-profit	Informal	With Employees	No Employees
Percent With Paid Memberships	57.14%	68.75%	55.88%	46.15%	66.67%	54.17%
Percent With Club League	39.68%	56.25%	38.24%	23.08%	66.67%	31.25%
Percent With Tournaments	84.13%	81.25%	88.24%	76.92%	100.00%	79.17%
Percent With Coaches	50.79%	87.50%	41.18%	30.77%	93.33%	37.50%
Percent With Junior Program	38.10%	68.75%	35.29%	7.69%	93.33%	20.83%
Percent With Equipment Sales	38.10%	81.25%	26.47%	15.38%	86.67%	22.92%

3.4 Club Revenue Source Analysis

Twelve different revenue sources were counted as part of the survey data. These revenue sources included membership dues, walk-in player fees, training programs, equipment sales/rental, tournament proceeds, member donations, sponsorship benefits, event hosting fees, league fees, food/drink revenues, parent organization funding, and other fund-raising efforts. Table 6 shows how many of those revenue sources each club type was drawing from.

Informal clubs operated with the fewest different revenue sources. This fit their overall picture as places with limited resources. Some respondents noted that their host organization limited the ways in which they could make money. It was unexpected that the for-profit clubs would have fewer revenue sources compared to the others. This may be because they are unlikely to receive donation-type revenue. The most notable comparison in revenue diversity came from the clubs with and without employees. Being able to pursue revenue sources takes time and it may be that clubs with employees simply have the resources required to do that.

Table 6. Club Revenue Source Diversity by Business Type out of 12 Types Surveyed

Total Sources Declared	Overall	For-Profit	Non-profit	Informal	With Employees	No Employees
Mean	4.67	4.5	6.27	2.92	7.64	3.69
Median	4	3.5	7	3	7.5	3
Mode	3	3	8	2	5	3

3.5 Club Growth Analysis

Table 7 shows aggregated three-year growth rate responses from the 38 clubs that filled out the growth portion of the survey and also were at least three years old as of the survey date. Growth was measured in terms of the number of players that frequented their club at least once per week and at least six months out of the year. Impressively, only 2.63% of clubs reported negative growth over the last 3 years. However, around 40% of clubs only have 0-5% growths, which is nearly no growth. It shows that many clubs are staying at the same number of members for long time. This is especially true of the informal clubs, which had the slowest growth rate by

far. On the other hand it is encouraging that, 57.37% of clubs have more than 5% growth at the past three years. While the data does not show whether other measures such as profitability are growing also, the increase of regular players shows the market for table tennis is on the rise.

Table 7. Three-Year Growth Rate Details by Business Type for Clubs At Least Three Years Old

Growth Data	Overall	For-Profit	Non-profit	Informal	With Employees	No Employees
Total Clubs that fit Criteria	38	7	24	7	5	33
Negative Growth	2.63%	0.00%	4.17%	0.00%	0.00%	3.03%
0-5% Growth	39.47%	14.29%	37.50%	71.43%	20.00%	42.42%
5 to 15% Growth	28.95%	57.14%	25.00%	14.29%	20.00%	30.30%
15 to 50% Growth	18.42%	14.29%	20.83%	14.29%	20.00%	18.18%
Above 50% Growth	10.53%	14.29%	12.50%	0.00%	40.00%	6.06%

3.6 Club Labour Analysis

As shown by Table 8, volunteers overwhelmingly do the labour at American Table Tennis clubs. Even the for-profit clubs and the clubs with employees tended to have more volunteers than employees. The fact that 56.25% of for-profit clubs did not have employees was interpreted to mean that the business owners were not counting themselves as employees.

Recalling the operation results from Table 3 and service results from Table 5, the clubs with paid employees have significantly more open hours, and offer more services to public. The fact that these attributes follow the presence of paid employees regardless of business type is significant but the data does not provide a full explanation. It is unlikely that any given club can attain success simply by hiring an employee. It is more likely that the presence of employees is a side effect of a well-managed business that is not only busy enough to require the extra help but also has the income to support it. According to the “Fair Labour Standards

Act of 1938”volunteers at an organization cannot legally do the same kind of work that a paid employee does at the same organization.” In other words, hiring an employee is an enormous step for a business because it begins a shift toward employee labour that is difficult to reverse.

As shown by Table 6, the clubs with paid employees offered every measured club service greater rate than those without employees. This may be because paid employees have an inherent responsibility to the business which volunteers by definition do not.

As shown in Table 1, 79.41% of non-profit clubs and 76.92% of informal clubs have been running more than 5 years but only 14.71% and 7.69% of clubs from these groups respectively employ paid employees. This suggests that most of these clubs are not growing their businesses. According to Yu, Y. (Personal Interview, January 9, 2015), Mr. Kenneth Muller, the President and long-time member of The Austin Table Tennis Club, he said in the interview “we used to play table tennis at a bar and the fire department, and now we really appreciate that we have a consistent club to play in. However, we never thought about the future of the club, the only thing we

needed to do is to make it break even so we could have a place to play." Austin Table Tennis Club (ATTC) began as a place for a group of volunteers to play and have fun but without intending to run like a business or try to promote table tennis in any big way. Many clubs in the survey data fit the pattern of ATTC's early days, and not all can expect such similar good fortune. This could be one of the reasons that table tennis has not been promoted in The United States.

Table 8. Club Labour by Business Type

Club Labour	Overall	For-Profit	Non-profit	Informal	With Employees	No Employees
Percent with any Employees	23.81%	56.25%	14.71%	7.69%	100.00%	0.00%
Mean Employees	0.68	1.94	2.76	0.08	2.87	0
Median Employees	0	1	1	0	2	0
Mode Employees	0	0	0	0	1	0
Percent with any Volunteers	93.55%	81.25%	96.97%	100.00%	80.00%	97.87%
Mean Volunteers	4.21	3.25	5.27	2.69	2.6	4.72
Median Volunteers	3	2	5	2	2	4
Mode Volunteers	2	0	5	2	2	3

4. CONCLUSION

First of all, the data suggested that, among other things, clubs with employees were better able to handle more involved tasks such as providing more services, pursuing more varied revenue sources, and having longer open hours compared to those with only volunteers. The separation of the data based on business type and the presence of employees was instrumental to the rest of the investigation. There was an initial assumption that separation by business type would be the only relevant way to distinguish club businesses. In general this was successful but it was found that attributes such as club services were not falling easily into these categories. The presence of employees at a business, regardless of type provided an additional viewpoint into table tennis businesses that made some previously vague results much more clear.

Second, the for-profit type did not differentiate between different subtypes such as sole proprietorships but in general these businesses have an inherent incentive to grow and be profitable to survive. The data showed they were more able to provide services and longer open hours compared to the other groups. Overall, non-profit club data indicated relatively slow growth and middling levels of services. However, many non-profits with employees were comparable to for-profit businesses. The informal designation was the vaguest because it included clubs that had no official legal status, existed as subdivisions of larger organizations, and/or other situations where club leadership was not sure how to self-classify. This classification was deemed appropriate because these groups seemed to share a general characteristic to simply be a place to play for a small group of people and not pay attention to business concerns.

Third, although table tennis is not a popular sport in the United States, it still has consistent player communities that keep many clubs in operation for decades even if growth is slow or non-existent. The market of table tennis is growing because most

clubs have more than 5% growth over the past three years. The situation appears to be changing due to the relatively fast-growing for-profit clubs appearing over the past decade. These for-profit clubs have been surviving more than 5 years, which suggests they are able to profit from table tennis. Clubs with employees also help lead this growth regardless of business type.

Lastly, there four major reasons why table tennis in The United States is not well promoted:

- A large percentage of clubs do not have the desire or resources to grow and appear to exist for a group of volunteers to play.
- There is a lack of playing resource for the public.
- There is a lack of trained professional coaches to promote table tennis
- There is a serious lack of attention for juniors who are the future of this sport.

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Technical and tactical analysis on Yuto Muramatsu VS Fan Zhengdong in final match at 2014 Youth Olympic Games

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Abstract: In this paper, the technical and tactical approach between Muramatsu Yuto and Fan Zhendong on the 2014 Youth Olympic Games finals is analysed by means of literature and statistics. This paper research on technique and tactics of Muramatsu Yuto, a rising chopping star in Japan, and makes a reference for the Chinese table tennis players' technical and tactical. The research shows that Muramatsu Yuto has certain ability to grab and serve with high-quality service and the changeable serve placement, also, his backhand chop defensive ability is excellent while the forehand stalemate ability is poor.

Keywords: technical and tactical analysis, chop, Yuto Muramatsu, three phase method

1. INTRODUCTION

17-years-old Yuto Muramatsu was runner-up at the 2014 Youth Olympic Games. Yuto Muramatsu won one game against Zhang Jike in the 2014 Asian Games team competition. He also has a good performance in the 2014 World Junior Table Tennis Championships. He is a chopper star in Japan. In this paper, technique and tactics of the chopper is analysed and summarized, in order to provide reference for Chinese table tennis players.

2. RESEARCH OBJECT AND RESEARCH

2.1. Research object

The final match at 2014 Youth Olympic Games: Yuto Muramatsu VS Fan Zhengdong, the score 2:3 (8-11, 11-9, 11-9, 9-11, 4-11).

2.2. Research methods

2.2.1 Literature reviews: Read the literature of table tennis technique statistics, analyse and summarize the technique and tactics of Yuto Muramatsu VS Fan Zhengdong according to previous literatures.

2.2.2 Mathematical statistic method: The technique and tactic of Yuto Muramatsu in the final match at 2014 Youth Olympic Games was analysed by the classic three-phase method and the Simi Scout technical and tactical analysis software. Also

analyse the technique and tactics of Yuto Muramatsu in serve and attack phase, receive and attack phase and rally phase respectively.

Scoring rate = score in the phase /(score in the phase +lose points in the phase)×100%

usage rate = (score in the phase +lose points in the phase)/(global score +global lose points)

3. RESEARCH RESULTS

Table 1. The data of three-phase of Yuto Muramatsu VS Fan Zhengdong

	Score	Lose points	Subtotal	Usage	Scoring rate
Serve and attack phase	12	6	18	16.5%	66.7%
Receive and attack phase	10	9	19	17.4%	52.6%
Rally phase	25	47	72	66.1%	34.7%
Subtotal	47	62	109	100.0%	43.1%

What can be seen from Table 1 is that Yuto Muramatsu is at a higher scoring percentage in serve-attack phase and receive-attack phase, 66.7% and 52.6%, respectively, but the usage rate is only 16.5%. It is shown that the players have a certain ability to serve-attack and receive-attack. The usage rate in the rally phase is 66.1% while the scoring rate is only 34.7%. It is shown that most of the balls in this game have entered the rally phase, but Yuto Muramatsu had high turnovers and hit the ball without aggression.

Table 2. The data of Yuto Muramatsu in Serve and attack phase

	Score	Lose points	Subtotal
Serve	3	1	4
Serve and attack	5	3	8
Third ballbackhand chop	4	2	6
Subtotal	12	6	18

According to Table 2, Yuto Muramatsu serve 3 points and lose 1 point, which explains that the player serve in high quality and stably. He got 5 points and lost 3 points in serve and attack phase. He won 4 points and lost 2 points by serving all the backhand chop, which explains that the player can beat it quickly and have a certain hit rate. He had a good ability of dealing with the first third balls. Also backhand chop has high quality. The player won 12 points and lost 6 points in the whole Serve and attack phase. Combining with the video, it can be seen that in the whole Serve and attack phase Yuto Muramatsu's serve had high quality. The drop point and rotation of the ball had a lot of changes. His serve was mainly at the backhand half-length court and long serve, combined with forehand deviation centreline short serve. He had some ability to attack after serve.

Table 3. The data of Yuto Muramatsu in Receive and attack phase

	Score	Lose points	Subtotal
Receive and control	3	2	5
Receive and chop	5	2	7
Control after receive	1	-	1
Chop after receive	1	5	6
Subtotal	10	9	19

According to Table 3, Yuto Muramatsu scored 10 points in Receive and attack phase, including 8 points by receiving. 3 points in receive-control and 5 points in receive-chop consist of 8 points by receiving, which explained that the players has a strong ability of receiving. Combining with the video, it can be seen that Yuto Muramatsu's receive used backhand chopping technique more, chop long and short less. The drop point of receive was mainly in the opponent's backhand. The player scored 1 point and lost 5 points in chop after receive phase, which lost most points in the whole Receive and attack phase. Therefore, the players should strengthen the training in the respect of the technique in chop after receive, especially in the judgment to the ball return to opposite player, in order to improve the quality of Chop after receive. Receive is based on control and chop. Receive direct score more while receive and attack scoreless. Therefore, Yuto Muramatsu should strengthen the consciousness of receive and attack in the game. In this way he can master the game more quickly and exert their own advantages.

Table 4. The data of Yuto Muramatsu in rally phase

	Score	Lose points	Subtotal
Attack	8	5	13
Passive	2	21	23
Chop	15	21	36
Subtotal	25	47	72

In general, Yuto Muramatsu had ability to change defensive to attack with huge threat of force in rally phase, which made him score directly, but error rate was high. His backhand chopping defensive was good, and forehand rally ability is poor. His backhand chopping defensive was good, and forehand rally ability is poor. Most of the time the match entered rally phase. Combining with the video, it can be seen that the player's forehand rally ability is relatively weak and the stability is poorer, which makes him depend on his backhand chopping defensive.

4. CONCLUSION

(1) Yuto Muramatsu's serve had high quality. The drop point and rotation of the ball had a lot of changes. His serve was mainly at the backhand half-length court and long serve, combined with forehand deviation centerline short serve. He had some ability to attack after serve.

(2) His Receive used backhand chopping technique more, chop long and short less. The drop point of receive was mainly in the opponent's backhand.

(3) Yuto Muramatsu had ability to change defensive to attack with huge threat of force in rally phase, which made him score directly, but error rate was high. His backhand chopping defensive was good, and forehand rally ability is poor.

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Research on Table Tennis Fitness and Entertainment Market Actuality and Development Countermeasures in China

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Abstract: This essay aims to investigate and summarize the table tennis fitness and entertainment market actuality and existing problems comprehensively and systemically from different angles such as main dual-parts of market supply and demand, and object of market, as well as propose developing train of thought and countermeasures. In the meanwhile, it intends to provide theoretical and factual basis of rapid and healthy development of table tennis fitness and entertainment market in China. Research methods such as document literature, expert interviews, questionnaire surveys, mathematical statistics and logic analysis will be carried out to investigate the main table tennis business sites or amateur table tennis fitness clubs in three representative cities --- Beijing, Guangzhou and Haerbin.

Keywords: table tennis, fitness and entertainment market, actuality, countermeasures

Table Tennis Fitness and Entertainment Industry is the basic of table tennis industry, so taking it as the strategic emphasis for current table tennis industry development not only can pull the whole table tennis industry to grow rapidly, but also has crucial theoretical and realistic meaning of pushing "National Fitness Project" and "Olympic Honor Project" these two strategies to be implemented and realized.

This essay aims to investigate and summarize the table tennis fitness and entertainment market actuality and existing problems comprehensively and systemically as well as propose, developing train of thought and countermeasures. In the meanwhile, it intends to provide theoretical and factual basis of rapid and healthy development of table tennis fitness and entertainment market in China, to expand the 'national ball sport' market and achieve sustainable development of it by investigating the main table tennis business sites or amateur table tennis fitness clubs in three representative cities --- Beijing, Guangzhou and Haerbin.

1. ACTUALITY OF SUPPLY SUBJECTS IN THE TABLE TENNIS MARKET

1.1 Scale of Supply Subject Market

According to the author's investigating visit and incomplete statistics, there are 24 operating sites (or amateur table tennis fitness clubs) in Haidian district, 19 in Chaoyang district in Beijing that provide table tennis fitness and entertainment service. When referring to online data which can be checked about this kind of

operating sites, there are 120 in Beijing, 15 in Shanghai, besides, there are at least 7 in Guangzhou, 33 in Haerbin, 28 in Jiangsu Province, 10 in Puyang City in Henan, 12 in Urumqi City in Xinjiang, 20 in Wuhan, 12 in Xi'an. In fact, the proportions of these table tennis business sites are much higher than these numbers in these cities. To a certain extent, all these above reflect macroscopically the whole scale of supply subjects of table tennis fitness entertainment industry in our country. In a manner of speaking, the supply subject of table tennis fitness and entertainment market in our country, operating table tennis clubs, has already begun to take shape.

If we analyse from the angle of floor spaces and table tennis tables' quantity holding, operating table tennis sites are mainly middle and small ones, while it is quite rare to see distinctive and brand-advantage large chain operating ones.

1.2 Economic Property of Clubs

At present, there are different ownership economical forms existing in table tennis operating firms, of which the majority is state-owned, collective and private economical management, while the former is slightly higher than the latter. In Zhejing Province, private economy of fitness and entertainment suppliers accounts for 70%. In Puyang of Henan Province, operating table tennis clubs organized by individual investors have become a mainstream. In Wuhan, Xi'an, Urumqi, operating table tennis clubs organized by individual investors occupy the largest part among all. Therefore we can infer that table tennis profit-making places will give priority to the private sector, showing obvious characteristics of regional economy.

1.3 Modes and Measures of Club Management

1.3.1 Pluralism of Managing Modes

It can be divided into three categories according to the relationship between table tennis and operating project's emphasis: (1) table tennis specialized operating such as Beijing Double Happiness Sports Clubs; (2) table tennis is the main business, at the same time there are other projects engaged in, for example, Beijing University Student Activity Center; (3) table tennis is one of sideline content, for instance, Hilton Beijing Fitness Center.

1.3.2 Abundant Managing Measures

At present, most table tennis operating places adopt a variety of measures to go in for business activities, usually combine membership system with non-membership one. Moreover, every operating site used different promotion methods respectively. Some undertake various types of table tennis tournaments, some conduct long-term or short-term training courses, and some are engaged in doing table tennis products, sports drinks and other foods to increase revenue.

1.3.3 Operating Open Time and Charging Price

It can be seen that open hours are quite long every day, all more than 10 hours according to the 120 table tennis operating sites in Beijing, meanwhile those investigated in Guangzhou and Haerbin are in the same situation. Basically consumers' needs for different time can be met by current open hours.

The charging prices are not the same, of which the highest ones commonly belong to those table tennis sites attached to big restaurants and hotels with 40 to 60 yuan per hour. Most operating places (such as fitness, health and leisure, professional table tennis clubs, etc.) make their prices between 15 to 30 yuan per hour, furthermore a small number of college and state-owned stadiums set theirs generally between 5 to 15 yuan per hour due to national sports regulations to open to the public. Besides, it is worth mentioning that it is by no means completely proportional relationship between the level of economic development, people's income and the development of table tennis industry, sometimes the size of the elasticity of demand will also affect the price of intermediate-level table tennis operating sites.

1.3.4 Cognition of managing purpose and prospect by operators

According to the 25 operators investigated and visited, their chief business purposes are obtaining economic benefits, promoting table tennis's socialization, marketization and industrialization, popularizing "national ball" sports, expand social contact and strengthening ball fans' communication.

In terms of profit and loss situation, less than 50% clubs could profit with a little savings, while about 20% are losing money. It is thus evident that current operating condition is not ideal enough. When we ask questions about the developing prospect of table tennis fitness and entertainment market, 21 operators in Beijing think this has quite developmental potential, and 4 operators consider it promising. All these can reflect that table tennis operators are very optimistic and confident to its business prospect from another aspect.

1.3.5 Low Utilization of Sites

Survey investigation and related data indicate that the space utilization rate of table tennis operating places is generally low. Which may be following main reasons: (1) Table tennis consuming consciousness is not too strong at present. (2) There are certain differences between service products' quality and products' quality in consumers' expectations (Table 1). (3) Operators are not good at using all kinds of marketing strategy and pricing strategy. (4) There is lack of scientific and strict management and managers' quality is not high.

Table 1. Questionnaire of Service Product' Quality Satisfaction Degree by Consumers

	Very satisfied	Satisfied	Normal	Not Satisfied	Far from satisfied
Number of choosing people	5	22	49	123	4
Percentage (%)	2.5	10.8	24.1	60.6	2

1.4 Existing Problems

(1) Operating and developing measures need to be innovative and there is lack of cultivation. Marketing methods and channels with table tennis' professional characteristics have not been widely adopted.

(2) Guiding power of table tennis fitness is weak. From the perspective of service provided by table tennis operating sites, most places (except for operating places mainly comprised of professional technical training) are short of professional table tennis guiding personnel. In the survey that whether table tennis technical guiding personnel are necessary or not to consumers, 91.2% chose "yes" and only 8.8% chose "no", this above suggests that table tennis consumers have a strong desire to play and even play well. However, 56.6% people said they were not willing to, more than a half, when we asked their inclinations if the price was higher. There may be two main reasons: One is that the whole sports-consuming level is not high as present in our country, the other is that the consuming perception and consciousness of table tennis participators still remain to be strengthened.

(3) There is a lack of operating and managing talented people and the inner managing level is really low.

(4) Cognizance and perception problems exist. The cardinal representation is that there is perceptions of paying attention to compete but ignoring groups with management center as main body, and neglecting the relationship between popularization and improvement, which is closely relative of the whole country's sports environment.

2. ACTUALITY OF CONSUMING SUBJECTS IN BUSINESS SITES

2.1 Characteristics of Vital Statistics

2.1.1 Consumers' Age Distribution and Sexual Structure Condition

The investigation illustrates that average age of people going to operating places to play table tennis is 33.1, mainly centered between 21 years old to 40 years old which occupying 65.8% among those surveyed, this is identical to the primary age range of table tennis audience to a large extent.

Males are more than females who participate. In fact, the characteristic of table tennis is more suitable for female's physiological and psychological characters. Expanding female market is also a possibility for Chinese table tennis's fixed position of participation consuming market, but still needs to concentrate efforts on propaganda and packaging.

2.1.2 Consumers' Occupational Structure Condition

The most intensive occupation goes from education general staff, students, administrators, civil servants as well as doctors, lawyers, engineers, etc., of which all types of professions account for the dominant position except for students in our country.

2.1.3 Education Degree Structure Condition

People with medium and above degrees occupy larger proportion, which hold 86.2% among those pulled. To a certain extent, this reflects that table tennis participation consuming groups in our county are kind of a group with higher educational level. We know that those people with higher educational level have larger demand for table tennis training from the conversation between the author and related coaches.

2.1.4 Consumers' Income Condition

According to the survey among the consumers taking part in table tennis fitness and entertainment, the per capita monthly income is 4398.96 yuan and the family monthly income is 6147.32 yuan, which is much higher than the average capita income in Beijing - 2000 yuan. This to some extent reflects that currently the group who usually go to operating sites to play table tennis have rather higher income.

2.2 Characteristics of Behaviour

2.2.1 Consumers' Life Style in Spare Time

Statistics show that the first three living arrangements that table tennis consumers in operating sites have in their spare time in proper order are: watching TV, sports activities and reading books, newspapers. Sports activities is in the second place among these, so we can say that consumers pay attention to and aspire to fitness and entertainment and they are the main object in developing table tennis fitness and entertainment market.

2.2.2 Primary Motives for Participating in Table Tennis Exercises or Learning

The survey results indicate that primary motives consumers take part in table tennis activity go from interests and hobby, fitness, entertainment, and learning sports skills. It is clear that cultivating people' interests and hobby of table tennis activity is of great concern. Consequently, establishing amateur table tennis clubs, developing and popularizing table tennis activity in primary schools, high schools and universities respectively may after all be accepted as a good measure.

2.2.3 Primary Forms of Participating in Table Tennis Exercises or Learning

According to the investigation, the main forms of joining in table tennis activity by consumers are doing it with family, colleagues and friends and schoolfellows, and individually, while going there with association ball fans together is in the fourth position, which explains the lack of public self-controlling associations at present in our country.

2.2.4 Frequency of Participating in Exercises

From the survey, we can see that currently the highest frequency of consumers taking part in exercises is once a week, occupying 39.3% of the pulled, exercising three times and above per week accounts for 20.5%. It is obvious that frequency of table tennis consumers participating is rather high, basically in the upper level.

2.2.5 Consuming Condition in Table Tennis (besides of exercises)

(1) Consuming Modes

According to the survey, besides going to the arenas to play table tennis by people investigated, the top two consuming modes at present in proper order are purchasing professional materials (such as rubbers, etc.), and purchasing professional clothing (including table tennis shoes), which are object material consumption. At the same time, non-physical consumption is in the third and fifth position.

(2) Cause investigation of influencing consumers to consume in table tennis

Lacking of table tennis consuming environment is at the top place among all the reasons of influencing people surveyed to consume. There into, the main reason is not enough propaganda for the table tennis operating organizations themselves so that consumers do not know the existence of these organizations. In addition, service product's bad quality, economical condition and so on are also primary reasons of influencing the pulled to consume table tennis activities.

3. MAIN FACTORS OF AFFECTING TABLE TENNIS FITNESS AND ENTERTAINMENT MARKET TO DEVELOP

According to questionnaire investigating results (Table 2) and reorganized interviews of club operators, we can conclude that the main factors affecting table tennis fitness and entertainment market to develop in proper order are: consuming level of living and sports, spare time, table tennis's values and attitudes, transport, etc., which if majorly from the aspect of influencing consumers' table tennis demand. Furthermore, table tennis operating and managing personnel, national relevant policy support and laws and regulations in the market and so on will also exert crucial influences on this market's development.

Table 2. Cognition of main factors that influence table tennis fitness and entertainment market and training market development by consumers

Options	Number	Average Selectivity Coefficient	Precedence
Table Tennis Values and Attitudes	134	1.06	3
Consuming Level of Living and Sports	187	1.48	1
Transport	112	0.89	4
Spare Time	173	1.37	2
Others	24	0.19	5

Monoidal Average Value=Total Number of Choosing People/Project Sum=630/5=126

Average Selectivity Coefficient=Monoidal Number of Choosing People/Monoidal Average Value=173/126=0.9

4. DEVELOPING THINKING AND COUNTERMEASURES OF TABLE TENNIS FITNESS AND ENTERTAINMENT MARKET

4.1 Developing Thinking

Table tennis fitness and entertainment market must aim at newest developing trends of public fitness and entertainment market, establishing a fitness system whose main body is table tennis association to gradually form and set up other amateur clubs at all levels. Schools, sports bureaus and enterprise institutions should rely on existing venues and renew ideas to build new multi-functional table tennis fitness and entertainment places step by step and standardize every activity's working hours and patterns. Amateur table tennis clubs is the main form of public table tennis sports development and it should be a primary support for table tennis fitness and entertainment market in our country.

4.2 Developing Countermeasures

4.2.1 Strengthen the Occupational Managing Functions of Table Tennis Association (Center)

We should specially set up a public sports working institution inside the management center under China table tennis association, which can be named tentatively "Communal and Youth Ministry", as well as fully arouse the enthusiasm of local table tennis associations, sports associations and street community associations, strengthen communication and collaboration between them. At present, table tennis associations should pay attention to cultivate public table tennis clubs by strengthening vocational guidance and personnel training. What's more, we need formulate relevant laws and regulations about the public table tennis clubs and set up a table tennis fitness instructor training system and certification work, etc.

4.2.2 Establish and Consummate Amateur League System

Competition is a crucial lever of macroscopic readjustment and control and coordination of amateur table tennis clubs by table tennis associations. Table tennis associations should concentrate on establishing and consummating amateur league competing system mainly suitable for public fitness and entertainment.

4.2.3 Expand Input Channels of the Masses' Table Tennis Clubs

When referring to profit-making table tennis clubs, we must stick to principles of "who invests, who owns, who benefits", breaking boundaries of departments, regions and ownership, and encouraging and supporting a variety of economical elements to develop table tennis fitness and entertainment market together. For non-profit public table tennis clubs, we should not only advocate them to do self-financing through operating activities and develop their own hematopoietic function, but also set up the table tennis developing fund to mainly aid financially table tennis clubs with remarkable social benefits.

4.2.4 Enhance Propaganda and Guide Consumption

First, table tennis associations and table tennis clubs should make full use of media such as television, radio, newspapers, magazines, the Internet and other media to inspire and induce the masses' demand for table tennis sports by multi-faceted, multi-angle propaganda and education and help them set up correct table tennis consumption values and concepts. In addition, replaying and undertaking table tennis matches can also strengthen the sense of identity of the masses. Second, it is important to correctly guide table tennis club operators to master sports and table tennis market quotations, as well as sports consuming psychology of the masses.

4.2.5 Fighting for Policy Support from the Country

Currently, table tennis associations should have the aid of government power, fighting for a certain preferential policy support for majorly helping to sustain public welfare table tennis clubs. The main forms can be subsidies, venue free or preferential use, lottery bonus, preferential tax policy, etc. Table tennis associations at all levels (management center) should give policy support or funding within the scope of their functions and powers to ensure its survival and development, based on the practical difficulties encountered in the early development in the public welfare table tennis clubs of this region.

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An Exploring Study on the Packaging of Broadcasting Table Tennis Matches

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Abstract: Employing the method of literature review, the method of video observation and method of statistics, this paper has taken the token examples of NBA and Tennis Grand Slam packaging through the utilization of game stats as reference, exploring the future packaging plan for table tennis matches. The results are: 1) using game stats to serve for match broadcast complies with the trend of development in contemporary sports, raising the quality and ornamental value of sports matches, a trend which table tennis must grab, enhancing its development in this field; 2) The packaging of table tennis broadcasting also needs to follow the popular model, using game stats accordingly for pre-match packaging, packaging during the match and after match packaging; 3) pre-match packaging mainly provides the recent statistics on matches of both sides, specified statistics of matches between the two opposing sides, so as to reflect the current status, advantages & disadvantages and technique features, suggesting the watching focus and commentaries; 4) packaging during the match generally needs to provide statistics promptly and properly, backing up the commentaries through graphs and subtitles; 5) for after match packaging, the key is to provides game stats through graphs and tables of this very match, reviewing the critical factors, leading the broadcast to a wonderful end. Table tennis broadcast employing game stats for its packaging has just reached its starting stage. This paper suggests chose high level world competitions as primary packaging targets, then promoting the use of game stats in more table tennis matches so its packaging level can be improved.

Keywords: table tennis, broadcast packaging, game stats

1. INTRODUCTION

The combination between sports and television creates a “win-win” situation, these two affect each other, boost each other and have been forming a co-exist effect [1]. This tightened combination has become a symbol reflecting the quality of a successful sport packaging. Samaranch once divided sports events into two categories: one suitable for the taste of television, the other not. Only belongs to the first category can sports events prevail. Or, sports events will either decline or standstill with no progress. [2] As a classic representative of sports that compete with a net in the middle of the court, table tennis is extremely competitive.

However, the development of this event is in danger. For instance, the International Olympic Committee proposed in the last Olympic circle that evaluation should be made on TV audience rating, preference and others, a total of 33 indicators, and for sports whose voting rate below 50% will be kicked out of the 2012 Olympic Games. [3]

Copying with the crisis, researches have been proposing the direction of development: spectacular matches are not enough, it also needs stimulations that continues to attract spectators and fans.[4] Early media communication researches suggested that under the context of marketization, development of TV made itself become commodity, and commodity need packaging and advertisement so that TV can be acknowledged by audience, ideal watching rate can be reached and brand be established.[5] Certainly, table tennis is deficient in its broadcast packaging, especially in providing game stats, up till now, is still a relative blank: besides watching the match itself, what other information spectators can get about the match is simply game score and results through subtitles. However, subtitles with words and graphs have become an indispensable part of contemporary sport broadcasting, broadcast without subtitles can never be called a complete sport broadcast today.[6] The current level of table tennis broadcast packaging still has great potential in improving the ornamental value, increasing watching focus and so on. Therefore, this research starts from game stats, exploring and discussing the future development of table tennis broadcast packaging and conceiving some specific plans for reference.

2. METHODOLOGY

2.1 Research subject

The subject is the packaging of table tennis broadcast, adopting Men's Singles Final of 2013 Paris World Table Tennis Championships (2013 Paris WTTC) as the conceiving packaging subject, using game stats to serve for different stages of its broadcast packaging.

2.2 Methodology

2.2.1 Literature review

Searching literature in the field of Sport Presentation, Sport Packaging and Sport Media & Communication, studying relative theories about sport packaging of its status, function, methods and so on, laid down a theoretical base.

2.2.2 Video Observation

Observing match broadcast of tennis and NBA, collecting, extracting and implanting the inspirational contents, format and ideas into the packaging of table tennis broadcast.

2.2.3 Statistics

Employing the statistic method established through expert interview from Zhou Yi's paper A Study on the Method and Application of Table Tennis Technique Presentation, collecting data from 4 world title matches of Wang Hao VS Zhang Jike from 2010 to 2013, collecting data of Wang Hao's and Zhang Jike's road to the Paris Finals, providing specific game stats for match broadcast packaging; likewise, using the same statistic method to collect live game stats of the 2013 Paris Men's Single Final match. All these data collection aims to provide actual data and reflects the effect of packaging with real game stats.

3. RESULTS AND DISCUSSION

3.1 Game stats serve for broadcast is a prevalent trend.

A typical way of lifting the ornamental value of sports competition and enriching match contents is presenting game stats. The fundamental goal of packaging is to promote the main body of packaging itself, which is the same for broadcast packaging[7]. To stage high quality broadcast, it is not enough to just have great matches, especially for important matches: all-round report about the match must be provided for the spectators[8]. It is worth of taking reference from the successful experience of NBA and tennis match packaging.

Fig. 1. NBA Game Stats

Fig. 2. Individual Stats

As shown in Figure 1 and 2: using proper tables and graphs, game stats such as points scored, rebounds, assists and many other information are provided in NBA broadcast, which provides spectators much more information and kept them focused and reach a better appreciation and deeper understand of the match.. Shown in Figure 3, tennis also utilizes game stats during broadcast: comparison between numbers of service ace, scoring rate, winners and so on.

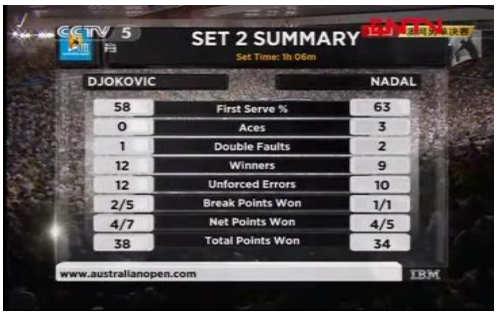

Fig. 3. Tennis Game Stats

With a table systematically presents the winning factors of tennis game, this kind of packaging is very meaningful both for support commentary and entertainment, a good example for table tennis broadcast packaging.

In short, in the context of competitive sports entertainment-orientated, it is imperative for table tennis to follow trend, introducing game stats in its broadcast packaging.

In short, in the context of competitive sports entertainment-orientated, it is imperative for table tennis to follow trend, introducing game stats in its broadcast packaging.

3.2 Great potentiality latent in table tennis broadcast packaging.

Sport event packaging which offers various information, spectacular images and better effect has become an indispensable part of broadcast[9]. During the broadcast of 2013 Paris WTTC, China Central Television Sports Channel (CCTV5) introduced a new part in broadcast which is technique & tactic analysis: after the end of each match, commentators make brief analysis on players technique & tactic performance according to the match with the support of game stats. This act has changed the current status of traditional table tennis broadcast which always based on anecdotal judgment of commentators without the support of convincing game stats. Seen in Figure 4, an example of the game stats after the end of Women's Doubles Final match including points scored through "attack-after-service", offence, defense, control and so on are provided for spectators. It is certainly a new attempt and a breakthrough for table tennis broadcast packaging.

Fig. 4. Game Stats for Women's Double Final of Paris World Championship

Though introduced technique & tactic analysis, this part only appeared in the after match packaging, which means it was not a complete and all-round packaging. This paper choose 2013 Paris WTTC Men's single final as an example, trying introducing game stats in pre-match packaging, during the match packaging and after match packaging, so as to come up with a packaging recommendation and reference for future table tennis broadcast packaging.

3.3 Packaging recommendation

Packaging can supply all-round information in and out of the competition and highlight videos clip can prolong broadcast duration, which contributes to the watching rate and better refined broadcast effect[10].

3.3.1 Pre-match packaging

Pre-match packaging is a kind of "warm-up" guiding spectators "swarm into" sport broadcast. According to the significance of different matches, corresponding level of broadcast are made. Regular elements of pre-match packaging usually includes: 1) Video Cassette Recorder (VCR) reviewing key information of the opposing players; 2) game stats analysis: analyse the recent performance, historical matches, advantages & disadvantages, pre-match prediction, comments and so on coordinating with the game stats shown in graphs, tables or subtitles.

(1) Road to Championship

Fig. 5. Wang Hao Game Stats of Road to Championship

Use interface with tables & graphs to provide spectators a series of game stats which comes from the precious matches of this player. Thus the current status, edges, weakness and other information can be reflected. Through reviewing the performance in terms of game stats from the players' road to the championship, it enable the spectators to have an overall acquaintance about players recent status, making preparation for the following packaging of the very final that is about to start.

(2) Historical stats comparison of world title finals between this rival

Fig. 6. Historical stats comparison 1

As Figure 6 and 7 shown, there are several merits to provide game stats from the previous meets of this rival:

1) Game stats from the previous meets between this rival makes the analysis more eloquent and objective; 2) making the technique & tactic more specific, which provides support for pre-match prediction and evoking suspension; 3) clearly reflecting the advantages & disadvantages of both players in their historical duels.

Fig. 7. Wang Hao VS Zhang Jike Comparison 2

All these stats is very helpful for commentators to coming up with watching focus and creating relative atmosphere for better appreciation of the final match that is about to start next.

3.3.2 During-match packaging

During the broadcast of table tennis match, if there are only descriptions and commentary based on anecdotal or subjective experience, it would be hard to convince the spectators and the commentary effect may be undermined.[7] Therefore, it would be of significance to provide live game stats supporting the commentary while the match is being played. The key is to present game stats at the right moment and provide meaningful game stats under the premise that the broadcast picture is not disturbed by subtitles or graphs.

(1) Moment available to provide game stats

Table tennis match has the feature of fast pace, rhythm and short intervals. Current laws and regulations about the intervals are: a) up to one minute interval between each game; b) players are entitled to towelling after each 6 points have been scored; c) each side has one chance for a time-out up to one minute; d) if due to accident, player is injured, the suspension of the match shall not over 10 minutes [11]. In real broadcast, sometimes slow motion reviews are provided, but besides slow motion, usually, the picture on TV screen is the camera following the player's walking, retrieving the ball or towelling. All these short intervals when the ball is not in play are actually ideal opportunities to provide some game stats.

(2) Meaningful game stats

The key to provide meaningful game stats is to choose the indicators that meet the needs of broadcast, and this paper deems meaningful game stats are: a) coordinating with the description or reflection of commentary and the relation between the provided game stats and the commentary are close; b) eminent, significance game stats which reflect the insights of the match; c) blending beautifully with the picture of the available intervals.

Take the match of Zhang Jike VS Wang Hao for demonstration:

Example 1) significant comparison

Second game 6:8, commentator pointed out that Wang Hao has got 3 consecutive points through chopping the ball to the end line, and at the same time, points earned by Wang Hao through this chop technique reaches 7 points accumulatively in this match up until then, which is a significant comparison with Zhang Jike whose chop only earns one point at that time, as shown in Figure 8:

Fig. 8. Significant comparison

Example 2) Adding watch focuses and enriching the content of packaging：

As shown in Figure 9, the 3rd game when Wang Hao goes to the surround to pick up the ball, the TV screen only shows this simple and blank action: retrieving the ball. If provides some game stats at this moment, spectators will get more watching focuses, and it also serves as a fluent transition for spectators attention to move into the next rally, keeping spectators being focused.

Fig. 9. Add watch focus and fluent transition (Note: indicator “AAS” in the picture means “attack after service”)

Example 3) Making use of the intervals between games:

During the one minute interval between games or time-out period, tables or graphs of game stats can be provided, and commentators can make relative analysis according to the statistics, such as some basic and key indicators of table tennis

technique & tactic: service, receiving, attack after service and so on, as shown in Figure 10.

Fig. 10. Game stats shown at intervals

Another example, the fourth game 12:13 Zhang Jike asks for a time-out, and the camera keeps fixating on the racket and the table, this moment is an perfect moment to post graphs such as Figure 11: bar graphs showing the comparison between the rival players about their using rate of offence, defense and control, which help the spectators to gain better understanding of the situation and momentum and offer some topics for commentators to discuss.

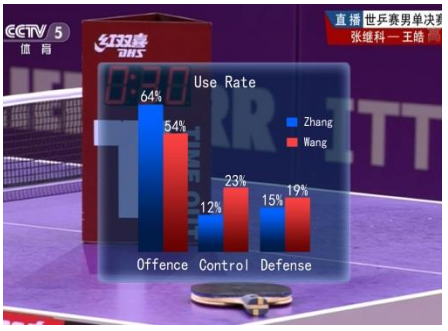

Fig. 11. Graphs provided during time-out

Example 4) Coordinating with commentary and provide data support:

At the beginning of the fifth game, the commentator points out that both players have the specialty of backhand which is a decisive factor for this match. Coordinating with this commentary, game stats about backhand can be provided as shown in Figure 12.

Fig. 12. Support commentary

Above all, without disturbing the broadcast picture or the on playing match, game stats can be provided accordingly, coordinating with the commentary, supporting the commentator, increasing watching focuses and improving the watching value of table tennis broadcast.

3.3.3 After-match packaging

Commentary after the match mainly is to give a channel for funs to release their emotion, which is a good feedback for spectators[6].

1) Game stats analysis

At the end of this men's single final, game stats of this very much is provided, and commentators can give relative comments and analysis based on the game stats of this just finished final match as shown in Figure 13

Fig. 13. Using Rate of Position and Path

2) Polygon review the momentum shift of the match

As shown in Figure 14, polygon can give a panoramic review of the momentum shit. Use offensive effectiveness as the indicator, this fluctuation graph can help the commentator to give a better review and analysis of the match for the spectators.

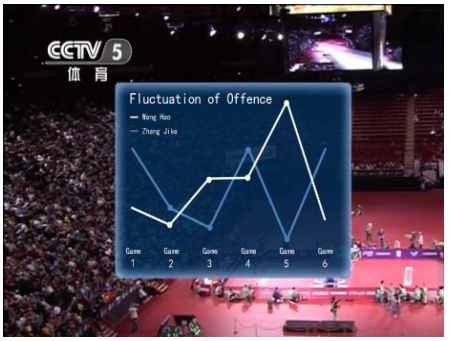

Fig. 14. Fluctuation of Offence Effectiveness

3) Placement of services distribution for technique & tactic analysis

Service is the only technique totally free from the disturbance of the opponent, therefore player who holds the opportunity to serve usually design his play around the service sophistically, which creates a lot of topics and analysis material for commentators. Graphs present service placement distribution can be provided as shown in Fig 15 and 16.

Fig. 15. Wang Hao service placement

Fig. 16. Zhang Jike service placemen

4. CONCLUSIONS & SUGGESTIONS

4.1 Conclusions

4.1.1Using game stats to serve for match broadcasting complies with the trend of development in contemporary sports, raising the quality and ornamental value of sports matches, a trend which table tennis must grab, enhancing its development in this field.

4.1.2 The packaging of table tennis broadcasting also needs to follow the popular model, using game stats accordingly for pre-match packaging, packaging during the match and after match packaging.

4.1.3 Pre-match packaging mainly provides the recent statistics on matches of both sides, specified statistics of matches between the two opposing sides, so as to reflect the current status, advantages & disadvantages and technique features, suggesting the watching focus and commentaries.

4.1.4 Packaging during the match generally needs to provide statistics promptly and properly, backing up the commentaries through graphs and subtitles. Usually, it needs to choose the indicators that are comparatively significant, or indicators that show the insight of the match; when the broadcast picture is simple and dull, providing game stats can create more watching focuses and enriching the packaging content.

4.1.5 For after match packaging, the key is to provide game stats through graphs and tables of this very match, reviewing the critical factors, leading the broadcasting to a wonderful end.

4.2 Suggestions

4.2.1To introduce live game stats into table tennis broadcast packaging needs technical support according to the real demand, exploring data collection software and establishing relative data bases, designing the whole system suitable for the features of table tennis match broadcast.

4.2.2 Data collection is a huge systematic project and a well-trained statistic team is to be assembled so that preparations for match packaging can be done and the live data collection tasks can be accomplished.

4.2.3 Table tennis broadcasting employing game stats for its packaging has just reached its starting stage. This paper suggests chose high level world competitions as primary packaging targets, such as the World Cup or World Championships and the Olympic Games, and then further promoting the use of game stats in more table tennis matches so its packaging level can be improved.

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The Application of Augmented Feedback in Coaching Table Tennis Youth Athletes

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Abstract: This paper serves as a guide to help table tennis coaches understand augmented feedback applications based on the following categories: a) types, b) content, c) timing, d) frequency, and e) strategies. This paper presents different perspectives of feedback application related to motor skill learning in the context of competitive youth table tennis. A misleading traditional view is that the greater the feedback provided to athletes, the better the quality of coaching and learning. Indeed, this approach only enhances short-term performance in practice rather than true learning demonstrated in competition. This paper demonstrates the importance of understanding the benefits of reduced feedback frequency since skilled athletes rely more on internal feedback for learning outcomes. Coaches need to reflect on and become aware of their feedback strategies that are contradictory to the research findings. This paper will enable coaches to overcome the past mistakes in using feedback with a thorough investigation of augmented feedback as well as to ensure optimal physical and psychological learning outcomes for table tennis athletes.

Keywords: augmented feedback, knowledge of results, knowledge of performance, table tennis, youth athletes

1. INTRODUCTION

Table tennis is one of the sports which require a very high accuracy in the game and it is typical for players to make multiple mistakes in the learning process. Therefore, coaches often need to enhance the accuracy of their athletes by providing feedback in practice and competitions. Since augmented feedback during practice can facilitate or degrade skill learning by increasing or reducing errors, its correct application is very important. Feedback is particularly important in coaching youth athletes because children and adolescents build knowledge and self-confidence based on feedback in terms of their performance, especially at the competitive level (Allen & Howe, 1998). Moreover, they are still not cognitively mature and rely heavily on coaches' feedback for skill development.

There are two types of feedback that inform athletes about their performance outcomes and the cause of the outcomes (Magill & Anderson, 2014):

1. Task-intrinsic feedback: Sensory-perceptual information (i.e., visual, auditory, proprioceptive, tactile) that is a natural part of the performance

2. Augmented (also known as extrinsic or external) feedback: Information about a performance that supplements sensory feedback that comes from an external

source

Since augmented feedback adds information that otherwise would not be available to athletes (Magill & Anderson, 2014), its proper use by coaches is critical for skill acquisition and improvement of athletes.

This paper aims to provide research evidence as well as practical tools for coaches to:

1. Use a combination of augmented feedback to help youth athletes learn table tennis skills
2. Decide in various practice situations which type of augmented feedback is the most effective for skill learning
3. Create skill-learning conditions in which augmented feedback would enhance learning
4. Compare and contrast the use of different augmented feedback contents
5. Identify practice situations in which concurrent augmented feedback would be beneficial or detrimental to skill learning
6. Apply two different time intervals associated with terminal augmented feedback in coaching; use appropriate time and activity in feedback to enhance skill learning
7. Learn various ways to reduce the frequency of giving augmented feedback in order to facilitate skill learning and motivation in youth athletes
8. Use specific feedback strategies in the context of competitive table tennis to improve practice and competition performance of youth athletes

2. TYPES AND ROLES OF AUGMENTED FEEDBACK

There are two main types of augmented feedback (Magill & Anderson, 2014):

1. Knowledge of Results (KR): Externally presented information about the outcome of an attempt to perform a skill (e.g., "You missed two out of ten forehand shots")
2. Knowledge of Performance (KP): Information about the movement characteristics that lead to the performance outcome (e.g., "You missed two forehand shots because you made the shots too early")

The two major roles of augmented feedback in the skill learning process are (Magill & Anderson, 2014): (a) to facilitate the achievement action goal; and to (b) motivate the learner. What are the unique benefits of KP and KR? Studies indicate that both KR and KP can be valuable for skill learning when they are used appropriately in different situations (e.g. Silverman, Woods, & Subramaniam, 1999).

2.1 KR

KR is helpful when (Magill & Anderson, 2014):

1. It helps athletes confirm their assessments of task-intrinsic feedback. For example, they are told the spin of the opponent's serves even if they knew it from observation.
2. Athletes cannot determine the outcome of performing a skill from task-intrinsic feedback. An example would be an intermediate player learning counter-

loop, an advanced technique, for the first time.

3. It establishes discovery learning among athletes through the engagement of trial-and-error activity, such as looping balls of different spins.

4. It induces an external focus of attention in practice which enhances learning.

2.2 KP

KP is especially beneficial when (Magill & Anderson, 2014):

1. Skills have to be performed with regard to specified movement characteristics, such as backspin serves.

2. Movement components with complex coordination need to be improved, such as transitions between forehand and backhand.

Verbal KP. A well-represented research by Fishman and Tobey (1978) showed that PE teachers give KP rather than KR 94% of the time. Giving verbal KP more than verbal KR has an advantage of giving athletes more information to help them improve the movement characteristics that underlie skilled performance. Giving KP about one performance feature can lead to improvement in other features too (Magill & Anderson, 2014).

Visual/Video KP. Feedback can usually be given either verbally or by demonstration. Verbal feedback uses cues to indicate how and what athletes have done right or wrong in order to improve the skill. On the other hand, physical demonstration helps correct table tennis strokes by showing athletes the best strokes for that particular skill. A recent study (Siahaan, 2014) showed that table tennis students perform significantly better under direct feedback using demonstration than verbal feedback using cues for developing strokes among students. Augmented visual feedback could also facilitate learning of spatial aspects of the movement effectively (see Sigrist, Rauter, Riener, & Wolf, 2013 for a review).

In video replays, a critical factor for effectiveness is the skill level of the learner rather than the activity. In general, skilled youth athletes receive benefits from video replays when attention-directing instructions are available (Magill & Anderson, 2014). For the features that are difficult to visually discern, such as weight transfer during the shots, verbal KP is preferred to video KP.

Regardless of the type of KP, there is always a challenge for coaches to select the appropriate features of the performance for giving feedback to youth athletes since table tennis includes many complex motor skills (Magill & Anderson, 2014). In this sense, this paper provides coaches with insights into a variety of feedback strategies with which they can match their youth athletes the best.

3. CONTENT

3.1 Quantitative versus qualitative

Quantitative feedback involves a numerical performance standard, whereas qualitative feedback is information regarding the performance quality without numerical values within the feedback (Magill & Anderson, 2014). In table tennis, an example of quantitative feedback could be the exact angle of the motion (e.g. 45 degrees), while that of qualitative feedback could be the relative timing (e.g. too

late) in attacking.

After the beginning stage of learning, youth athletes are able to perform some simple skills (i.e. knowing what to do) during a table tennis practice. Quantitative information becomes more valuable in order to refine characteristics of performing the skill that lead to higher consistency and efficient action (Magill & Anderson, 2014). Nevertheless, coaches ought to be careful in providing quantitative or qualitative feedback that may be erroneous. In anticipation timing tasks, such as forehand and backhand drives, uncertainty may exist when erroneous augmented feedback contradicts visual task-intrinsic feedback of youth athletes. Task-intrinsic feedback is difficult to consciously observe, interpret, and use, so youth athletes may rely on coaches' erroneous feedback as a critical source of information to make future adjustments (Buekers, Magill, & Sneyers, 1994). Inaccurate judgment can also worsen athletes' performance so coaches need to think for "a second" before giving an "autopilot" feedback.

3.2 Internal versus external focus

Coaches usually give feedback in relation to an internal (i.e. movement itself) or external (i.e. effects of movement) focus of youth athletes. An external focus of attention appears to speed up the learning process by facilitating movement automaticity (constrained action hypothesis; Wulf, McNevin, Fuchs, Ritter, & Toole, 2000). Specifically, a focus on the movement effect promotes the utilization of unconscious or automatic processes, whereas an internal focus on an athlete's movements results in a more conscious type of control that constrains the motor system and disrupts automatic control processes of the performance. Consequently, coaches should implement feedback that guides athletes to focus their attention externally on outcomes of movements rather than on internal control processes (Wulf et al., 2000).

Bahill and LaRitz (1984) found that the major league baseball batter visually tracked the ball longer than the college players. Specifically, the major league batter followed the same visual tracking pattern with head position changed less than one degree in every stance. This visual tracking pattern can be applied similarly to table tennis athletes by asking athletes to focus on where and how to hit the ball rather than on their strokes. Furthermore, an external focus on the effects of the movements rather than on the environment helps develop a more effective image of the goal movement pattern. Wulf et al. (2000) compared two external attentional foci in golfputting and showed that focusing on the trajectory of the club was more effective than focusing on the trajectory of the ball towards the hole. Todorov, Shadmehr, and Bizzi (1997) showed that focusing on the kinematics of the end-effector of the limb (e.g., table tennis paddle) gave the learner crucial information about the motor action.

3.3 Positive versus negative

Coaches can present augmented feedback in a way that influences an athlete's feelings of success or failure with positive or negative feedback. Coaches should use positive feedback often as an effective way to help athletes pursue a task goal or

perform in a tournament. Abundant research has revealed positive feedback or feedback after good trials promotes both motivation and performance in motor skills, whereas negative feedback or feedback after bad trials deteriorates them (e.g. Chiviacowsky & Wulf, 2007; Tzetzis, Votsis, & Tourtessis, 2008). Positive feedback, in particular with social comparison, can boost intrinsic motivation, self-efficacy, and confidence of athletes, which in turn enhance their effort, attention, and goal setting (Lewthwaite & Wulf, 2010).

Despite the benefits of positive feedback, research evidence has consistently shown that error information in feedback is more effective in facilitating skill learning (e.g. Wallace & Hagler, 1979), especially in terms of durability and transfer capability (e.g. competition). For example, a study of intermediate badminton players showed that only the combination of error and correction cues increase self-confidence of difficult skills (Tzetzis et al., 2008). Therefore, focusing on what is done correctly while learning a skill is not sufficient by itself to produce optimal learning. Operating on error-based augmented feedback is especially important during skill acquisition to enhance skill performance and self-correct capability (Magill & Anderson, 2014). Since skilled athletes have already developed their self-efficacy and want to seek improvement through refining skills, specific negative feedback about certain techniques is necessary and helpful.

If a youth athlete makes significant mistakes without noticing, feedback should be given immediately to correct them for skill adjustment. Nevertheless, one very important point in using negative feedback is being constructive and "change-oriented". Change-oriented feedback (Carpentier & Mageau, 2013) is empathic, accompanied by choices of possible solutions to correct the problem, based on clear and attainable objectives known to athletes, free from person-related statements, paired with tips, and given in a considerate tone of voice, which positively predicted athletic performance.

4. TIMING OF AUGMENTED FEEDBACK

4.1 Concurrent versus terminal

In table tennis, concurrent feedback means giving athletes feedback while they are about to or in the process of performing a technique; Terminal feedback means giving them feedback after a shot or a point. Though commonly used, coaches should limit concurrent feedback since it directs youth athletes' attention away from the critical task-intrinsic feedback to augmented feedback (Magill & Anderson, 2014). Dependency will also develop if youth athletes receive a lot of concurrent feedback.

While learning more complex and novel tasks, youth athletes can potentially profit from concurrent feedback, such as in situations where relevant features of the task-intrinsic feedback are difficult to discern (Magill & Anderson, 2014). This enhancing effect has been demonstrated in virtual table tennis tasks to prevent cognitive overload (Todorov et al., 1997). But if concurrent feedback is provided in subsequent phases of technique refinement, the error-detection mechanisms of a youth athlete will not improve due to the dependency on feedback.

4.2 KR-delay and post-KR intervals

In table tennis, the KR-delay interval can be defined as the time interval between the completion of a shot and the augmented feedback; the post-KR interval can be referred to as the time interval between the augmented feedback and the beginning of the next trial (Magill & Anderson, 2014). The length of these intervals represents how soon coaches give feedback to athletes between trials.

Regarding the use of KR-delay, it is common to hear that coaches should give feedback as soon as athletes perform a skill or athletes would forget the feedback otherwise. However, coaches ought to examine the difficulty and activity of the tasks carefully to determine the length of KR-delay. Guadagnoli and Lee (2004) found that frequent and immediate feedback would enhance learning for high difficulty tasks. But for low difficulty tasks, learning would be facilitated by less frequent or delayed feedback. During this period, coaches may use a subjective performance evaluation strategy by asking youth athletes to evaluate the performance outcome and/or the movement-related characteristics, which is beneficial to learning (Swinnen, 1990; Liu & Wrisberg, 1997).

For post-KR intervals, a minimum amount for time is suggested to let athletes engage in the learning and planning processes required (Magill & Anderson, 2014). During this period, coaches should not direct athletes to any other activities that require high attentional demand.

5. FREQUENCY OF AUGMENTED FEEDBACK

5.1 Skill level

As mentioned earlier, optimal relative frequency of augmented feedback is specific to a technique and the skill level of youth athletes (see Guadagnoli & Lee, 2004 for a discussion). According to the guidance hypothesis (Winstein & Schmidt, 1990), there is a reduced frequency benefit, especially for skilled players to prevent dependency on feedback. Coaches should provide less feedback in order for them to engage in more cognitive activity during practice, including problem solving for skill improvement.

5.2 Task

Augmented feedback is helpful when performance improvement reaches only to a certain level for some relatively simple skills (Magill & Anderson, 2014), such as footwork. Feedback is needed when athletes are not able to discriminate how much they should move before hitting. Another use of augmented feedback to enhance learning is in complex skills that require athletes to acquire an appropriate pattern of coordination, such as step-around forehand attack.

In the brevity of the response window, the speed of the ball forces table tennis athletes to use internal advanced cues to decide what response is required and how that movement should be carried out (Abernethy, 1991). Thus, coaches ought to train youth athletes with appropriate decisions about what to do (i.e., tactics) by providing learning conditions that are inconsequential for mistakes instead of a pre-established strategy (Sève, Saury, Ria, & Durand, 2003). Being able to deal with

uncertainty and specificity is the key to ultimate success in table tennis so task variability with less feedback should be implemented when youth athletes become more skillful (Raab, Masters, & Maxwell, 2005).

6. FEEDBACK STRATEGIES TO ENHANCE SKILL LEARNING

6.1 Performance bandwidth

Performance bandwidth is a feedback strategy that coaches can use by establishing performance error limits and giving augmented feedback only when the amount of error is greater than a set range. Research with a rapid elbow-flexion task showed that among the three groups receiving KR only when their error is greater than the bandwidths of 0%, 5%, and 10 % respectively, the 10% bandwidth condition resulted in the least variable errors while the 0% group resulted in the most errors (Sherwood, 1988). The finding supported that the reduced KR frequency during practice was the key to improve learning. It is the same concept as the fading technique (Winstein & Schmidt, 1990) in which systematically reducing the KR frequency produced the optimal complex movement pattern.

Performance bandwidth is especially useful in instructing a group of athletes as there are limited opportunities for individual interactions. When using this strategy, coaches should let their athletes know in advance that not receiving KR means they are essentially "correct" to help them understand the implicit message without KR (Butler, Reeve, & Fischman, 1996). The ultimate goal is to encourage players to use their own intrinsic feedback to maintain and to refine their competence in applying various techniques with awareness.

Ripoll (1989) found that for uncertain situations (e.g., a tournament match), the movement preparation phase of table tennis increased, compared to regular training situations. Thus, athletes need a larger time window for visual encoding of cues such that shot direction is anticipated more slowly. Decision Training (DT; Vickers, 1999) is a coaching model that focuses on improving cognitive effort, self-direction, and decision making within the practice environment through cognitive training. Performance bandwidth is one major DT tool shown effective in youth athletes (Chambers & Vickers, 2006). It has the power to not only enhance performance but also athlete-coach relationships and overall development of athletes at all levels (Chambers & Vickers, 2006).

6.2 Self-controlled feedback

Janelle, Barba, Frehlich, Tennant, and Cauraugh (1997) took the concept of dependency on augmented feedback one step further by investigating the effect of personal control over feedback frequency on the performance of a non-dominant throwing skill. The group with self-controlled frequency scored better on form and accuracy in the transfer condition. They unknowingly created a faded feedback schedule by requesting less input as their performance improved. A study on table tennis by Bund and Wiemeyer (2004) measured the self-efficacy of individuals learning the topspin forehand shot, with participants assigned to self-control conditions, where they were allowed to control a preferred aspect of the task (i.e.,

model presentation) or a non-preferred aspect (i.e., task variability), and to control groups yoked (i.e., same feedback frequency) to each condition. Both self-controlled conditions demonstrated higher accuracy and self-efficacy than their respective yoked control conditions. Chiviacowsky and Wulf (2002) stated that self-efficacy might enhance learning by promoting deeper processing of relevant information.

Self-controlled feedback can enhance learning because it tailors the administration of feedback to individual needs and preferences. However, coaches should educate athletes on appropriate decisions in receiving feedback according to their knowledge of the task and their individual capabilities. Furthermore, coaches must monitor and evaluate the effectiveness of their activities at various points to correct their self-controlled feedback because some athletes may not be aware of the need to improve certain movement characteristics.

6.3 Summary and averaged feedback

Feedback strategies that delay and summarize performance information have been shown to be more effective for long-term motor skill learning (Goodwin & Meeuwsen, 1995; Winstein & Schmidt, 1990). Based on the idea of reduced frequency, plausible causes of benefits in summary and average feedback are related to "cognitive effort" (Lee, Swinnen, & Serrien, 1994). The effects of both strategies are similar (e.g., Guay, Salmoni, & Lajoie, 1999), requiring athletes to mobilize cognitive processes for detecting performance information when receiving less augmented feedback. This claim is supported for youth aged 9 to 17 (Ward & Williams, 2003).

Before delivering summary feedback in table tennis, coaches should construct a list of "form cues" on the basis of a skill analysis (see Figure 1) and determine what verbal KP to give with regard to the most critical aspect of a technique. Athletes will be overwhelmed if every aspect is evaluated. Frequently, table tennis skills are divided into 5 phases: a) preliminary movements, b) back-swing or recovery, c) force-producing movements, d) critical impact instant, and e) follow-through. This breakdown process helps coaches examine and give feedback on the mechanics that affect a specific skill component. In order to give effective averaged feedback, coaches should decide which component must be done properly to achieve the skill action goal.

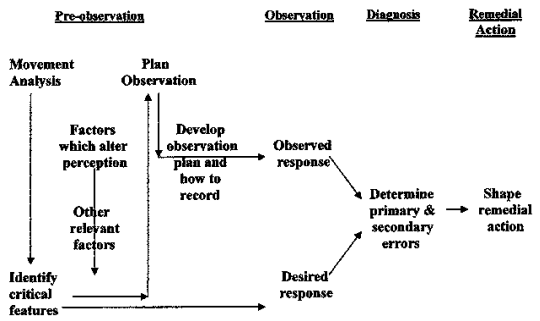

Fig. 1. Skill analysis model. Adapted from "How coaches analyse skill," by R. Fullen, 2002, *http://protabletennis.net/content/how-coaches-analyse-skill*

6.4 Learning model and observation

Modelling is a use of demonstration as a way to deliver information on how to perform a skill (Magill & Anderson, 2014). It helps youth athletes develop a cognitive representation, which is used to regulate movement production and error detection (Carroll & Bandura, 1990). When youth athletes are able to see other competitive players' movement patterns and outcomes, they could perform more similarly to the models. Self-efficacy and motivation also increase after observing the model's improvement (Bandura, 1986). However, these benefits exist only with augmented feedback from coaches (Hebert & Landin, 1994).

One way to create a learning model is to pair up athletes into dyads during group training. Shea, Wulf, and Whitacre (1999) found that participants who practiced in dyads generally performed better than those who undertook only physical practice individually. The learning efficiency of the dyad participants was about twice since the dyads had only half of the physical practice trials.

Another way to create a learning model is to show videos of table tennis players with different styles and levels, followed by presenting feedback on "how to do" and "what to do" for the skill decisions during replay (Raab et al., 2005). The high degree of complexity associated with learning skills holistically encourages the use of implicit rather than explicit cognitive processes. By comparing own performance to a model performer, youth athletes can also identify their strengths and weaknesses. While analysing the performance quality of the model (see Figure 1), youth athletes actually act as a coach to break down table tennis skills into the three main components (i.e., preparation, action, and recovery), identify errors by understanding the mechanics, and then improve their own physical practice.

6.5 Competition orientation

Sève et al. (2003) offer insights into training table tennis athletes on decision making for optimal performance in competition. They analysed the three top table tennis players in the French national men's team through videotape review of their matches. The results revealed the significance of exploratory and interpretive activity (i.e., conducting an inquiry about opponents) at the beginning of a match. Therefore, coaches should often give related feedback to skilled athletes during practice matches, including observing the strengths as well as weaknesses of their opponents to vary effective strokes against different playing styles. In table tennis competitions, as points are won and lost within a small margin, the choices made and strokes produced by athletes largely depend on their psychological states and self-confidence shaped by practice (Sève et al., 2003).

6.6 Motivational feedback

As most coaches should understand, a positive approach to feedback can enhance skill learning in multiple ways. One easy-to-remember strategy to use is "feedback sandwich" (see Figure 2), which includes the following steps (Thompson, 2003):

1. Reinforcement: Tell youth athletes what is good and positive about the techniques. This builds up motivation and creates a good feeling.

2. Corrective instruction: Highlight specific points for correction. Learning progress can be much slower if athletes get into bad habits during practice. This negative feedback serves as guidance to eliminate mistakes.

3. Encouragement: Be positive again once the performer has worked on the piece of corrective feedback. Reinforce them by using praise.

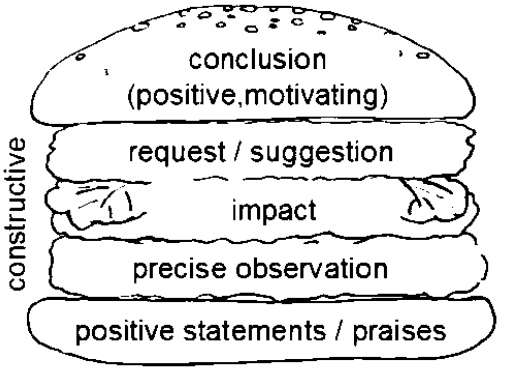

Fig. 2. Feedback sandwich strategy. Adapted from "Feedback is a burger," by J. Schweitzer, 2012, *https://www.tele-task.de/archive/podcast/11384/*

Coaches should notice that not all positive feedback is good. Feedback needs to be concise and specific since athletes can only think about one or two points at a time between trials. Too much information will confuse and demotivate them by slowing the learning process.

7. PRACTICAL IMPLICATIONS

Contrary to many common beliefs, coaches should not feel compelled to give augmented feedback after every practice attempt in order to avoid dependency. Reduced feedback provides opportunities for youth athletes to develop their own sensory feedback to tell them about their performance throughout the process of skill learning. Although many research studies have been done across sports with evidence on augmented feedback, this paper focuses on the sport of table tennis to help coaches learn to use feedback in particular scenarios. The feedback strategies are mostly applicable in other sports with fine adjustments.

In order to link theory to practice with simplicity, here summarize the aforementioned feedback strategies with regard to the eight goals of this paper.

7.1 A combination of augmented feedback

KR. Give outcome feedback to youth athletes when they are not sure about their outcome assessment (e.g., spin of a serve) or cannot tell the outcomes (e.g. "the serve is too high/too long").

Verbal KP. Take step-around forehand attack as an example, it is more useful to give feedback to youth athletes on how they move, change their stance, turn their waist, and swing their paddle in a short time rather than to tell them the results of

the shots.

Visual/Video KP. Use it with attention-directing instructions, such as pointing out what the youth athletes should look for in video replay of their performance, in order to facilitate the learning of performance features and mistake corrections.

7.2 Feedback decision in various practice situations

Use KR in youth athletes at the early stages of learning a specific technique. Otherwise, use mostly KP instead of KR. Visual KP is more beneficial in learning a new technique, whereas verbal KP is preferable when youth athletes have performed a technique fairly well.

7.3 Optimal skill-learning conditions with feedback

Use various dyad practices instead of only individual practices in order to enhance skill learning and efficiency. For instance, coaches can have their youth athletes work in pairs within a training group. Athletes have to observe their partner perform certain skills (e.g. service return) and give him/her feedback, followed by coaches' feedback to athletes as a group.

Also, try to avoid erroneous KR from coaches or peers because inaccurate performance information alters athletes' decision-making abilities, which in turn, increase unexpected performance errors.

7.4 Comparison and contrast of feedback contents

Incorporate more quantitative than qualitative feedback for youth athletes who have passed the initial stage of learning to understand specific technical information for their skill refinement.

Give feedback with an external instead of internal focus of attention. In table tennis, coaches ought to provide external cues for corrective feedback on the motion of the paddle rather than on the trajectory of the ball. A feedback example is "watch the ball all the way to the paddle" in teaching looping, because it directs their external visual attention as long as physically possible.

Provide positive and negative feedback depending on the performance and characteristics of individual athletes, but always convey information in a positive way. Use corrective feedback mainly in teaching a new skill with the "feedback sandwich" method.

7.5 Use of concurrent feedback in practice

Use some concurrent feedback when skilled athletes learn a new technique but reduce the use as athletes make progress. For instance, if a skilled athlete does not know how to distinguish some type of serves, coaches can give concurrent feedback whether the serves are "topspin, backspin, or sidespin" in the beginning so that athletes can successfully return them.

7.6 Application of two time intervals in terminal feedback

Ask youth athletes to reflect on their performance characteristics (e.g. appropriateness of the contact angle) and performance outcome (e.g. speed and

spin) during KR-delay before giving them feedback. Give youth athletes enough time in post-KR intervals (i.e., between feedback and the next attempt) without adding any activities that may interrupt their cognitive process from feedback.

7.7 Feedback strategies for reduced frequency

Performance bandwidth. Use a variety of performance bandwidths to provide feedback, including, but not limited to, speed, spin, accuracy, and agility. For example, coaches can give feedback to youth athletes only when they miss three shots in a row.

Self-controlled feedback. Due to the associated cognitive (e.g., effort) and psychological benefits (e.g., intrinsic motivation), coaches should ideally give youth athletes choices on how and when to receive feedback. For instance, skilled athletes performing a forehand loop may request feedback only when their accuracy drops below 80%. But if their loop shots have enough consistency but not speed and spin, coaches should point that out and help them improve the quality of a technique with demonstration and/or verbal cues.

Summary and averaged feedback. Determine a standard feedback schedule for reduced frequency on a particular skill. For instance, one of the most critical components in pushing is to hit the ball flat at the precise timing and angle. For summary feedback, coaches may focus on how an athlete has controlled the angle and then give verbal KP on whether the shots are high or low for every attempt after 10 to 15 trials. For averaged feedback, on an average of 10 to 15 trials, coaches may comment on how the push shots of an athlete are in general, and which one to two major component(s) needs to be changed for improvement in future trials.

7.8 Feedback strategies from practice to competition

Learning model. Use peer observation and video demonstration paired with specific technical feedback to increase skill learning efficiency.

Competition orientation. Emphasize exploration by providing positive feedback and autonomy during practice. Athletes can then feel more competent and motivated to explore different strategies during competition without fear of losing.

Motivational feedback. Be specific and concise. Words such as "good" or "well done" may be motivational but do not help athletes improve skills. Instead, a specific statement, such as "the forehand loop was powerful as you were using your waist and generating spins", gives athletes both performance and movement information about what they have done well so that they can keep doing it correctly.

8. CONCLUSION

Learning needs to be seen as a relatively permanent change in an individual's capability to perform a skill (Magill & Anderson, 2014). Therefore, coaches should not infer a rapid change in performance or achievement of athletes under practice conditions as true learning, because feedback, modelling, and other variables in practice contribute to the short-term changes. In contrast, true learning is shown in competitions, a transfer condition that feedback does not exist between points. In a

sport with a great deal of uncertainties during matches, important practice goals for coaches are increasing autonomy, problem solving, and self-regulation of youth athletes through augmented feedback. Coaches have to provide choices for youth athletes to decide when and how they would like to receive KR and KP respectively, in order to fulfil their individual needs in skill learning.

Although one of the goals in competitive table tennis is winning, the sport should be more than the "X's and O's". Coaches should never sacrifice the enjoyment of youth athletes for performance by giving detrimental feedback. Coaches, as educators, have the ability to help youth athletes learn crucial life lessons that may empower them to be successful in other life aspects by developing critical thinking and persistence. It is my hope that this paper can serve as a reference to implement optimal feedback strategies for the creation of better coaches and thus better youth athletes.

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GLOSSARY

Feedback Terminology

Augmented feedback – A generic term used to describe information about performing a skill that is added to task-intrinsic feedback and comes from a source external to the person performing the skill; it is sometimes referred to as extrinsic or external feedback

Concurrent augmented feedback – Augmented feedback that is provided while a person is performing a skill or making a movement

Guidance hypothesis – a hypothesis indicating that if augmented feedback is provided too frequently, it can cause the learner to develop a dependency on its availability and therefore perform poorly when it is not available

Knowledge of performance (KP) – A category of augmented feedback that gives information about the movement characteristics that led to a performance outcome

Knowledge of results (KR) – A category of augmented feedback that gives information about the outcome of performing a skill or about achieving the goal of the performance

KR-delay interval – The interval of time between the completion of a movement and the presentation of augmented feedback

Performance bandwidth – In the context of providing augmented feedback, it refers to a range of acceptable performance error; augmented feedback is given only when the amount of error is greater than this tolerance limit

Post-KR interval – The interval of time between the presentation of augmented feedback and the beginning of the next trial

Qualitative augmented feedback – Augmented feedback that is descriptive in nature (e.g., using such terms as good, long), and indicates the quality of performance

Quantitative augmented feedback – Augmented feedback that includes numeric values related to the magnitude of a performance characteristic (e.g., the speed of a pitched baseball)

Task-intrinsic feedback – The sensory feedback that is naturally available while performing a skill

Terminal augmented feedback – Augmented feedback that is provided after a person has completed the performance of a skill or the making of a movement

Table Tennis Terminology

Backspin – A type of spin used mostly on defensive shots (e.g., push or chop)

Counter-loop – To loop a loop.
Footwork – How a person moves to make a shot
Loop – A heavy topspin shot. Usually considered the most important shot in the game
Match – A two out of three or three out of five games contest
Push – A backspin return of backspin. Usually defensive
Serve – The first shot, done by the server. Begins with the ball being thrown up from the palm
Sidespin – A type of spin causing the ball to move left or right after it strikes the playing surface
Spin – The rotation of the ball
Stepping around – A strategy of footwork where the ball comes to player's backhand and the player chooses to step to the backhand direction in order to allow him to play the ball with his forehand (e.g, A right-handed player would step around by moving to the left)
Stroke – Any shot used in the game, including the serve
Topspin – A type of spin used on most aggressive shots, with an extreme amount being used in the loop shot

Structure of technical-tactical activities in table tennis

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Abstract: For the purpose of determining the hierarchical structure of technical-tactical activities in table tennis 110 technical-tactical elements, best representing the entire group of technical-tactical skills used in table tennis, were selected and a new measuring instrument (a questionnaire) was formulated that takes advantage of the expert knowledge of top, world class table tennis coaches. As the experts evaluated the importance and role of technical-tactical elements in table tennis the results have showed that the overall structure of the technical-tactical activities forming the table tennis technique can be divided into three basic groups; a group of technical-tactical elements (A) used in *the phase of preparing one's own and disabling the opponent's attack*; a group of technical-tactical elements (B) used in *the phase of attack and counterattack*; and a group of technical-tactical elements (C) used in *the phase of defense*.

Keywords: racquet sports, technical-tactical skills, expert coaches, cluster analysis

1. INTRODUCTION

Table tennis is considered to be one of the most demanding sports games when viewed in terms of its structural complexity in comparison with other sports disciplines. It is technically and tactically an extremely complex sport because it demands a wide range of technically different strokes which, among other things, depend on the material (type of rubber) with which a stroke is made, and the type of stroke made by the opponent. Therefore, studies of players' technical-tactical activities assume a key role in the structural analysis of table tennis.

While team sports games have attracted a relatively large number of research studies determining and analysing the role of various technical-tactical structures and elements in a game, there are much fewer studies concerning racquet sports (O'Donoghue, 2001; Lees, 2002, 2003; Cabello-Marinique and Gonzales-Badillo, 2003; Zhang and Hohmann, 2004; Zhang et al., 2007; Yu et al., 2010), including table tennis. In previous research studies conducted in table tennis on the structural characteristics of the game, technical-tactical actions during competition have been evaluated (Méndez Patiño et al., 2010; Pfeifer et al., 2010; Pradas et al., 2010; Zhe et al., 2010), different types of players' technical-tactical activities in matches have been analysed (Galina, 1992; Guan et al., 2011; Djokić, 2001, 2007; Dong, 2007; Hao et al., 2007; Zhe et al., 2007; Yu et al., 2008; Wang et al., 2009; Poizat et al., 2012),

and the role of certain technical-tactical elements and the characteristics of certain playing styles have been estimated (Drianovski and Otcheva, 2000; Sun, 2007; Zhao X. et al., 2007; Zhao H. et al., 2007 etc.). The data have primarily been collected by means of video analyses of table tennis matches.

Unlike all of the above-mentioned table tennis research studies which analysed and evaluated the role of only a limited number of technical-tactical contents or activities in the game, the aim of this study was to determine the hierarchical structure of the overall group of technical-tactical elements used in table tennis.

When seeking to establish and scientifically analyse the hierarchical structure of the overall group of technical-tactical elements used in table tennis one of the main issues is choosing the most appropriate method for collecting the data. The main "problem" in collecting data in a table tennis game (like in all sports games) is that there are always two opponents (or teams) confronting each other and therefore the data obtained from the matches also depend directly on the quality of the opponent (Hudetz, 2003). For that reason, it is very difficult to obtain from a video analysis of table tennis matches an objective image of the real value of all technical-tactical elements used in a table tennis game (even if a large sample of matches is observed) because the data obtained merely represent a partial or relative value in the observed matches.

Since a single match only generates a limited amount of information, in order to determine the overall group and more reliably evaluate the importance and role of each individual technical-tactical element, one should statistically analyse a huge sample of matches, point by point, and note every technique performed. In doing so, one should also ensure that players with different styles (systems) of play meet and play with different materials (rubbers) so as to enable all table tennis techniques to appear in the sample in order for them to be adequately evaluated. It is evident that such an approach would present the researcher with huge organizational problems when collecting data in terms of the vast use of time and means, whilst even then it is still uncertain that it would be possible to fully cover the entire group of technical-tactical knowledge and include all the factors that determine the real value and role of the technical-tactical elements of table tennis.

Having that in mind the aims and extent of this research, the authors chose a new approach to solve the mentioned data collecting problem. A new method (compared to those used in previous research studies conducted in table tennis) was therefore applied in this research that takes advantage of the expert knowledge of top table tennis coaches in order to establish the overall structure of the technical-tactical elements used in table tennis.

For this purpose, a measuring instrument (a questionnaire) was formulated in order to gather a large pool of empirical expert knowledge (which the experts have acquired through decades of top-level involvement in the sport) which should enable the collection of the largest quantity of information needed to achieve the aims of the research.

2. METHODS

Sample of entities

The sample of entities comprises technical-tactical elements in a table tennis game that were selected on the basis of information in the professional literature related to the systematization, i.e. division, of technical-tactical elements (Harangozo, 1963; Hudetz, 2000, 2003; Wohlgefahrt, 2004; Molodzoff, 2008; Zhan et al., 2012), along with interviews with table tennis experts.

In table tennis, all strokes (apart from service) are performed at a ball coming from the opponent's side. Therefore, the systematization of the technical-tactical elements depended on the type of ball a certain stroke is performed at. An opponent's balls vary in their speed, rotation, flight path, and landing location (placement) so they also require a player to use different techniques for the same basic stroke. As a result, despite belonging to the same basic family some strokes represent separate techniques since there are significant differences among them in both performance techniques and the tactical effects sought. Based on these criteria, 110 technical-tactical elements (listed in the appendix) best representing the entire group of motor knowledge in table tennis were selected, with the aim to cover all possible technical and tactical applications of each basic technique.

Sample of variables

The sample of variables includes 21 variables divided into six basic groups they were derived from, with each representing an individual segment of a table tennis game (*1. Systems of play; 2. Playing zones (spaces and surfaces) on and around the table; 3. Game phases; 4. Racquet grip styles; 5. Materials used in the game; and 6. Basic tactical means*). The selected variables seek to describe the basic characteristics (attributes) of a table tennis game with which it is possible to significantly distinguish the technical-tactical elements.

1. Systems of play (basic)

- Attack in the table zone (BSPATZ) – an offensive playing system mainly characterized by short and fast attacking techniques carried out from a distance next to the table (up to a maximum of 1 m from the table).
- Attack from a half distance (BSPAHD) – an offensive playing system above all characterized by attacking techniques executed at middle distances (1–2 m from the table).
- Defense (BSPDEF) – a defensive playing system largely characterized by defensive techniques executed at greater distances (more than 2 m from the table).

Variables within this group encompass three basic playing systems which best combine the various playing concepts used in modern table tennis. Although the professional literature (Hudetz, 2003, Wohlgefahrt, 2004; Molodzoff, 2008) outlines various systematizations and classifications of systems of play, for the purpose of this study such divisions are consolidated into three basic playing concepts (within which there are different variations) which all of the experts agreed exist in modern

table tennis (in varying proportions in table tennis for men and women). The purpose of this group of variables is to establish the importance of a single technical-tactical element for a certain system of play.

2. Playing zones (spaces and surfaces) on and around the table

Playing spaces outside the table:

- Zone "A" outside the table (PZZON «A») – the zone next to the table, up to a maximum distance of 1 m from the table.
- Zone "B" outside the table (PZZON «B») – the zone of half distance where strokes are played from a distance of around 1–2.5 m from the table.
- Zone "C" outside the table (PZZON «C») – the zone of distance where strokes are played at distances exceeding 2.5 m from the table.

Playing surfaces over the table (regarding the table's length):

- Net zone (PZZNET)

The zone from which all strokes are played *above the table surface*, at the opponent's balls whose *first bounce is so close to the net* that even the second bounce would be on the table.

- Middle zone (PZZMID)

- The zone from which strokes are played above the table surface, but *close to the edge of the table*, at the opponent's balls whose *first bounce is in the middle zone*, with the second bounce around the table's edge.

- Base line zone (PZZBAS)

- The zone from which all strokes are played outside the table surface, i.e. at the opponent's balls whose *first bounce is close to the edge of the table*, while the contact between the player's racquet and the ball occurs *outside the table surface*.

Variables of this group reveal six playing zones divided according to the positions in which certain techniques are used in relation to the table surface. This division reflects the information available in the professional literature (Hudetz, 2003; Wohlgefahrt, 2004; Molodzoff, 2008), as well as the interviews with the experts. The aim of these variables is to ascertain how successfully a single technical-tactical element is performed from different zones on and around the table.

3. Game phases

- Offensive phase (GPHOFF)
  - Attack with offensive strokes at defensive balls
- Passive defense phase (GPHDEF)
  - Defense with defensive strokes at offensive balls
- Active defense phase – counterattack (GPHCAT)
  - Counterattack with offensive strokes at offensive balls
- Phase of preparing one's own and disabling the opponent's attack (GPHPRD)

- Performing techniques which do not have a distinctly pronounced defensive or offensive component, but are used to disable a successful attack by the opponent or prepare a favorable situation to execute his/her own attack

The variables in this group encompass four basic technical-tactical phases in performance of the game and aim to establish how successfully a certain technical-tactical element is employed in a particular game phase.

4. Racquet Grip styles
- Shake hand grip/classical racquet grip (RGSCLA)
- Penholder grip (RGSPEN)

The two variables in this group describe two basic ways of holding a table tennis racquet. Their aim is to establish how much each racquet holding technique affects the performance of a certain technical-tactical element.

5. Materials (racquet rubbers) used in the game
- Pimples-in rubber and sponge – "backside" (MATBAC): an inverted rubber with pimples made from the most versatile rubber type that is able to generate tremendous spin due to its smooth and tacky surface. It is especially suitable for all styles of play from the all-out attacker to the most defensively minded chopper.
- Short pimples-out rubber and sponge – "soft" (MATSOF): an inverted rubber turned upside down with the pimples out that enables a player to take some of the spin off from the opponent's ball and allows the aggressive attacking of the opponent's shots regardless of the oncoming spin. It is very useful for hitting, blocking and returning serves, but is unable to produce as much spin as an inverted ("backside") rubber.
- Long pimples-out rubber – "grass" (MATGRA): an inverted rubber turned upside down with the pimples out, very similar in composition to short pip rubbers, although the pips are taller with the chief characteristic of reversing the oncoming spin. It is generally used by defensive players who rely on their opponents to make mistakes.

The variables in this group describe three basic types of rubber with different characteristics used in table tennis whose aim is to determine how successfully a certain table tennis technique can be performed with a particular type of rubber.

6. Basic tactical means
- Ball speed (BTMSPE)
- Ball placement (BTMPLA)
- Ball rotation (BTMROT)

Variables in this group describe three basic tactical means players have available when realizing their own tactical ideas. They aim to establish the extent of the role

of a single tactical means in the performance of an individual technical-tactical element.

Selection of the experts

The selection of coaches/experts was carried out according to very strict result criteria, with a condition that a trainer considered an expert had been a leading male or female player or member of a national team that had won a medal at the largest international table tennis competitions (European Championships, World Championships, Olympic Games, European TOP 12), or whose club team had played in the finals of a European club competition (European Champions League, ETTU Cup, Europe Super Cup). In line with these criteria, eight top table tennis trainers (experts) were selected and they agreed to participate in this research.

Measuring instrument

In order to collect the data, a measuring instrument (a questionnaire) used for researching personal opinions was formulated, while in this research the experts evaluated the importance and role of technical-tactical elements in table tennis. The questionnaire is based on the measuring technique of scaling, where the scale is made up of five numerically and descriptively expressed categories (a Likert scale from 1 to 5). They are classified so that each represents a certain level, i.e. they differ from the previous one by intensity, starting from the lowest to the highest degree.

An example of the measuring scale:

How important is a single technical-tactical element in a certain system of play?

1 – Not at all important or hardly important
2 – Below-average importance
3 – Average importance
4 – Very important (above-average)
5 – Extremely important

The table tennis experts were asked to give their opinions in the form of numerical answers in the questionnaire. By circling one of the scores, they evaluated the importance of every single technical-tactical element (listed in the appendix) in relation to every single variable and thus 2,310 scores per expert were recorded (the rating values of the 110 technical-tactical elements in relation to the 21 variables) before the questionnaire was completed.

Data-processing methods

After the data were collected, all of the experts' scores (2,310 scores per expert, 18,480 scores in total) were entered into the matrix before the following data-processing methods were applied:

1. Determining the metrical characteristics of the variables

This entailed determining the level of agreement among the experts (test particles) in the evaluation of common metrical characteristics (objectivity and homogeneity) in both classical and Guttman's models (of measuring), as well as

determining the sensitivity (discriminative ability) of the measuring instrument by analysing the basic descriptive (M, SD, Mdn, MIN, MAX) and distributional (K-S, MaxD) statistical parameters of the variables after condensing the individual experts' scores (test particles) into one unique common score.

2. Analysis of the grouping technical-tactical elements

This involved a hierarchical classification of technical-tactical elements into homogeneous groups by using taxonomic (cluster) analysis, Ward's method or the minimum variance method (Ward, 1963), which amounts to calculating the minimum sum of square discrepancies of any of the two hypothetical entity groups, and performs better than other methods when hierarchically grouping objects (Jain and Dubes, 1988).

3. RESULTS

Determining the experts' level of agreement in evaluations of the common subject of measurement

Table 1 shows the level of agreement among the experts (test particles). Their objectivity was determined by analysing several different reliability coefficients, using the classical and Guttman's measuring method, as well as the representation and homogeneity of the experts when determining the common subject of measurement.

Table 1. Determining the experts' objectivity and homogeneity when evaluating the common subject of measurement by analysing several different reliability coefficients with the classical and Guttman's measuring method.

No.	Variable	$a_{Cron.}$	a_{KC}	I_6	h_1	I_1	$V_{\%}$	msa
				BASIC SYSTEMS OF PLAY				
1.	BSPATZ	0.947	0.948	0.961	1	6.17	77.2	0.994
2.	BSPAHD	0.951	0.952	0.958	1	6.26	78.3	0.995
3.	BSPDEF	0.952	0.954	0.961	1	6.31	78.9	0.995
				PLAYING ZONES (SPACES AND SURFACES)				
4.	PZZON "A"	0.980	0.981	0.985	1	7.13	89.1	0.999
5.	PZZON "B"	0.941	0.945	0.959	1	6.03	75.4	0.993
6.	PZZON "C"	0.974	0.975	0.982	1	6.99	87.4	0.998
7.	PZZNET	0.987	0.987	0.993	1	7.43	*92.9*	0.999
8.	PZZMID	0.969	0.972	0.975	1	6.89	*86.2*	0.997
9.	PZZBAS	0.980	0.981	0.984	1	7.20	90	0.999
				RACQUET GRIP STYLES				
10.	RGSCLA	0.757	0.777	0.963	0	3.38	42.3	0.937
11.	RGSPEN	0.966	0.969	0.974	1	6.84	85.5	0.997
				MATERIALS				
12.	MATBAC	0.908	0.912	0.928	1	4.96	62	0.972
13.	MATSOF	0.952	0.953	0.957	1	6.17	77.1	0.994
14.	MATGRA	0.967	0.969	0.976	1	6.78	84.7	0.997
				BASIC TACTICAL MEANS				
15.	BTMSPE	0.958	0.960	0.967	1	6.47	80.9	0.997
16.	BTMPLA	0.916	0.919	0.932	1	5.50	68.7	0.986
17.	BTMROT	0.975	0.976	0.985	1	6.96	87.1	0.998
				GAME PHASES				
18.	GPHOFF	0.984	0.984	0.989	1	7.30	91.2	0.999
19.	GPHDEF	0.986	0.988	0.991	1	7.48	93.6	0.999
20.	GPHCAT	0.969	0.970	0.983	1	6.78	84.8	0.998
21.	GPHPRD	0.979	0.980	0.985	1	7.17	89.6	0.999

Note. $a_{Cron.}$ – Cronbach's coefficient of reliability measured with the classical measuring method on original (Cron.) and standardized (SB) results on the assumption that all particles equally determine the subject of measurement; a_{KC} – Kaiser-Caffrey's coefficient of reliability measured with the classical measuring method on standardized values of entities on a linear combination of test particles; I_6 - Guttman-Nicewander's coefficient of reliability measured with Guttman's measurement model by transforming the results of entities in particles into universal (Harris') metrics (Harris, 1962); h_1 – homogeneity of the test particles based on the

number of principal components with positive coefficients of reliability l_1 – first typical value of the correlation matrix among the experts; $V_{\%}$ – percentage of common variance of the experts' opinions; msa – Kaiser-Rice's coefficient of the experts' representation determined on the basis of an evaluation of the size of the error expressed as a ratio between the sum of the correlation matrix squares of the anti-image variables and the sum of the correlation matrix squares

The results show that the experts have a high level of agreement, with the variable describing the classical racquet grip (RGSCLA) being the only exception. For all the other variables, the experts reveal admirable objectivity (the measurement reliability level exceeds 0.90) and homogeneity in determining the common subject of measurement independently from the applied measuring model (classical or Guttman's).

Analysis of the descriptive and distributional parameters of the variables

Table 2. Descriptive statistical parameters for all variables obtained by condensing the experts' original scores using Burt's simple summation method (intact realistic metrics)

No.	Variable	M	Mdn	Min	Max	25%	75%	MaxD	K-S	nd
				BASIC SYSTEMS OF PLAY						
1.	BSPATZ	3.10	3.13	1.00	5.00	2.25	4.25	0.101	p< .20	
2.	BSPAHD	3.22	3.38	1.00	5.00	2.63	4.00	0.093	p> .20	
3.	BSPDEF	3.08	3.00	1.00	5.00	2.13	4.00	0.076	p> .20	
				PLAYING ZONES (SPACES AND SURFACES)						
4.	PZZON"A"	3.69	4.31	1.00	5.00	2.44	4.88	0.208	p< .01	*
5.	PZZON"B"	2.51	2.44	1.00	4.50	1.50	3.50	0.159	p< .01	*
6.	PZZON"C"	2.00	1.25	1.00	4.88	1.00	2.88	0.232	p< .01	*
7.	PZZNET	1.65	1.13	1.00	5.00	1.00	1.38	0.341	p< .01	*
8.	PZZMID	2.61	2.63	1.00	4.75	1.13	4.00	0.136	p< .05	*
9.	PZZBAS	3.77	4.25	1.00	5.00	3.13	4.75	0.204	p< .01	*
				RACQUET GRIP STYLES						
10.	RGSCLA	4.36	4.38	3.25	5.00	4.13	4.63	0.140	p< .05	*
11.	RGSPEN	3.52	4.06	1.00	5.00	2.25	4.63	0.187	p< .01	*
				MATERIALS						
12.	MATBAC	4.11	4.13	2.75	5.00	3.75	4.63	0.124	p< .10	
13.	MATSOF	3.58	3.69	1.25	5.00	2.88	4.38	0.097	p> .20	
14.	MATGRA	2.12	1.63	1.00	5.00	1.00	3.13	0.227	p< .01	*
				BASIC TACTICAL MEANS						
15.	BTMSPE	3.21	3.13	1.50	5.00	2.38	4.13	0.105	p< .20	
16.	BTMPLA	3.65	3.81	2.25	4.88	3.00	4.25	0.121	p< .10	
17.	BTMROT	2.84	2.75	1.13	5.00	1.50	4.13	0.147	p< .05	*
				GAME PHASES						
18.	GPHOFF	2.21	1.38	1.00	5.00	1.13	3.63	0.283	p< .01	*
19.	GPHDEF	1.95	1.13	1.00	4.75	1.00	2.63	0.311	p< .01	*
20.	GPHCAT	1.85	1.50	1.00	5.00	1.13	1.88	0.264	p< .01	*
21.	GPHPRD	2.67	2.19	1.00	5.00	1.25	4.38	0.176	p<.01	*

Note. M – arithmetic mean (average value of obtained scores); Mdn – median (middle value of obtained scores); Min – minimum average value of obtained scores; Max – maximum average value of obtained scores; 25% – 75% – interquartile (the range in which there are 50% of central results); MaxD – value of the expected result frequency; K-S – significance of differences between the observed and expected (MaxD) result frequency; nd – * the distribution of results differs significantly from the normal distribution

Table 2 presents the basic descriptive and distributional statistical parameters of all variables after condensing the results of their particles into a unique common measuring result with Burt's simple summation method (Burt, 1941 as cited in Momirović et al., 1999).

Analysis of grouping the technical-tactical elements

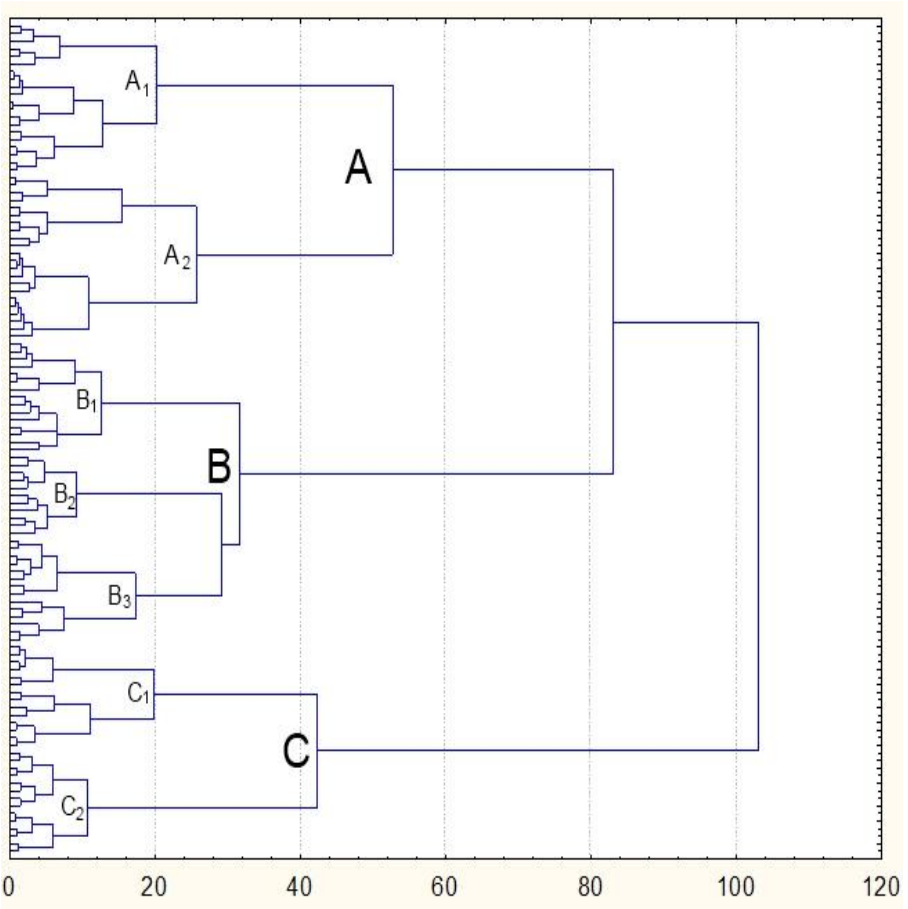

Fig. 1. Hierarchical structure of technical-tactical elements in a table tennis game after grouping them in clusters using Ward's method

Figure 1 presents the structure of the grouped technical-tactical elements by applying a hierarchical taxonomic analysis (Ward's method) in the area of selected variables describing a table tennis game. The technical-tactical elements are classified in three basic groups (A, B and C) according to similarities in the technical-tactical characteristics.

- Group (A) contains technical-tactical elements used in *the phase of preparing one's own and disabling the opponent's attack*

- Group (B) includes technical-tactical elements used in *the phase of attack and counterattack*
- Group (C) encompasses technical-tactical elements used in *the phase of defense*

Within the basic groups (A, B and C), the technical-tactical elements can be further divided into sub-groups (A_1, A_2; B_1, B_2, B_3; C_1, C_2), which have even more homogeneous common characteristics (Table 3).

Table 3. Elements classified in certain sub-groups after grouping them into clusters using Ward's method

Sub-group	Technical-tactical elements
A_1	1, 95, 3, 2, 96, 4, 61, 62, 92, 91, 63, 64, 93, 94, 67, 68, 101, 102, 103, 104
A_2	65, 66, 109, 110, 77, 83, 78, 84, 89, 90, 73, 79, 81, 75, 85, 87, 74, 80, 82, 76, 86, 88
B_1	5, 9, 13, 107, 7, 11, 21, 6, 10, 108, 14, 8, 12, 99, 100
B_2	15, 97, 17, 105, 19, 16, 98, 18, 20, 106, 22
B_3	47, 48, 49, 50, 51, 52, 53, 54, 55, 57, 59, 56, 58, 60
C_1	23, 24, 27, 28, 25, 26, 43, 44, 45, 46, 69, 70, 71, 72
C_2	29, 30, 33, 34, 37, 38, 41, 42, 31, 32, 39, 40, 35, 36

Note. The numbers for the elements correspond to the elements described in the appendix

4. DISCUSSION

The aim of this research was to establish the structure of technical-tactical elements in table tennis. The data were obtained by collecting and analysing the expert knowledge of selected top table tennis coaches, with their professionalism being ensured by very strict criteria for their selection.

The experts strongly agree (Table 2) on evaluating the common subject of measurement (the importance and role of the technical-tactical elements in table tennis) because for all variables, except for the variable describing the classical racquet grip (RGCLAS), they demonstrate very high objectivity (the level of measurement reliability exceeds 0.90) and homogeneity, independently of the measurement model applied (classical or Guttman's).

In the variable describing the traditional racquet grip (RGCLAS), a low level of reliability is achieved on those coefficients based on the classical measurement theory, while in Guttman's model the reliability is very good even for this variable. Due to its diversity, the classical racquet grip facilitates the successful performance of all table tennis techniques and facilitates playing in all systems of play (which, for instance, is not the case with the penholder grip). Therefore, all results for this variable are situated in the upper half of the measurement scale (above a score of 3) because all technical-tactical elements in table tennis can be performed well using this most popular racquet grip technique. The weak variability of the results negatively influences the sensitivity of the measurement instrument, and thereby also the homogeneity of the experts who, within such a narrow range of results, define the main subject of measurement differently such that the overall variance

breaks down. As a result, the variable RGCLAS is the only variable for which the results of the experts' scores are not situated on the same main component (Table 2).

The outcome of the hierarchical taxonomic analysis (Figure 1) reveals that the total structure of technical-tactical elements in table tennis can be divided into three basic homogeneous groups of elements.

The first group (group A) consists of 42 technical-tactical elements used in *preparing one's own and disabling the opponent's attack*. The list of technical-tactical elements making up this biggest group includes those technique elements that represent the basis of the first playing phase, i.e. technical-tactical elements such as placing the ball in the game (*service*), returning the service ball (*return*), as well as elements with which, during a point, one attempts to prepare one's own attack and simultaneously disable a successful attack by an opponent *("short at short", "chop", "flick")*. The technical-tactical elements in this group (group A) can also be divided into two basic sub-groups with more homogeneous common characteristics which are, in relation to the place from where they are played, divided as follows:

- a group of technical-tactical elements (A_1) used in the preparation of one's own and disabling the opponent's attack, and played above the surface of the table (*"flick", "short at short", offensive chop*); and
- a group of technical-tactical elements (A_2) used in the preparation of one's own and for disabling the opponent's attack, and played outside the surface of the table (*service, defensive chop*).

The second group (group B) comprises 40 technical-tactical elements used *in the phase of attack and counterattack* as very *offensive techniques*. The list of technical-tactical elements in this group includes offensive techniques used or with the aim of direct scoring (final topspin or "drive" attack strokes – smashing), gaining or keeping the advantage (*initial topspin, topspin at topspin counterattack, drive counterattack or active block*), i.e. gameplay initiative (*continuation of topspin or strong "drive" attacks*). Technical-tactical elements in this group (group B) can be divided into three basic sub-groups with even more homogeneous common characteristics:

- a group of offensive technical-tactical elements (B_1) played in the attack phase at the opponent's defensive balls, and characterized by playing strokes with a great forward rotation of the ball (*attack with rotation – topspin*);
- a group of offensive technical-tactical elements (B_2) played in the attack phase at the opponent's defensive balls, and characterized by playing strokes without a ball rotation (*attack without rotation – drive attack);* and
- a group of offensive technical-tactical elements (B_3) played in the counterattack phase at the opponent's offensive balls (*active block, drive counterattacks, topspin at topspin*).

The third group (group C) contains 28 technical-tactical elements employed *in the phase of defense* as *defensive techniques*. The list of technical-tactical elements in this group includes defensive techniques used as basic techniques in the defensive

system of play (*backspin defense*), or as "rescue" techniques in difficult situations when the opponent has the initiative in a point (*passive block, flat balls, balloon defense…*). The technical-tactical elements in this group (group C) can be divided into two basic sub-groups with more homogeneous common characteristics:

- a group of defensive technical-tactical elements (C_1) played in the phase of defense in situations of an opponent's evident initiative, chiefly with the aim of returning the ball into the game at any cost and thereby remaining in the point (*passive block, flat balls, balloon defense*); and
- a group of defensive technical-tactical elements (C_2) mainly used as basic techniques in the defense system of play (although they are sometimes also used as "rescue" techniques in offensive systems), as a playing style whereby the player goes tactically and consciously into defense and defends him/herself from the opponent's offensive balls (backspin defense).

The results provided by this research enable a better understanding of the structure of technical-tactical elements in table tennis. Apart from the contribution of adding to technical knowledge of the game, the results of this research provides the basis for evaluating the role of the grouped technical-tactical elements within some of the individuals segments of the game, e.g. in basic playing systems (Munivrana et al., 2015).

5. CONCLUSION

The expert analysis of the structure of the technical-tactical elements in table tennis showed that the whole group of technical-tactical elements forming the table tennis technique can be divided into three basic groups: a group of technical-tactical elements (A) used in *the phase of preparation of one's own and disabling the opponent's attack*; a group of technical-tactical elements (B) used in *the phase of attack and counterattack*; and a group of technical-tactical elements (C) used in *the phase of defense*.

Within those basic groups (A, B and C) the technical-tactical elements are divided into (sub) groups (A_1, A_2; B_1, B_2, B_3; C_1, C_2) in which they have even more homogeneous common characteristics, which in future studies can enable a more precise determination of the role and hierarchical importance of certain groups of table tennis techniques in different segments of the game.

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Appendix: You can obtain the list of selected entities at:
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Anthropometrics characteristics of elite paddle players

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Abstract: The aim of this study was to analyse the anthropometric profile, body composition and somatotype of top-level paddle players ranked top 50 in World Paddle Tour 2014. Sixteen female players participated in this study. A total of fifteen anthropometric variables were recorded for each player. Mean (SD) somatotype of elite female paddle players (EFPP) could be defined as mesoendomorphic (3.8 (0.8), 4.0 (0.7), 2.6 (0.7)). This study provides the biotype data that represent a suitable reference for elite female paddle players. New studies that focus on the importance of anthropometric parameters in paddle performance are needed to clarify their inclusion in talent identification programs.

Keywords: paddle, elite, anthropometry, body composition, somatotype

1. INTRODUCTION

Nowadays, paddle is very popular in Spain and during the last decade it has expanded significantly (Pradas et al., 2014). A 20x10m field is used during competitions and the match requires four players (Figure 1).

Fig. 1. Action during a paddle match.

One of the most relevant characteristics of paddle are the walls surrounding the

field. Players use the walls and ground many times during rallies (Figure 2) (Pradas et al., 2014).

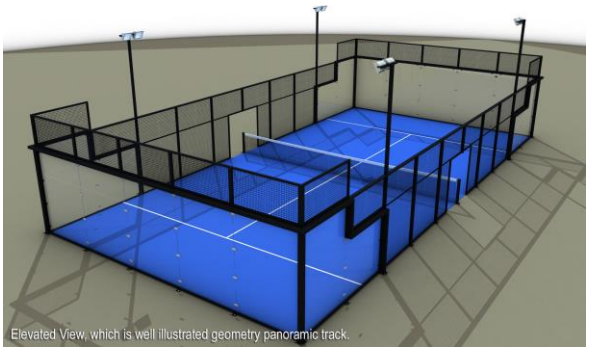

Fig. 2. Walls view (bottom and sides) in a paddle field.

The knowledge of the metabolic demand during sport training and competition has a growing interest for planning and performance aspects (Konig et al., 2001; Leso, Demetrovic and Piric, 1982; Locke, et al., 1997; Majumdar et al., 1997; Montpetit, 1990).

The aim of this study was to analyse the anthropometric profile, body composition and somatotype of top-level elite female paddle players (EFPP) ranked top 50 in World Paddle Tour 2014.

2. MATERIAL AND METHODS

Sixteen (n= 16) EFPP aged between 24 and 37 years (29.8±3.7 years), ranked top 50 in World Paddle Tour (WPT) participated in the study. All subjects performed professional training during at least 9 hours/week, competing in international and national matches during the last 4 years.

Subjects were informed about the nature of the study and they provided a written informed consent for their participation.

The anthropometric measurements performed were: body mass (kg), height (cm), six skinfolds (mm) (triceps, subscapular, illiocristal, abdominal, calf and leg), four perimeters (cm) (arm relaxed, contracted, flexion, calf and leg) and three diameters (cm) (biepicondylar, bicondylar and bistyloid).

The protocol of the International Society for the Advancement of Anthropometry (ISAK) was used to record each measure. All measurements were performed by an ISAK expert. A 5% error was set for skinfold and 2% for the other measures according to the recommendations of Ross and Marfell-Jones (1991).

A skinfold calliper (Holtain Ltd, Crymych, UK) was used in the protocol with 0.2mm precision. In order to determine body mass and height, a Seca 714 (Seca Instruments Ltd, Hamburg, Germany) was used. Diameters were evaluated with a precision measuring tape (Holtain Ltd, Crymych, UK). Body composition was calculated using De Rose and Guimaraes method (1980).

Fat percentage was obtained using Yuhasz's recommendations (1974) and bone

mass following Rocha's recommendations (1975). Muscle mass was calculated using Lee's recommendations (Lee et al., 2000). Somatotype was obtained following Carter and Heath protocols (1990).

3. RESULTS

General data of participants are summarized in Table 1. Data are expressed as mean and standard error of mean. Training hours are summarized in Table 2.

Table 1. General data of EFPP

	Mean (SEM)	Min	Max
Age (yr)	29.82 (±3.7)	24.1	37
Body mass (kg)	60.4 (±4.5)	49.6	65.8
Height (cm)	166.7 (±5.2)	155.4	173,8
BMI (kg/m^2)	21.7 (±1.2)	19.8	23.3

Table 2. Training volume

	Mean (SEM)	Min	Max
Paddle (M/Y)	10,8 (±1)	9	12
Paddle (D/W)	5,5 (±0,7)	4	7
Paddle (H/S)	2,5 (±0,6)	2	3
Paddle (H/W)	15,5 (±3,6)	9	18
Physical conditioning (H/W)	2,5 (±0,7)	1	3

Y: year; M: month; W: week; D: days; H: hours; S: session

The values obtained during the skinfolds measurements, muscular perimeters and bone diameters are summarized in Table 3.

For body composition we used the categories proposed by Carter and Heath (1990). The tested subjects showed a tendency to mesomorphy (4.0±0.7). Figure 3 shows the somatotype pattern recorded for EMPP.

Table 3. Skinfolds, perimeters and diameters

	Mean (SEM)	Min	Max
Skinfolds (mm)			
Triceps	16 (±4.0)	10	22
Subscapular	9,5 (±2.7)	6.2	16
Illiocristal	11.1 (±4.0)	6.2	22
Abdominal	17.9 (±6.7)	8.2	35
Calf	23 (±4.7)	15.4	29.4
Leg	15.1 (±3.9)	9	20
∑6 skinfolds	*92.7 (±18.9)*	*66.8*	*142.2*
Perimeters (cm)			
Relaxed arm	26.7 (±1.3)	24.2	28.6
Contracted arm	28 (±1.2)	25	29.8
Mid calf	52 (±1.7)	49.1	54.3
Leg	35.6 (±1.6)	33.1	38.4
Diameters (cm)			
Bicondylar	8.9 (±0.4)	8.2	9.4
Biepicondylar	6.4 (±0.3)	5.8	6.8
Biestiloideo	5 (±0.2)	4.7	5.5

Table 4. Body composition and somatotype

	Mean (SD)	Min	Max
% fat	17.7 (±2.9)	14.1	25.4
% muscle mass	36.6 (±2.8)	32.7	42.5
% bone mass	15.6 (±0.7)	14.5	16.4
Endomorphy	3.8 (±0.8)	2.7	5.9
Mesomorphy	4 (±0.7)	2.8	5.3
Ectomorphy	2.6 (±0.7)	1.6	3.5

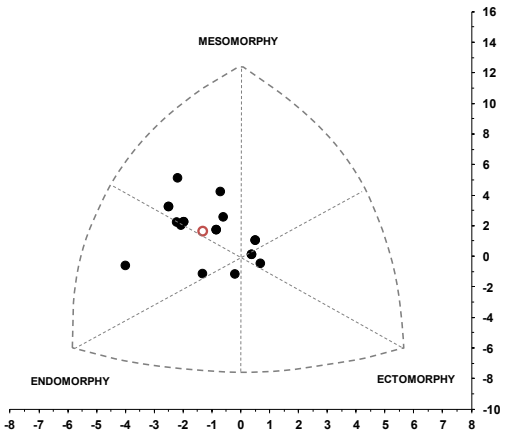

Fig. 3. Somatotype distribution

4. DISCUSSION

Many studies analysed the anthropometric profile, body composition and somatotype in racket sports such as badminton (Centeno et al., 1999; De Hoyo et al., 2007; Faccini et al., 1996; Hughes et al., 1995; Ooi et al., 2009), squash (Alvero et al., 2006; Chin et al., 1995; Johansen et al., 1999; Mellor et al., 1995, Todd et al., 1995), tennis (Barbados-Tudor et al., 2011, Groppel et al., 1992; Hornery et al., 2007; Juzwiak et al., 2008; Smekal et al., 2001; Sánchez et al., 2007; Sanchís et al., 1998) or table tennis (Allen, 1991; Pradas et al., 2012). However, only few studies analysed these variables in paddle (Pradas et al., 2014; Castillo, Hernández and Alvero, 2014).

The mean height of the subjects tested in this study are similar to those obtained by Dias & Ghosh (1995), and Hughes (1995) in badminton female players, but lower than those recorded by Pradas et al. (2013) in table tennis. Height could be an important factor during transitions from net to bottom wall reducing those movements.

BMI values of EFPP are similar to the results achieved by Allen (1991) in table tennis elite female players. Higher BMI values tend to influence the quantity of movements during competition due to the increased energy cost.

The somatotype values recorded reveal a tendency to meso-endomorphy in EFPP. Our values are similar to those obtained in a recent investigation performed by Pradas et al. in EFPP (Pradas et al., 2014; Castillo et al., 2014). However, other racket sports such table tennis report an endomorph somatotype pattern (Pradas et al., 2013).

5. CONCLUSIONS

This study provides biotype data that represent a suitable reference for EFPP.

The somatotype of EFPP who participated in this study tends to meso-endomorphy.

New studies focused on the importance of anthropometric parameters in paddle performance are needed to clarify their inclusion in talent identification programs.

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Core skills for world-level table tennis competition

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Abstract: In the world-level competition, the coaching staff helps athletes develop the essential strengths to excel at the highest level. The strengths are acquired from systematic training to enable athletes with the skills to understand the competition from the physical, technical, and mental perspectives to gain advantages over his/her opponents. In this research, we analysed team China's coaching culture from 2002 to 2014 under the head coach Liu Guoliang. We aimed to derive the key elements of team China's training philosophy, learned from their own success and failure in Olympics and World Championships competitions. Significantly, our analysis led to ten core skills/abilities to focus on. They are: (1) the physical strength and durability, (2) fundamentally sound techniques for steady performance, (3) ability to adjust and execute in-game strategies, (4) right attitude while facing challenges in competition, (5) ability to control the flow/tempo in competition, (6) awareness of the in-game transitions and opponent's strategy, (7) mental strength to compete while trailing behind, (8) skill of in-game analysis, (9) big game experience, and (10) flexibility to integrate with team training/conditioning to peak for tournament. These ten points can serve as the training guidelines for coaches and athletes in preparation for the world-level competition.

Keywords: coaching, training strategy, world-level competition

1. INTORDUCTION

For world-level table tennis players, the purposes of training are to improve their competitiveness by: (i) developing new skills and tactics, (ii) overcoming the technical challenges encountered in prior matches, and (iii) maintaining or strengthening their technical advantages over opponents. In addition to the table tennis techniques, systematic training also helps athletes adjust their physical and mental conditions to peak for winning the world-level tournament.

World-level competitions are the ultimate test bed for any table tennis skills and training physiology. Learning through competitions is essential for both the athletes and coaches. Athletes' strength, experience and problem-solving ability are learned and developed through competitions. Likewise, coaches need competitions to gain experience on in-game analysis to help players understand and summarize the situation for a winning strategy. In this study, we first examine how team China learned from their success and failure in the world-level competitions. We then categorize their learned lessons into ten core skills for the world-level table tennis competitions. The ten core skills provide coaches the guidelines to help athletes educate, evaluate, and condition themselves to achieve successful training and tournament results.

2. METHODS

The subject of this study is the leadership philosophy of Chinese coach Liu Guoliang from 2002 through 2014. Methods include literature review, interview, and induction. Interview subjects include coaches at the provincial and national levels and sport science staffs of team China. The victories and defeats of world-level competitive table tennis players were analysed to derive the top ten core skills for winning in the Olympic Games, the World Table Tennis Championships, and the Table Tennis World Cup.

3. RESULTS

Liu Guoliang retired from competitive table tennis and became coach for the Chinese national table tennis team in 2002. On June 23, 2003, he became head coach for men's Chinese national table tennis team. On February 26, 2013, he was signed to be the head coach for the Chinese national table tennis team at the same time - the fifth head coach succeeding Cai Zhenhua.

During Liu's term as head coach for the men's Chinese national table tennis team from 2003 through 2014, the team won almost all championships in the singles of the Olympic Games, the World Table Tennis Championships, and the Table Tennis World Cup. The only three instances in which the team did not win championships were the Olympic Games 2004 (won by Ryu Seung Min), World Cup 2005 (won by Timo Boll), and World Cup 2009 (won by Vladimir Samsonov).

Based on Liu's leadership philosophy, the ten core skills for competitive table tennis players include: (1) the physical strength and durability, (2) fundamentally sound techniques for steady performance, (3) ability to adjust and execute in-game strategies, (4) right attitude while facing challenges in competition, (5) ability to control the flow/tempo in competition, (6) awareness of the in-game transitions and opponent's strategy, (7) mental strength to compete while trailing behind, (8) skill of in-game analysis, (9) big game experience, and (10) flexibility to integrate with team training/conditioning to peak for tournament.

3.1. Physical strength and durability

The level of specific fitness for table tennis has great influence on the techniques and development of competitive players. Specific fitness for table tennis requires consideration of players' age, physical and psychological development, world trend of table tennis techniques to design specific plans for each player based on individual styles and techniques for scientific training.

Matches of different levels and ages require corresponding fitness levels to achieve desired results. Factors to be assessed for physical training of competitive table tennis players include physical requirements of different rules, daily intensity of matches, physical requirements of a high-intensity match, and time zone differences. Criteria of players' competitive fitness include specific fitness for increasing number and quality of hits, specific fitness for consecutive hits during wide-range fast movements, and the physical modulation from point to point.

In response to new table tennis rules, enhancing specific fitness for competitive table tennis players is a way to increase number and quality of hits and is an issue that requires continuous attention in long-term training. Mentality is the most prominent factor that affects a player's in-match physical condition - warm-up being the second and injury prevention being the third.

3.2. Fundamentally sound techniques for steady performance

One of the critical factors in winning is a player's spontaneity. Despite pre-match preparations, pressure affects in-match techniques, and players have to focus on their skills and tactics. Therefore, the more quickly a player warms up to the match, the higher technical level they can exercise.

The technical capability of a table tennis player is mainly observed in technical style and the main scoring technique. Through systematic and specific training, a player's number and quality of hits can be improved, and arrangement of techniques can be optimized. Coaches and players should train primary and secondary techniques based on technical requirements of matches, including strong techniques and weaker techniques. Whether a player's style rely more on first three strokes or rallies for scoring can be determined for enhancing the main scoring technique. To examine a player's technical competencies, one can observe a player's confidence and errors and the way to score during critical moments of a match.

In the 11-point scoring system, players are required to quickly reach the competitive condition and be well-trained in the techniques for the first five hits. When in a match with an opponent whose style is unfamiliar, specialty skills and tactics should be used; when with an opponent whose style is familiar, advantageous skills and tactics should be used. Factors influencing a player's technical stability include frequency, accuracy, and scoring when using main techniques, player's mentality, and physical condition, which are the foundation of a rallies competition.

3.3. Ability to adjust and execute in-game strategies

Tactical ability is a critical factor in winning. Key points in technical training include maintaining a tactical mentality when in training and enhancing the techniques required. A match requires multiple tactics in place. In a match, a tactical advantage has to be discovered by using various serve-and-stroke combinations to win. Tactics has to be adapted for different players at different times. Tactical variation and adaptability are critical abilities for winning.

Coaches' in-game tactical analysis should include: (i) the tactical intention and type of tactics of the opponent and (ii) the effectiveness of our player's tactical execution. Based on the mental, technical, and tactical assessments, coaches should help players summarize the situation and give both key points and detailed instructions between matches.

In tactical preparation before a match, a player uses imagery practice to think through or write down the tactics being planned for the main opponent. Simple tactical planning include listing brief tactics for serving, receiving, integrating serving and tackling, integrating and arranging serving and receiving, and dealing with rallies, leading or falling behind, and critical points.

3.4. Right attitude while facing challenges in competition

In the 11-point scoring system, the fear of losing is a taboo because it results in players being too nervous to exercise their skills and game plan. Therefore, players are required to be highly capable in mental endurance and modulation, especially when dealing with critical points.

The coach's observation of a player's mentality is the basis for regular counseling and in-match conversations. A player's ability of self-modulation and control is a prerequisite for correctly handling the relationship between training and competition. Winning specific matches can restore and enhance players' confidence. In-match mentality can be trained using simulated matches with reverse scenario training. A focus of observation for the coach and the player are the psychological changes at different scores, the opponent's eyes and expressions, whether hands are shaking, whether the steps were heavy, and whether hits are rigid.

Requirements for matches include 1) full mental and tactical preparation to treat each opponent and each match with respect, 2) striving for surprise wins and avoiding surprise loses, 3) showing the three elements of dominance - aggression in swift attacks, determination, and intelligence in winning key points, and 4) knowing the key factors of winning or losing a match.

3.5. Ability to control the flow/tempo in competition

Training involves determining what to train, how to train, and how much to train. There are two main ways to train in-match flow and tempo - specific simulations and playing opponents of different styles. Controlling the active in-match flow and tempo requires the ability to handle opponents of various styles.

A match is a competition of adapting, reverse adapting, control, and anti-control. When a player encounters difficulties in a match, his or her rhythm will be assimilated into the opponent's rhythm, and the opponent takes control of the match. An active rhythm requires a player to be calm about the tactics of stealing, controlling, adapting, pressing, defending, and reversing in the first six hits and rallies.

A player needs the ability to control the rhythm of the match to do the following. First, open well and win the first round. Second, speed up or slow down the tactical rhythm according to the progress of scoring, so as to take control or turn a passive play into an active one. Third, mind the timing of an active time-out and use the opponent's time-out to adjust tactics. Fourth, actively attack and avoid the opponent taking control.

3.6. Awareness of the in-game transitions and opponent's strategy

The main difference between an experienced world-level player and a regular player with similar skill sets is the awareness of the in-game transitions and opponent's strategy.

In-game transitions could occur in: 1) the first round, critical around, and match round in a seven-round or five-round match, 2) in the beginning, middle, and end of a round in a one-round match, 3) playing the two serves of each round to score, 4) considering the one-point in the first three hits and in rallies, 5) dealing with active,

passive, and rallies situations, 6) playing the critical point, and 7) reacting and controlling the development of the match and the scores.

For regular training a coach needs to conduct thematic specific and non-specific training based on the scenarios above. Only by training with intensity levels that are higher than actual matches can players acquire the critical abilities of controlling the development of a match. Therefore, coaches need to reinforce match development control abilities for players to readily control and react to changes and development in matches.

3.7. Mental strength to compete while trailing behind

In the 11-point scoring system, players are required to quickly reach the competitive condition. When players fail to do this, disadvantage occurs. This could happen at the first four points, in the middle of the 11-pint span, or at the game point. Disadvantage refers to a temporary condition in which the player cannot exercise his or her advantageous skills and tactics. Athletes will need strong mentality, calmness, use of time out, and specific instructions from the coach to devise a strategic plan for reversing the situation.

Factors that help players reverse the condition include willpower, confidence, calmness, tactical variations, and adaptability. Simulation training for reversing disadvantage involves two key scenarios - 1) being in the lead at critical point and cannot win and 2) preparing the timing and mentality for reversing disadvantage with the opponent in the lead.

3.8. Skill of in-game analysis

In-match analytical abilities are a criterion for the value of a coach. Good in-match analytical abilities mean good diagnosis of the player's tactical and mental conditions, enabling high-quality in-match instructions and providing basis for future planning of specific training.

In-match analysis is crucial in enhancing players' confidence. With good in-match analytical abilities, players can understand the factors involved in their winning or losing, helping themselves with tactical variations, adaptability, and controlling the rhythm and development of the match.

In accordance with global trend, it has become an important strategy for teams of the world to cultivate competitive and intelligent players with culture and sophistication to win at the major games of the world.

3.9. Big game experience

Playing tournament matches are important in training and a necessity in obtaining the desired training result. The effectiveness of training can be observed in matches, and the adjustment of training plans should be based on evaluations of match results to integrate training and competition. The purpose of accumulating competition experience is to continuously enhance players' tactical and mental advantage to result in winning.

Competitive experience should include matches of different rules, climates, locations, times, and athletic levels. The development of a competitive table tennis

player is a long journey during which players accumulate their confidence and experience. A player will experience victories and defeats on one level and then move on to a higher level to accumulate more competitive experience.

One characteristic of the 11-point scoring system is that there are particularly many critical moments, and how critical points are handled is a decisive factor in winning and losing. A core factor in how a player handles critical points is largely based on his/her past experience. Coaches and players should understand the positive and negative effects of accumulating competitive experience. Experiences of victory can help a player strive for victory on the next level, and while experiences of defeat can help in obtaining future success, they can also cause mental barrier for a player.

3.10. Flexibility to integrate with team training/conditioning to peak for tournament

A player's competitive capability is an integration of physical abilities, techniques, tactics, intelligence, mentality, and experience. Players will experience highs and lows. For the Olympic Games, international championships, and other important tournaments, use of a team training and conditioning environment will provide the most effective method to help antitheses peaking before the critical matches.

When preparing for competition, each coach and competitive player should establish their own modulation pattern for stronger and weaker opponents and pressure from different rules in order to optimize their competitive abilities for singles and doubles. Players should learn from successful players and overcome negative influences to effectively optimize their competitive abilities and condition and obtain valuable experience.

The training before important matches is crucial in modulating competitive conditions. Understanding the potential challenges in a match and analyse the tactical characteristics of the simulated opponent are the prerequisite of devising an integrated training plan. Coaches should plan for different levels of intensity, competition, stress, and simulative matches to stimulate athletes' reaction in a team training environment.

4. CONCLUSION

World-level table tennis matches are the competitions of overall abilities. Athletes' physical, mental, and technical abilities all influence their performance. To prepare for these abilities, both athletes and coaches should be aware of the unique features of the modern 11-point score system and learn from team China's adjustment to the system by developing the ten table-tennis core skills summarized in this study. Because the ten core skills have been tested and demonstrated in team China's performance at the world-level competitions, our summary will help coaches and athletes of other counties analyse their own training program and philosophy to compete at the highest level.

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A Study of Motivation and Sustained Involvement of University Students Who Played Table Tennis after School

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Abstract: The purpose of this study was to understand the motivation and sustained involvement of students who played table tennis after school while they enrolled in table tennis class as their P.E. Elective. The objects were the students studied at National Formosa University who took table tennis as their P.E .elective in the academic year of 2013. Our research instrument was the University Student Motivation and Sustained Involvement Factor Questionnaire. Descriptive statistics, T-test, one-way ANOVA and discriminate analysis were utilized for statistical analysis. The conclusions of this study were: 1. After school more male students played table tennis than female students did. 2. The students who had taken part in campus cups of table tennis had higher motivation to participate after-school table tennis activities.3. The students who had taken part in campus cups of table tennis had more sustained involvement for after-school table tennis activities.

Keywords: motivation, P.E. elective, sustained involvement

1. INTRODUCTION

School sports has been known as the foundation of national sports, as well as the cradle of social sports (Xu, 1992). Therefore, the cultivation of sports habit is dependent upon the foundation laid school sports.

Students' participation in afterschool sports is closely related their value recognition. Therefore, participation motivation is one of the important factors affecting students' willingness to participate in sports. Students' strong interest in a certain sports and obsession with it directly affect their sustained involvement in sports. If students are willing to continue involving in a sports, their will view is as a hobby (venkatraman, 1990), which will become a habit.

Therefore, the implementation of teaching of a sports item in physical education (PE) class that students are interested in can help them better understanding it. The learning of sports skills enables students to better understand a sports item, which will further become their interest. In addition, they will continue participating in it after school and cultivate a good exercise habit, which is beneficial to the development of a decent leisure activity and adjustment of physical and psychological functions.

According to the review, the sports events held by colleges includes table tennis,

and even a collegiate table tennis completion is also held by various schools, such as National Taiwan Normal University Cup, Fu Jen Catholic University Cup, Tamkang University Cup, and National Formosa University Cup. The number of participants in these competitions has increased year by year. The table tennis competition of annual National Intercollegiate Athletic Games is a must. Although it is under the impact of low birth rate, the number of students electing table tennis class is still very large. Perhaps, it has a lot to do with expanding strength, speed, an agile mind, definite muscular endurance, etc. by playing table tennis, then it greatly increases the health of participants (Lin, 1999). Therefore, this study enrolled the students electing table tennis class as interest option in PH class to understand whether the election of table tennis class increases their motivation to participate in afterschool table tennis sports, the factors affecting students' willingness to participate in table tennis and whether the election of table tennis class increases their willingness to continuously participate in sports. It is hoped that the research results can be provided as reference for PE teachers and administrators to implement the operation of options of PE class or instruction, in order to improve deficiencies, increase students' interest in PE class, and further cultivate students' lifelong sports habit.

2. METHDOLOGY

2.1. Research Subjects

The research subjects of this study were students electing table tennis class as interest option in PH class at National Formosa University in academic year 2014.

2.2. Research Tools

This study referred to the Participation Motivation Scale developed by Ko-hwaWu and sustained involvement scale developed by Yong-fa Wu, and revised them as "Scale on Students' Motivation to Participate in Afterschool Table tennis Sports and sustained involvement." Factor analysis was used to extract four factors – "physiological need," "psychological need," "social need," and "achievement need" from the items of scale on participation motivation. Factor analysis was also used to extract two factors – interest & satisfaction and life centrality from the scale on sustained involvement.

2.3. Data Processing

After the questionnaires were returned, this study excluded the invalid questionnaires, and then registered and coded valid questionnaires. This study used computer package software SPSS for Windows 18.0 to perform statistical analyses, and used the following statistical methods according to the research purposes.

2.3.1. This study used descriptive statistics to analyse all kinds of basic information of subjects.

2.3.2. This study used independent sample t test and one-way ANOVA to test the difference in motivation to participate in afterschool table tennis of students with different background variables. If the results of one-way ANOVA showed that the difference reached significance, Scheffe post hoc comparison was

performed.

2.3.3. The significant level of statistical tests in this study was set at $\alpha<.05$.

3. RESULTS

3.1. Situation of Students' Motivation to Participate in Afterschool Table Tennis Sports and Sustained Involvement

The situation of motivation to participate in afterschool table tennis sports and sustained involvement in table tennis of students electing table tennis class as interest option in PE class is shown in Tables 1& 2. As shown in Table 1, among the four dimensions of the scale on participation motivation, the average score of psychological need was 3.81. Each score of dimension ranked from high to low in sequential order is psychological need (3.94), health fitness (3.88), social need (3.76), and achievement need (3.67). Therefore, the most important factor affecting students' motivation to participate in afterschool table tennis sports was psychological need – To relax psychologically and to alleviate pressure. Then, they considered the best way to increase health was table tennis. However, the influence of achievement need – To increase self-confidence or to generate a sense of accomplishment – was lower. According to this result, we believed that students had strong motivation to participate table tennis after school due to psychological need. It has shown that they gave great care upon relieving pressure and tiredness under heavy school work pressure. Secondly, they believed they could improve their physical fitness by playing table tennis. Based on the study by Hsu and Wu (2007), students thought playing table tennis was not only for increasing exercise efficiency but also improving health condition. That was the most important reason why they were willing to participate table tennis after school. On the other hand, from the lower score of social need and achievement need, we have known that it was weak for students to enhance their friendship and interpersonal relationship and gain accomplishment from representation of athletic, and this result was basically similar with the research of Hsu and Wu (2007). Therefore, it also reaffirmed that students still focused on school work in the university, in addition, most of the participants might think that table tennis was a recreational sport, not like the members of varsity table tennis team focused on technique. Thus, they didn't care about the success of athleticism.

In the scale on sustained involvement in this study, low score was defined as high involvement. Therefore, as shown in Table 2, the average score of two dimensions of sustained involvement was 2.97. Among it, interest and satisfaction (2.83) was higher than life centrality (3.1). Hence, the main reason why students continued involving in table tennis upon completion of courses was that they developed a great interest in table tennis. For instance, according to the study of Chang et al. (1999), the leading reason why students continued involving in recreational sports after school was that they thought the first considering factor to participate recreational sports was nature of sport. This was conformed to our result of research. Moreover, this result was consistent with the studies by Chang (2008) and Yeh (2010) about that the bicycle participants continued involving in bicycle activity. Therefore, regardless of sports

types, interest and satisfaction are the most important factors affecting participants' sustained involvement. As a result, teachers should provide students in different levels with different instruction content to trigger their stronger interest in table tennis, and increase their willingness to continue involving in table tennis as well.

Table 1. Distribution of Scores of Students' Motivation to Participate in Afterschool Table tennis sport

	Average Score	Order
Social need	3.76	3
Health fitness	3.88	2
Psychological need	3.94	1
Achievement need	3.67	4
Total average	3.81	

Table 2. Distribution of Scores of Students' Sustained Involvement in Table Tennis

	Average Score	Order
Interest& satisfaction	2.83	1
Life centrality	3.1	2
Total average	2.97	

3.2. Differences in Students' Motivation to Participate in Afterschool Table Tennis Sports and Sustained Involvement

The differences in motivation to participate in afterschool table tennis sports and sustained involvement in table tennis of the students electing table tennis class as interest option in PE class are shown in Tables 3 to 5. As shown in Table 3, there was a difference in motivation to participate in afterschool table tennis between students who had elected table tennis class and those who had not elected it. As shown in Table 4, there was a difference in level of sustained involvement in table tennis in students of different genders. It was also a difference in level of sustained involvement in table tennis between students who had elected table tennis class and those who had not elected. Moreover, as shown in mean, male students were more likely to continue involving in table tennis than female did. This result was consistent with the study of road runners by Wu. It was a significant difference in sustained involvement in road running between male and female participants. Furthermore, male runners were more likely to continue involving in road running than female did. Besides, the motivation to participate in afterschool table tennis sports of students who had elected table tennis class was stronger than that of those who had not. In addition, students who had elected table tennis class would continue involving table tennis. This result was similar to the study by Hsu (2002). In the research of Hsu, students played table tennis after school of their own accord because of the love of table tennis. For example, they had the table tennis course before, so they had technical and learning experience or they wanted to join the varsity table tennis team. Therefore, they engaged in table tennis spontaneously. This is consistent with the Maslow theory of needs. Apparently, after electing table tennis class, students would develop a strong interest in table tennis, and thus elected it again. In addition, they would be motivated to participate in afterschool table tennis sports and

continue involving in it.

Table 3. The Table of t test on Motivation to Participate in Afterschool Table Tennis Sport of Student of Different Background Variables

Background Variables	Groups	M	SD	t	p
Gender	Male	3.69	0.81	0.82	0.4
	Female	3.6	0.56		
Elected table tennis class	Yes	3.89	0.58	0.42	0.13*
	No	3.71	0.6		
Participated in any competition	Yes	4.2	0.55	-1.61	0.1
	No	3.8	0.6		

*p<.05

Table 4. The Table of t test on Sustained Involvement in Table Tennis Sports of Students of Different Background Variables

Background Variables	Groups	M	SD	t	p
Gender	Male	2.88	1.07	-2.96	0.03*
	Female	3.3	1.09		
Elected table tennis class	Yes	2.86	1.01	2.28	0.03*
	No	3.16	1.16		
Participated in any competition	Yes	2.33	0.53	1.51	0.13
	No	3.01	1.09		

*p<.05

Table 5. The Table of one-way ANOVA on Motivation to Participate in Afterschool Table Tennis Sports and Sustained Involvement in Table tennis of Students of Different Background Variables

Background Variables	Groups	Motivation to Participate	Sustained Involvement	Scheffé post hoc comparison
Grade	1. sophomore 2. junior 3. senior	0.42	0.21	
Experience in table tennis team	1.No experience 2.Department team 3.School team	0.01*	0.01*	Motivation to Participate 2>1 Sustained Involvement 1>2
Weekly sports participation	1.Once 2.Twice 3.Thrice 4.At least four times	0.01*	0.01*	Motivation to Participate 2>1 Sustained Involvement 2>1

*p<.05

As shown in Table 5, difference in team experience and difference in weekly table tennis participation frequency would lead to a difference in motivation to participate in afterschool table tennis and sustained involvement in table tennis of students electing table tennis class. Post hoc comparison found that, the

participation motivation of students who had joined department team was stronger than that of those who had no experience. The participation motivation of students who played table tennis twice weekly was stronger than that of those who played it once weekly. Furthermore, about the sustained involvement, the result is that the students who had not joined table tennis team were more willing to continue involving than those who had joined department team were. The students who played table tennis twice weekly were more willing to continue involving than those who played it once weekly were. It probably was that after the students who had not joined table tennis team trained in the table tennis lessons, they developed an enormous interest in table tennis. So, they were willing to continue involving in table tennis. However, the reason why the participation motivation of students who had joined department team was weaker than that of students who had no experience was if they couldn't participate in the domestic big competition and gain the achievement from it. Nonetheless, the result will be shown until the following research to investigate in the future.

4. CONCLUSION AND SUGGESTIONS

4.1 Conclusion

This study investigated the situation of motivation to participate in afterschool table tennis class and sustained involvement in table tennis of the students electing table tennis class as interest option in PE class. This study enrolled the students electing table tennis class as interest option in PH class at National Formosa University in academic year 2014. The results showed that, the most important factor affecting students' motivation to participate in afterschool table tennis sports was psychological need. The reason that students continued involving in table tennis upon completion of courses was that they developed a great interest in table tennis. The motivation to participate in afterschool table tennis sports of students who had elected table tennis class was stronger, and they would continue involving in table tennis. Moreover, male students who had no experience of joining in table tennis team were more willing to continue involving in table tennis than those who had joined department team were.

4.2 Suggestions

This study has found that students' motivation to participation in afterschool sports and sustained involvement are significantly correlated with interest & satisfaction and psychological need. Therefore, interest option in PE class is one of the important courses inspiring students to continue lifelong sports. Teachers should teach students in accordance with their aptitude to enable students in different levels to perceive the fun provided by sports, increase their motivation to participate in afterschool sports, and further develop their lifelong leisure sports to cultivate their lifelong sports habit and promote national health fitness.

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Contextual Interference Effect of Learning Four Selected Basic Table Tennis Skills of University of the Philippines' Two Major Table Tennis Classes

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Abstract: The study determined which practice schedule is most effective in Contextual Interference Effect in terms of a certain span of time. 36 participants, 12 from the Basic and 24 from the Advanced Table Tennis Classes were involved. A pre-test used Multiball Training where they were told to hit accurately the targets across the other side of the table adopted from the measurement setup of ETTA's Halex Proficiency Awards using only the skills they already have without any experimental intervention. From this, they are categorized into three practice groups namely: random, blocked and serial group using the ABBA assignment/ counterbalance procedure. Results showed that there is no significant difference between the scores of students from the Basic and the Advanced Classes. In terms of skill and form of execution, results showed that there is no significant difference in all the participants even when grouped separately according to the three practice schedules. However, results showed that the Random Practice Schedule, with regard to the period of time, is the most effective because it showed significant differences in terms of the accuracy points gained from pre-test to post test. All three practice schedules showed improvement in terms of accuracy. Random practice schedule gave a faster improvement from pre-testing to post testing. In future researches, in teaching table tennis using practice schedules, the element to be considered is with the proper guidance of teachers.

Keywords: contextual interference effect, multiball training/drill, ETTA's Halex proficiency award table measurements, ABBA assignment/ counterbalance procedure, practice schedules

1. INTRODUCTION

1.1 Background of the Study

Most of the theories in motor skill learning and motor control have one consistent characteristic which is emphasized on the learning and performance

benefits to increase the chances or capability to execute a skill for future performance by competently rehearsing the particular skill by way of practice variability. According to Magill (1998), "Practice Variability is the variety of movement and context characteristics a person experiences while practicing a skill" (p. 371). Because of practice variability, there is a higher chance that the learner of the skill executes the practiced skill correctly in the future (Retention). Retention Test is a way to assess learning experience or phenomena by having a pre-test before the intervention or treatment and a retention interval wherein there is an allotted time to rest before undergoing another test which is the post-test.

Table Tennis is the most popular racquet sport in the world today. Moreover, this sport also ranked as second overall based on the number of people who participate in this sport. Surprisingly, over 10 million table tennis players compete in almost 350 sanctioned tournaments every year (Nelson & MacNee, 1996, p.505; http://www.tulsatabletennis.com/facts.html).

This sport also has one of the fastest innovation in a short period of time from modifying the equipment such as the ball (size of the ball from 38 mm. to 40 mm.; weight and material composition of the ball from rubber and cork to celluloid), racket or paddle (combination bat such as anti-loop and long pimples; black and red racket covering), to the rules (point system from 21 to 11 pts.; expedite system), and dimensions of the playing area (height of net from 6.75 in. to 6 in.) (Royal Navy; Hodges, Nordby, and Seemiller, 2000).

Because of this astounding progress in Table Tennis, it can be considered as one of the most influential sports which can engage people in learning the basic skills required in playing it not for a long time, and at the same time to involve oneself in such kind of sport which provides overall fitness anyone wants to achieve. Hence, Table Tennis is one of the ideal sports to demonstrate how the acquisition of motor learning works.

As one can notice, table tennis is a sport that is appropriate for the Philippine context because the skills that are involved in this sport focus on agility, speed, power, endurance, flexibility, and strength and thus not solely on the height or anthropometric measurements of its participants and that is the reason why anyone can play this game. Furthermore, age and height are not considered as an advantage or disadvantage in playing this sport. It is just purely based on the skills, mental toughness, dexterity and strategy.

This is one of the reasons or objectives of this research, and as a result, the researcher aims to teach the sport in a way that the participant will not only showcase the skills required in performing table tennis well but also, to maximize the learning in this sport in a span of time through variations in practice.

Table Tennis involves many different motor skills that a person should acquire to learn the sport but the first essential thing that a novice should study is how to strike the ball so that it will travel across one side of the table, over the net or to the target area on the other side of the table using a paddle, bat, or a racket. There are different ways or strokes to achieve that objective but there are four basic skills which are most commonly taught by some table tennis teachers, coaches, and instructors and these are the following: 1) Forehand Drive/Topspin; 2) Backhand

Drive/Topspin; 3) Forehand Chop/Push/Backspin; and 4) Backhand Chop/Push/Backspin. Because these strokes are the fundamental skills of table tennis, these skills will be one of the significant instruments which will be used as a way of evaluating the performers' degree of learning the said sport and which will also be assessed to determine in which category these skills will be classified according to its general nature concerning some specific aspect of the skills as what was mentioned from the previous paragraph.

The four selected basic strokes in table tennis that will be used as a mechanism of assessment can be categorized into three motor skill classification systems namely according to precision of the movement; defining the beginning and end points of the movement; and stability of the environment (Magill, 1980, 1985, 1989). In terms of precision of the movement, the four table tennis skills can be classified between the continuum of Gross motor skills and fine motor skills because the said skills involve large musculature and at the same time, small muscles to successfully perform the goal of the skill. Regarding the basis of how clearly defined its beginning and end points, the four table tennis skills can be considered as a Continuous motor skill rather than a discrete motor skill because some external force, which is the ball fed by an opponent or a ball-feeding machine such as the Robo-Pong, determines the beginning and end point of the skill and not the task itself. Lastly, in terms of the stability of the environment, the said skills are classified as Open skill instead of being a Closed motor skill because "the performer must act upon the object according to the action of the object that take place in a temporally and/or spatially changing environment" or in other words, the table tennis skills are "externally or forced-paced skill" which means that the action of the performer is initiated by an external source or a stimulus.

This study does not only focus on the degree of learning and execution of four selected table tennis skills of the participants but also their ability to adapt from a skill to the other novel skill variation under the influence of the treatments or interventions which are the three types of practice schedule that they will undergo, which also have something to do with Contextual Interference Effect.

Contextual Interference (CI) was first demonstrated by William Battig (1979). It is the *interference* that results from performing various tasks or skills within the *context* of practice. There are three types of schedule arrangements in generating CI namely random, blocked, and serial practice schedule. Random Practice Schedule produces high amount of CI which involves random arrangement of trials so that all task variations are performed in each practice session. Blocked Practice Schedule includes low CI in such a way that the practice of each task variation is organized in its own block, or unit of time. Lastly, Serial Practice Schedule is situated in the continuum between the Blocked and the Random Practice Schedule. Contextual Interference Effect occurs when high amount of Contextual Interference results in better learning of the task variations than low amount (Magill).

With regard to CI Effect, Schema Theory was introduced by Richard A. Schmidt. According to this theory, when an individual rehearses a task especially a motor skill, he or she develops a set of rules which is also known as "schema" and it is used by that individual to establish the "parameter values" necessary for producing

variations of that specific skill which he or she practices (e.g. short distance throw is produced by small amount of force). One way to develop how to acquire "schemas" is through a practice schedule arrangement called Varied Practice. Varied practice is a rehearsal sequence wherein the performer practices different versions of action of a movement class during a session. On the other hand, the kind of practice sequence which prevents the development of acquiring schema by executing only one variation of a movement class in a session is what they call as Constant Practice.

Because of these theories, the proponent aims to evaluate and assess the effect of Contextual Interference to the people who want to learn how to play table tennis based on the changes in the level of their performance with regard to the structure of the practice and the nature of the sport. Moreover, the results that the researcher will obtain may make this study of significant use for instructors, trainers, teachers, and coaches in teaching, propagating, and developing the sport, Table Tennis.

1.2 Statement of the Problem

Which schedule practice is the most effective to maximize the learning of a student in playing table tennis within a limited period of time with regard to his or her skill level?

Null Hypotheses:

H_o1. There is no significant difference between the pre-test and post-test results of the students who undergo Random practice schedule.

H_o2. There is no significant difference between the pre-test and post-test results of the students who undergo Blocked practice schedule.

H_o3. There is no significant difference between the pre-test and post-test results of the students who undergo Serial practice schedule.

H_o4. There is no significant difference between post-test results of the students who undergo Blocked, Random, and Serial practice schedule.

H_o5. There is no significant difference between the differences of pre-test and post-test results of the 134.1 (Basic Table Tennis) and 134.2 (Advanced Table Tennis) students who undergo any practice schedule

1.3 Objective(s) of the Study

1. To prove if Contextual Interference Effect really occurs especially in table tennis
2. To determine which schedule practice is more effective in teaching table tennis
3. To distinguish the different styles in teaching skills of a sport
4. To monitor if the students have made improvements in learning the selected table tennis skills after the subjects undergo retention interval (Permanence of the Learned Skill)
5. To assess if the levels of learning and performance benefit of Contextual Interference are similar with low skilled and intermediate to high skilled players of a sport

1.4 Significance of the Study

The importance of the study is to inform not only the students but also the teachers, instructors, and coaches on what will be the more effective and more appropriate way to teach table tennis in a way that the students will easily learn the said sport for only a limited span of time. The expected output will also aid the readers to be inclined in sports especially in table tennis in expanding their knowledge of the skills arrangement or sequencing used in the three kinds of practice schedules.

1.5 Scope and Limitations of the Study:

This study involved PEd 134.1 (Basic Table Tennis) and PEd134.2 (Advanced Table Tennis) students who underwent a series of practices. Likewise, this study used the ball feeding method called the Multiball Training drill in which the researcher lobbed some balls to the participants requiring accuracy, placement and consistent rhythm and speed in feeding the ball. Thus, the researcher was not after the form on how the subject will execute the four table tennis skills but the objective part which was the accuracy. The researcher has done his best to accomplish this requirement of the task and for the sake of validity of the research. The study used only one test which is Retention (Permanence). This test did an important role in discussing which of the practice schedules was the most effective in using the four skills in table tennis. Gender was not a concern in this study because it did not have any significance in the research and it did not affect the results. Additionally, the basis of the results of the participants was the distinction between the pre- and post-tests (Retention Test). The Significant Value that the researcher used to determine significant differences between dependent variables was 0.05 Probability of Error or 95% Level of Confidence. On the other hand, the research study did not include Knowledge of Results (KR) or in other words, Augmented Feedback to the participants because there were studies that show that giving external feedback to a person or to a group of persons has either positive or negative effect to their learning and performance of a motor skill. Because the participants of this study were students, the dropping out of the students in the class was unavoidable which the researcher cannot control. Also, students who got scores which were far different from other participants, also known as outliers, were not included in the calculation because they had a significant effect on the results.

2. REVIEW OF RELATED LITERATURE

2.1 Varied vs. Constant Practice Schedule and the Schema theory

One of the most significant ideas regarding Varied Practice schedule is the Schema theory which pursues the hypothesis that the more varied the practice is the greater amount of learning the skill(s) will be obtained (Schmidt, 1975). This was eventually supported by many claims.

One claim would be from Shea & Kohl's research with the objective of applying 175N of force to press a handle. They used a specific research design for this study wherein the constant group practiced the skill for 289 trials while varied group practiced the skill for four different amounts of force namely: 125N, 150N, 200N and 225N). This brought in more favourable results for the transfer test performed by the varied group compared to the retention test performed by the constant group for the 175N goal. This showed that the varied group performed accurately and therefore implies that the Schema theory is indeed to be considered in the field of studying motor learning skills (Shea & Kohl, 1990, 1991).

Another research study that supports Schmidt's Schema Theory in learning motor skill(s) is the experiment of Shoenfelt, Snyder, Maue, McDowell, and Woolard. The objective of this study is to determine in which kind of practice, between constant and varied practice, will the participants show better learning in shooting basketball free-throws. In this study, the participants who underwent constant practice schedule practice only free-throw shooting at the free-throw line for 3 weeks. On the other hand, the participants who underwent 3 varied practices in which one of these groups included free-throw shooting and others practice at different angles on different area of the court. The results show that the constant group that practiced only free-throw shooting for 3 weeks and had a 2 weeks of retention interval do not improve their level of performance from pre-test (before going through intervention) to post-test (after experiencing intervention) in their retention test of free-throw shooting while the 3 varied groups obtain higher level of performance than their pre-test (Shoenfelt, Snyder, Maue, McDowell, & Woolard, 2002).

2.2 Random vs. Blocked Practice Schedule and Contextual Interference Effect in High-skilled and Low-skilled Subjects in Applied/ Sports/ Field Setting

To justify further the existence of Effect of Contextual Interference, there are also research evidences about it in "real-world" setting especially in sports which illustrate different amounts of learning benefit to people with different skill levels.

Goode and Magill, one of the primary researchers who displayed this learning phenomenon in their study, used college women without previous knowledge in playing or performing skills in badminton as their subject. The objective of their study is to learn and to execute short, long, and drive serves in badminton from right service court. The college women were divided into two groups namely: the blocked practice group who practice one kind of serve each day of each week; and the random practice group who practice every serve randomly each day. They practiced these badminton service 3 days per week for 3 weeks with 36 trials in each practice session. They found out that in retention test, subjects in random practice group outperformed who were those in blocked practice group. They also assessed the subjects through transfer test wherein they performed the same services but at the left side of the service court. The same results took place which represent that in arranging practice schedule in random manner, the learners of the skill will adapt to different and changing condition with no troubles at all rather than in blocked fashion of arrangement (Goode & Magill, 1986).

Contextual Interference effect does not only occur in subjects with low skill level

(beginners, novice, etc.). In the study of Hall, Domigues, and Cavazos, the subjects that they used are skilled baseball players and their goal was to practice hitting different kinds of pitches such as fastballs, curves, and change-ups so that they improve their batting performance. The baseball players batted 45 extra pitches 3 days each week for 5 weeks. The baseball players who followed blocked practice program hit one kind of pitch per day while players who followed random arrangement of practice rehearsed batting 3 types of pitches in random order for each day. To assess the learning of batting performance of the baseball players, they pitched the 3 types of pitches in random fashion which simulates real-like game condition. They discovered that the random group surpassed the batting performance of the blocked group (Hall, Domigues, & Cavazos, 1994).

The ability of the learners in sports affects their acceptance of the knowledge of skills being taught to them. An example is the study by Hebert, Landin, and Solmon in which they examined the effects of practice schedule on the performance of low and high-skilled students. 83 college undergraduates enrolled in five tennis classes and completed a pre-test on the forehands and backhand ground strokes, practiced these skills under a blocked or alternating schedule, and then completed a post-test. Results showed that the ability of the student affects his or her performance. High-skilled students' performance were not affected by the practice schedule be it in a varied one or constant whereas low-skilled students assigned to the constant schedule had higher post-test scores than when in varied schedule (Hebert, Landin, & Solmon, 1996).

Also, a study by Buck, Harrison, and Bryce showed the difference in performance between high-skilled and low-skilled subjects in learning volleyball. Its objective was to determine the relationship between learning trials and achievement for four volleyball skills (set, forearm pass, serve, and spike. The results indicated that the ability of the students count in the level of their performance. "Low-skilled students did not get as many correct or total trials as high-skilled students" (Buck, Harrison, & Bryce, 1991).

2.3 Strategies in Teaching Table Tennis

The following are literatures on the techniques and methods of teaching skills in table tennis.

In "A Comparison of the Effectiveness of the Command Method and the Task Method of Teaching the Forehand and Backhand Tennis Strokes" by Mariani, "results revealed that the task method was superior to the command method in the teaching of the backhand tennis stroke, but no significant difference was found between the two methods in the teaching of the forehand stroke" (Mariani, 2013).

An interesting method also in teaching table tennis is a method proposed by Matsushima in his study "A Learning Approach to Robotic Table Tennis" wherein a robot controls the return of an incoming ball to a desired point on the table with specified flight duration (Matsushima, 2005).

Also, a technique known as mental rehearsal used in the study by Lejeune and Decker which is combined with observational and physical techniques "appeared to improve table tennis performance both qualitatively and quantitatively" (Lejeune &

Decker, 1994).

Learning by analogy is also an option as teaching strategy in table tennis. In a study by Liao and Masters, two experiments were performed so as to explore the hypothesis that this type of teaching strategy will "invoke characteristic of an implicit mode of motor learning". The first experiment involves novices to learn to hit forehand topspin implicitly, explicitly or by analogy. In the second experiment, "the performance of an explicit learning group was found to be impaired by both a stress intervention and a thought suppression intervention, whereas the performance of an analogy learning group was not". The results for these experiments established a conclusion that analogy learning may be an effective method for teaching skills implicitly in sport (Liao & Masters, 2010).

2.4 Assessment of Learning Table Tennis

The next thing that an instructor needs to do after teaching skills of a certain sport, he or she needs to evaluate at what point do his or her learners acquire the skills that he or she taught. English Table Tennis Association (ETTA) organized a scheme, which they called as the Halex Proficiency Awards, wherein they try to measure to what extent the candidates can execute the skills in table tennis in terms of their control of length and direction of the ball, consistency, accuracy, mobility, and their general ability. It also encourages sound system of learning the game as well as gives opportunity for the players to evaluate their "standards of play" and the improvement they are making in playing the said sport. This scheme is classified into three levels namely: Halex Bronze Award, Halex Silver Award, and Halex Gold Award. Every level requires tasks that the candidate should perform to pass that particular level but the Halex Gold Award is evaluated only at formal sessions organized by ETTA. Each test or level requires a controller, scorer, and assessor. The controller is the one who feeds and places slow and steady balls to required targets. Appropriate Target areas are the center points in the table with a measurement of 18 inches square or 45 cm. These are the areas where the candidates and the controller need to place their struck balls depending on what skill is to be measured. Lastly, the duty of the scorer keeps count of successful attempts and errors while the assessor is the one who will decide if the quality of the performance is appropriate for each test (Neale, 1978; Myers, 1977; Leach, 1978).

3. METHODOLOGY

3.1 Research Design

The Research Design which the researcher used for this study was an Experimental Design. In an experimental design, controlling or manipulating events or variables are necessary to provide a solution to the research problem or questions (Vincent, 1999). Additionally, the kind of experimental design that the researcher decided to choose was the Pretest-Posttest Three Experimental Group Design because the researcher believes that this research design is the most appropriate and the best way to collect the data that the researcher wants to measure, to organize, to treat, to analyse, to interpret, to evaluate, and to assess. Speaking of

data, the information that the researcher wants to gather and at the same time, will give comprehensive answer to the research question is through quantitative and qualitative type of data. The quantitative data was obtained through the results of pre-test and the post-test, which consists of the Retention Test, of the participants. Furthermore, this objective kind of data clearly presented the progression of the learning by the performance of the subject from his or her own pre-test up until the post-test. On the other hand, the qualitative type of data was gathered on the actual post-test wherein the quality of execution of the skills was evaluated based on some criteria in performing the skills properly.

In this research design, there were three experimental groups for each class of PEd 134.1 (Basic Table Tennis) and PEd 134.2 (Advanced Table Tennis) class. The first experimental group was the part of the sample that will undergo Blocked practice schedule, the second group consisted of those who are going to undergo Random practice schedule and lastly, the third group were those who will follow a Serial-typed schedule of practice.

In terms of the researcher's research design, the independent variable will be the three types of schedule of practice, which are the random, blocked, and serial practice schedule that were used as the treatment, because it is the variable which was controlled by the researcher and it is considered as the cause of the changes of the dependent variable. Conversely, the dependent variable in the research will be the post-test that is composed of the Retention test.

3.2 Subjects and Sampling

The subjects involved were the students of the University of the Philippines (UP) who took up Table Tennis class particularly PEd 134.1 (Basic Table Tennis) and PEd 134.2 (Advanced Table Tennis) class. Students who were part of Basic Table Tennis class were the ones who did not have experience playing the sport at all. On the other hand, the subjects in Advanced Table Tennis class were students who have knowledge playing and/or competing in the said sport. Some of the subjects in this class were table tennis players. The reasons why the researcher decided to use UP students who are taking up Table Tennis at the time rather than other category of the population are because of the skill levels and the pace of their improvement to learn the selected skills of the sport. Moreover, they do not have similar knowledge and abilities on how to execute the skills in terms of the form of execution, timing, footwork, ball control, spin, force to apply, etc. This assumption was made by the help of a table tennis expert through his subjective judgment, observation, and analysis (Expert Validity). Because the two classes of Table Tennis (PEd 134.1 and PEd 134.2) have different skill levels, there will be an assumption that the knowledge in skill learning is also different with one another. Likewise, the researcher took into consideration that individuals with low skill level have a more distinguishable and larger room for improvement than moderate to high skill level may be because of Performance Plateau or Ceiling Effect that the moderate and high skill level experiences during learning and performing motor skills. However, the researcher chose to include the group of population with intermediate or expert skill level because the researcher wants to compare, despite different skill levels, the degree

by which they learned the skill of a sport based on the pace of improvement depending on the type of practice schedule that they followed.

The researcher used Convenience sampling because the total number of population in those two classes of table tennis was sufficient for the research. The size of the population was neither too big nor too small.

3.3 Research Instrument

The research instrument that the researcher used was the Multiball Training or Drills. Since Robo Pong equipment is a new apparatus and is more expensive, some instructors who want to teach table tennis may not afford to use such. Thus, Multiball Training or Drills was decided for use in which the instructor will feed balls to the participant and he/she will hit the ball from his or her side of the table across the other side of the table over the net.

Although, one advantage of using Robo-Pong rather than the Multiball Drill is that the Robo-Pong will provide a constant and consistent feeding of the ball in which every performance from one attempt is similar to the next attempt and this environmental context does not involve Intertrial Variability. Intertrial Variability is a type of environmental context in which every attempt of a skill is similar with another attempt. In this method, the regulatory conditions will be the same. Another advantage of using the Robo-Pong is that it will not make the instructor get tired or being in the state of fatigue. If this happens, the instructor may feed the ball different from the first attempt to the succeeding attempt which can lead to the violation of Internal Validity of the research.

The disadvantage of the Robo-Pong is that the environmental context of the practice sessions does not simulate the test situation. Many studies already show that the practice conditions should be the same with the test situation. In practice sessions, Intertrial Variability is involved from which the participants will practice with a partner so that the ball will be different from the next. While at the test situation, characteristics of most of the balls that the Robo-Pong will feed are not so different from each other hence, intertrial variability is not involved.

On the contrary, Multiball Drill or Training will be a competent method than the Robo-Pong in terms of the characteristics of the environment between the practice sessions and the actual test situation. Intertrial variability is involved in practice sessions which are the same with the Multiball Training. Thus, there will be a higher chance of transfer of learning from the practice sessions to the actual test condition. The only disadvantage of Multiball Drill is that it will be exhausting for the accomplice to feed and pick the ball from the floor.

3.4 Procedures

On the first day of class, participants engaged to play the sport. All of those went through pretesting. This test acted as the assessment of the participants' initial knowledge and their familiarity about the sport. The said test was the basis of their improvement from the time they undergo treatment or intervention phase. In this test, these participants performed four selected basic table tennis skills namely: the forehand topspin/drive, backhand topspin/drive, forehand backspin/chop/push, and

backhand backspin/chop/push. The data gathered come from the results of the pre-test from which it was determined through the number of successful attempts that the participant executed. To collect these data, the research instrument that the researcher used was the Multiball Drill Training because the Robo-Pong, a machine which feeds pingpong balls, was not available that time. Using any of the methods, the researcher fed 40 balls for every kind of skill. Then, the student struck the ball and aimed for the designated target on the opposite side of the table adopted from the measurement setup of ETTA's Halex Proficiency Awards. The results were recorded by the participants based on the number of balls struck and hit the target and eventually, encoded by the researcher.

After the pre-test has been taken, using the ABBA assignment/ counterbalance method, the researcher divided each class to three divisions namely: random group, serial group, and blocked group. The Random group is the part of the population who underwent Random practice schedule in which every practice session, they performed the four selected skills in table tennis. The Serial Group is the portion of the population who followed a series arrangement of skills rehearsal which is a combination of both Random and Blocked wherein every practice session, the participants performed a skill and move on to the other skills either after every trial or after every specific number of time with a fixed order or sequence. Lastly, the Blocked group is the fraction of the population who underwent Blocked schedule of practice in which every practice session, the subjects learn only one of the four selected skills for the whole time.

The subjects practiced the four table tennis skills based on the practice schedule assigned to them 2 days per week. The practice sessions were monitored 3-4 weeks. After these, a retention interval was given to the subjects. In this retention interval the researcher did not allow the students to practice the skills and therefore the researcher used this time period to turn their attention to other things and not on practicing by discussing, lecturing and giving the students an idea about the kind of sport that they were taking up in their class, which was table tennis, by discussing the history of the sport and the changes or modification that it faces when the time passes by. To thoroughly discuss the nature of the sport, the researcher demonstrated the skills through the help of some instructional materials such as video clips which showed the proper technique, strategy, and form on how to execute the selected table tennis skills that the researcher was focusing on the research. Likewise, the researcher showed short video clips of some famous table tennis players in some remarkable match to give some amount of motivation to the subjects by letting them see how wonderful table tennis will be if they learn and possibly, become good at playing it. Subsequently to the retention interval, the subjects took the post-test which consisted of the Retention Test. In the Retention Test, the participants performed the same skills that they practiced before the retention interval and at the same time, they were rated by an expert in the field of table tennis in terms of the form of execution of the skills from a practice environment to a game simulation condition. The table tennis expert classified every participant's stroke form into 5 categories namely: poor, satisfactory, good, very good, and excellent.

The next step that the researcher did was to gather the results and encoded it. After encoding the results the researcher analysed the data through the use of the statistical tools which is the T-test (Independent and Dependent/ Repeated Measures), the Factorial Analysis of Variance (ANOVA), and the Chi-square. Because of these statistical tools, the researcher can answer the research question and make a conclusion and recommendation about the research.

3.5 Analysis of Data

Parametric and Non-parametric data analyses were used to answer the research problem by testing the null hypotheses that were previously presented. Parametric data analysis was used for interval or ratio kind of data. One of the parametric statistical tools that the researcher used to the gathered data for the statistical analysis of the research was the T-test. Dependent T-test was used to determine if there is a significant difference or improvement between pre-test and post-test (retention test) of every table tennis skill for each kind of practice group of each class. On the contrary, the Independent T-test was used in determining significant differences of pre-test and post-test (retention test) results between PEd 134.1 students and PEd 134.2 students. These calculations will show the distinction of their knowledge in learning and performing the selected table tennis skills. Another parametric statistical tool is the Analysis of Variance (ANOVA) or Factorial ANOVA. ANOVA or Factorial ANOVA was used for analysing significant differences among post-test (retention test) of the 3 kinds of practice schedule group for each class. This statistical analysis instrument displayed which practice group for each of the two classes has obtained the greatest amount of learning the skills after undertaking different kinds of treatments or interventions. Non-parametric data analysis was used for Nominal or Ordinal kind of data. Because an expert will rate and classify based on how the participants perform the table tennis skills, nominal data will be gathered. Using the Chi-square, the researcher could determine if there is a significant difference in learning among the three kinds of schedule of practice in which the participants undergo. For the convenience of analysing the data, the researcher computed the collected data through the use of a statistical software called SPSS.

4. PRESENTATION AND ANALYSIS OF DATA

4.1 Objective (Parametric)

PRETEST

As per conduct of pre-test with PEd 134.1 and PEd 134.2 students, the table below shows the preliminary scores of the participants using what they know about playing table tennis.

Table 1. Descriptive Statistics of Overall Pre-Test Results

	Skill Level	N	Mean	Std. Deviation	Std. Error Mean
Average Pre-test Score	Basic	24	16.813	3.8809	.7922
	Advanced	12	18.542	3.1942	.9221

In the table, the total number of participants in the basic skill level is twice as much as those of the advanced. This was obtained through convenience sampling which is the use of these available resources for the conduct of the study. Next are the values for the means or the averages of the scores of the N values of the two skill levels. Next are the standard deviations which indicate the variation between the individual scores. The purpose of this is to determine how far the scores are from one another. Based from the table, the scores are about three units away from each other. The last column shows the standard error of the mean that the sample mean is related to the population mean.

The next step in the procedures of the study is the testing of the normality of the average pre-test scores. Below is the graphical representation of this process along with its normal curve.

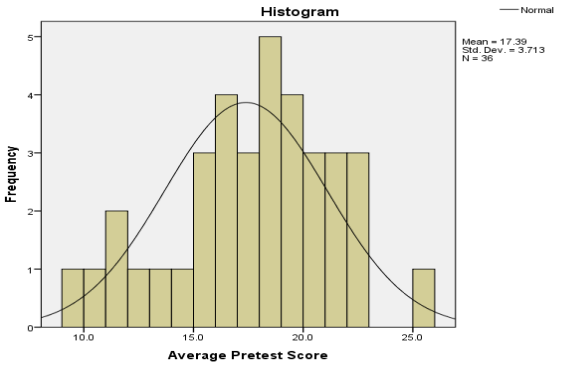

Fig. 1. Average Pre-test Scores' Normality

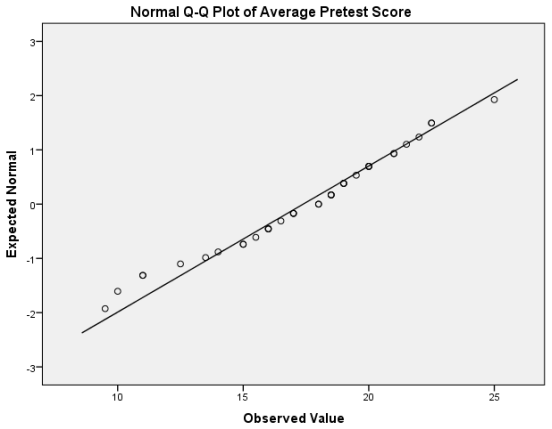

Fig. 2. Normal Q-Q Plot of Average Pre-test Scores

Both of the graphs above show that the data are in normal distribution. Figure 2 shows the mean which is 17.39 and therefore can be seen in the graph to be showcasing a normal curve signifying the normal distribution of the data with a bell-liked shape diagram. The test of normality is highly necessary to conduct the parametric data analysis such as T-test and ANOVA/ Factorial ANOVA.

Table 2. Independent T-test between the two Classes

		T	Df	Sig.(2-tailed)
Average Pre-test Score	Equal variances assumed	-1.332	34	.192
	Equal variances not assumed	-1.422	26.362	.167

For the independent t-test between the two classes, the Levene's test for equality of variances signifies that if the F-value has a Significance value that is greater than the .05 significance level, then one should read and consider values from the first row which states "Equal Variances Assumed". The value that is necessary in this table for the purpose of the study is the one under the Sig. (2-tailed) which if greater than the 0.05 significance level could mean that the difference between the scores of the participants from the two skill levels is not significant. Therefore, there is no comparable difference between the skill-playing of the two classes in terms of accuracy.

The next step used in the procedures is the ABBA assignment/ counterbalance method wherein participants are assigned to the different sequences, which are in this case, the random, serial, and the block practice schedules, according to their scores in the pre-test. In order for this assignment's effectiveness be tested, the following tables show that all three practice schedules have no significant differences.

Table 3. ANOVA between the Pre-test Scores of three Schedules of Practice
Average Pre-test Score

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	11.375	2	5.688	.398	.675
Within Groups	471.180	33	14.278		
Total	482.556	35			

Using the One-Way Analysis of Variance to test the equality of the three practice schedules at a time results showed that there is no significant difference between the three practice schedules since the value shown is .675 which is a greater value than the study's significance level.

Table 4. Multiple Comparison between the Means of the three Schedules of Practice

Dependent Variable: Average Pre-test Score
Tukey HSD

(I) Practice Schedule	(J) Practice Schedule	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Random	Serial	-1.3182	1.6112	.695	-5.27	2.63
	Blocked	-.1981	1.5225	.991	-3.93	3.53
Serial	Random	1.3182	1.6112	.695	-2.63	5.27
	Blocked	1.1201	1.5225	.744	-2.61	4.85
Blocked	Random	.1981	1.5225	.991	-3.53	3.93
	Serial	-1.1201	1.5225	.744	-4.85	2.61

Based from the table, the results showed that there is no significant difference between the three practice schedules

POSTTEST

What follows the procedures in displaying the pre-test results is the post-test. The succeeding table is the summary of the post-test results, which is also the same with the pre-test showcasing the descriptive statistics for the scores between the basic and advanced skill-levels participants.

Table 5. Post-test Results between of the Two Classes

		t-test for Equality of Means						
		T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
							Lower Bound	Upper Bound
Post Test Score	Equal variances assumed	-.21	34	.829	-.37	1.73	-3.88	3.13
	Equal variances not assumed	-.22	23.28	.827	-.37	1.69	-3.87	3.12

Again, results showed that there is no significant difference found between the two classes even with the use of experimental intervention in teaching table tennis. Therefore, still, even with the application of the tests made for the participants, the classes, be it basic or advanced, is still not significantly different from one another.

Table 6. Independent T-test between the Difference of Pre-test and Post-tests of the two Classes

		T	Df	Sig.(2-tailed)
Difference of Post-Pre-test	Equal variances assumed	.717	34	.478
	Equal variances not assumed	.670	18.584	.511

The results also showed that there is no significant difference between the two classes considering both the pre-test and post-test results by getting its difference.

Table 7. Between-Subjects Factors

		Value Label	N
Practice Schedule	1	Random	11
	2	Serial	11
	3	Blocked	14

Table 8. Descriptive Statistics of the Pre-test and Post-test of every Practice Schedule
*Measure: MEASURE_*1

Practice Schedule	test	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Random	1	16.909	1.14	14.591	19.227
	2	20.182	1.42	17.294	23.069
Serial	1	18.227	1.14	15.909	20.545
	2	22.636	1.42	19.749	25.524
Blocked	1	17.107	1.01	15.053	19.162
	2	19.071	1.25	16.512	21.631

Using Factorial ANOVA, results showed that there is no significant difference between the pre and post test scores but there is a significant difference between the scores for each group for the post-test.

Table 9. Descriptive Statistics of the Estimated Marginal Means of the three Practice Schedules

Measure: MEASURE_1

Practice Schedule	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Random	18.545	1.002	16.507	20.584
Serial	20.432	1.002	18.393	22.471
Blocked	18.089	.888	16.282	19.897

Table 10. Pairwise Comparisons of Schedules of Practice

Measure: MEASURE_1

(I) Practice Schedule	(J) Practice Schedule	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Random	Serial	-1.89	1.42	**.577**	-5.461	1.688
	Blocked	.46	1.34	**1.000**	-2.922	3.834
Serial	Random	1.89	1.42	**.577**	-1.688	5.461
	Blocked	2.34	1.34	**.269**	-1.035	5.720
Blocked	Random	-.46	1.34	**1.000**	-3.834	2.922
	Serial	-2.34	1.34	**.269**	-5.720	1.035

Results showed that that there is no significant difference between the three practice schedules because there is no two practice schedule that has a mean difference which is less than .05 level of significance.

Table 11. Descriptive Statistics of Random Group

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair1	Average Pre-test Score	16.909	11	3.4987	1.0549
	Postest Score	20.18	11	2.601	.784

Table 12. Relationships between Pre and Post-test Scores of Random Group

Paired Samples Correlations

		N	Correlation	Sig.
Pair1	Average Pre-test Score & Postest Score	11	.508	.111

Table 13. Differences between Pre- and Post-test Scores of Random Group
Paired Samples Statistics

		Paired Differences					T	df	Sig (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval				
					Lower	Upper			
Pair1	Average Pre-test Score – Post-test Score	-3.2727	3.1254	.9423	-5.3724	-1.1730	-3.473	10	**.006**

The results showed that there is a correlation between pre-test and post-test of the participants under Random Group. The correlation coefficient between pre-test and post-test is 0.508.

There is a significant difference between pre-test and post-test of participants who went through Random Practice schedule. Hence, there is a significant improvement from pre-test to post-test.

Table 14. Descriptive Statistics of Serial Group.
Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair1	Average Pre-test Score	18.227	11	3.3344	1.0054
	Postest Score	22.64	11	6.500	1.960

Table 15. Relationships between Pre and Post-test Scores of Serial Group
Paired Samples Correlations

		N	Correlation	Sig.
Pair1	Average Pre-test Score & Postest Score	11	.051	**.881**

Table 16. Differences between Pre and Post-test Scores of Serial Group
Paired Samples Test

		Paired Differences					T	df	Sig (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval				
					Lower	Upper			
Pair1	Average Pre-test Score – Post-test Score	-4.4091	7.4559	2.2480	-9.4181	.5999	-1.961	10	**.078**

There is no significant correlation between pretest and posttest of participants under Serial Group.

There is no significant difference between pretest and posttest of participants who went through Serial Practice schedule.

Table 17. Descriptive Statistics of Blocked Group.
Paired Samples Test

		Mean	N	Std. Deviation	Std. Error Mean
Pair1	Average Pretest Score	17.107	14	4.2751	1.1426
	Postest Score	19.07	14	4.305	1.151

Table 18. Relationships between Pre and Post-test Scores of Blocked Group
Paired Samples Test

		N	Correlation	Sig.
Pair1	Average Pretest Score & Postest Score	14	.388	**.170**

Table 19. Differences between Pre and Post-test Scores of Blocked Group
Paired Samples Test

		Paired Differences					T	df	Sig (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval				
					Lower	Upper			
Pair1	Average Pretest Score – Posttest Score	-1.9643	4.7453	1.2682	-4.7041	.7756	-1.549	13	**.145**

There is no significant difference between pre-test and post-test of participants who went through Blocked Practice schedule.

Therefore, participants who underwent Random schedule of practice significantly acquired the table tennis skills in terms of accuracy compared to the other kinds of rehearsal schedule such as Blocked and Serial arrangement despite of limited span of time.

4.2 Subjective (Non-Parametric)

In the Subjective part of Analysis of data, non-parametric data are used which means that the gathered data is not required to fit a normal distribution and has no parameters (defining properties) are involved such as assumptions that the samples are representative of the whole population. Additionally, these data can be categorized as nominal or ordinal data scale. Nominal Scales are those that are classified into different categories and concern with frequency counts. On the other hand, Ordinal Scales are data which gives quantitative rank order to the variables but do not measure or give information of how better one score from the others. On the succeeding analyses, both nominal and ordinal are used.

In this analysis, the data was gathered through the rating of the table tennis expert to the participants regarding their form on how to execute the skills without taking in consideration their class where they come from. The expert made his rating by classifying the participants into 5 categories namely: poor (as the lowest rating), satisfactory, good, very good, and excellent (being the highest).

NOMINAL DATA

The first statistical analysis tool used in this nominal kind of data is the Chi-square. Table 20 shows the frequency counts of ratings of the participants in connection with their practice schedule.

Table 20. Cross-tabulation between Form of Execution and Practice Schedule

		Practice Schedule			Total
		Random	Serial	Blocked	
Form of Execution	poor-satisfactory	0	0	1	1
	Satisfactory	1	0	0	1
	satisfactory-good	1	2	1	4
	good	0	4	4	8
	good-very good	5	2	4	11
	very good	2	1	3	6
	very good-excellent	2	2	1	5
Total		11	11	14	36

Table 21. Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.970[a]	12	.532
Likelihood Ratio	13.722	12	.319
Linear-by-Linear Association	.563	1	.453
N of Valid Cases	36		

a. 21 cells (100.0%) have expected count less than 5. The minimum expected count is .31.

Table 22. Symmetric Measures

	Value	Approx. Sig.
Phi	.552	.532
Cramer's V	.390	.532
N of Valid Cases	36	

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

According to Chi-square Tests and Symmetric Measures of Phi and Cramer's V, all of them ended up with the same results which is 0.532. Because this significant value is greater than 0.05 significance level, it means that there is no significant difference between expected and observed frequencies in the three kinds of schedule of practice with regard to their ratings. Hence, we end up with a conclusion that the students learn equally well in any of the three methods.

In terms of subjective rating of performance form of table tennis skills between the two classes, according to the table tennis expert, in general, students of Basic Table Tennis (PEd 134.1) class had difficulties in timing and anticipating the speed and spin of balls and had problems with agility and coordination of hands and legs. Also, the footwork, stance, and form such as follow-through and arm swing were not so refined which have a large effect on the control of the ball and the quality of

return. On the contrary, students of Advanced Table Tennis (PEd 134.2) class have more polished form class that is why they are superior in controlling the ball compared to the Basic Table Tennis class. Furthermore, the amazing thing about this class is that most of them can attack both sides (forehand and backhand) with an unbelievable speed due to well-coordinated hands and legs, footwork, stance, and follow-through. Also, their learning of applying spin on the ball during service could be an edge or advantage in playing table tennis.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

To summarize the results of the study based on the former presentations of data using Objective or Parametric statistics, first when analysing the pre-test, the results showed that the scores between students of each basic and advanced skill levels in the pre-test do not deviate much from each other therefore stating that all of the participants for the study have almost the same level of accuracy in their performances during playing the sport. This indicates that the participants are all in the same line of skill and are therefore in the same starting point for a wider learning capacity for this table tennis study based on accuracy scores which was the objective part of the study. This led to its normal distribution as shown in the normal curve and the Q-Q plot wherein points were along the same line that is supporting the previous statement that scores were not deviating largely from each other.

Another finding is that the scores between all the involved participants including the skill level class they belong to do not have significant difference and are therefore concluded to be the same with one another. Also, the point would be is that whether one can come from the advanced class or the basic, there is no difference with the initial results of their games for the pre-test derived from their accuracy scores and not the form of execution.

Also, the procedure used to divide the groups into three practice schedule group is the ABBA assignment/ counterbalance procedure or assigning the subjects for each group according to their pre-test scores. And its effectiveness was asserted by the tests for the homogeneity of the three practice schedules which resulted to the practice schedules to be homogeneous. The tests were the Levene's, ANOVA and the Post-hoc tests.

The same methods were applied in the post-test. Also, what was found out here is the same with the pre-test results, that is, all of the three practice schedules have no significant difference with comparison to one another. Therefore, even with the interventions, the scores between the participants of both advanced and basic skilled class are not significantly different from each other.

To sum up everything about the scores of the participants and the tests conducted, conclusion is that their results are almost the same across all groups which are not significantly different with one another.

In Factorial ANOVA however, according to the Levene's Statistics, there is significant difference between the pre-test and the post-test results but it initially did not specify what could be causing the significant difference.

Moving further with the analysis, in conducting dependent t-tests on each of the three practice groups, the results showed that the Random Practice Schedule caused the significant difference between the pre-test and the post-test therefore causing the fast-paced improvement within the participants' learning and performance.

On the Subjective part of the Analysis wherein Non-parametric statistics was used, the table tennis expert classified the form of execution of every student in every class into 5 categories namely: poor, satisfactory, good, very good, and excellent. Using the Chi-square statistical tool, it displays that there is no significant difference among the three schedule of rehearsal in connection with the rating on how they perform the skills.

5.2 Conclusion

The final conclusion for the study results would be that all the participants who belong to PEd 134.1 and PEd 134.2 do not have statistically significant difference with regard to their scores in terms of accuracy. Also, almost all participants have improved since pre-test with the interventions. This indicates their capacity to learn and to improve in their skills as table tennis players.

Also, speaking of their learning capacities, there is a significant difference between the three practice schedules considering the span of time it takes for this study to complete. It shows that the Random Practice Schedule, above everything else, caused the fast-paced improvement for almost all of the participants for this research. Therefore, considering the time constraint required for a player to be improving at the skills for table tennis, the random practice schedule is the most effective as a teaching tool. However, when there is plenty of time to teach one the table tennis skills required before a game, all of the three practice schedules would be beneficial since Serial and Blocked also caused the improvement for the scores in the post-test although not producing the ones with drastic improvements.

To support the assertions presented on the previous paragraphs, the non-parametric statistics indicates that even the participants undergo different kinds of practice schedule and eventually, rate their form and classify them into categories, there will be no significant differences with the group frequencies and that the students will learn and perform the skill equally well regardless of the way on how the skills are taught to them.

In terms of subjective rating of form in performing table tennis skills, based on the judgment of the table tennis expert, students in Advanced Table Tennis class have superior advantage compared to students in Basic Table Tennis class when it comes to form, control, stance, service, footwork, coordination, etc.

5.3 Recommendation

In line with the researcher's main objective of the study which is to determine what will be the more effective and more appropriate way to teach table tennis in a way that the students, with regard to their skill level, will easily learn the said sport for only a limited span of time, further research for this study has to be sustained. First, since table tennis has been one of the sports Filipinos usually get involved with, more elaborated studies shall be conducted and wider research shall be made its

future readers. Also, in this study, time has been one of its limitations. Should this experiment be repeated, a longer period of time shall be considered so as to examine deeper information regarding the three practice schedules. Robo-Pong shall also be used in future studies for it to yield more accurate and significant results.

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Mood States in Paddle-Tennis Competition: Differences by Performance Level

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Abstract: Paddle-tennis is a new sport that people gradually practices in the world. Moreover, mood states are different in every racket sport. Authors have explained the importance of "Iceberg profile" attributed by Morgan (1985). However, there is a controversy because other authors explain that there are not any differences among performance levels. The aim of this study was to assess the mood states prior to the match to paddle-tennis players according to the level of competition. Sixty-two paddle-tennis players from different levels participated voluntarily in this study. Profile of Mood States questionnaire (POMS) has been used to assess the mood states prior competition. The athletes completed POMS one hour before the match. One-way ANOVA test was performed to test significant differences in the six scales of mood states between different levels (C1, C2 and C3). The main result showed that depression and anger states were higher in C1 (45.63±8.46 and 51.69±9.87) than C2 (40.44±3.03 and 45.67±7.85; $p<0.05$; respectively). There were no differences in other scales of POMS. Vigor score was higher than 50 points in C1 (50.63±6.73), C2 (50.89±6.94) and C3 (52.03±7.74). Each category had "Iceberg profile", however two states were altered. Some studies claim that different athletes do not show "Iceberg Profile" prior to the competition. Nevertheless, there are no studies reporting what state explains performance when the vigour state is high in all cases. We conclude, therefore, paddle-tennis players have adequate psychological conditions prior to the competition (Iceberg Profile), whereas that other negative states increase.

Keywords: mood states, paddle-tennis, POMS, performance level

1. INTRODUCTION

Athletes must have a positive mental state before to the competition. Morgan (1980) affirmed that the prediction of sporting success could be analysed through the mood states prior to the match ("Iceberg profile"; Morgan, 1985). These states belong either augment or detract from his or her overall success or failures as an athlete (Beedie, Terry & Lane, 2000; Covassin & Pero, 2004; Scott, Stiles, Raines & Koth, 2002). More specifically, self-confidence, mood disturbances, cognitive and somatic anxiety have all been linked as contributing factors to athletic performance

(Hassmen & Blomstrand, 1995; Morgan, O'Connor, Ellickson, & Bradley, 1988; Ussher & Hardy, 1986). However, there is a controversy because others authors explain that there is not differences between performance levels with mood states knowledge (Rowley, Landers, Kyllo & Ethier, 1995; Prapavessis, 2000). Furthermore, for example, Cockerill, Nevill, & Lyons (1991) demonstrated that tension, depression, and anger could collectively predict finish time in cross-country running and Friend & LeUnes (1990) identified anger and vigour as significant predictors of a range of performance indicators in baseball. A theoretical model (Lane & Terry, 1998, 2000) proposes that the effects of tension and anger upon performance are moderated by depression. These authors argue that these states may not always exert a negative influence on performance as is often proposed.

Paddle-tennis is a racket sport practiced by 4.5 million people around the world and it is increasing each year. Physical and physiological responses are similar to single tennis and table-tennis sports but lower than squash and badminton in match play (Castillo-Rodríguez, Alvero-Cruz, Hernández-Mendo & Fernández-García, 2014). Psychological responses have not been studied yet. Mood states could be different in every racket sports and can affect the performance.

The aim of this study was to assess the mood states prior to the match to paddle-tennis players according to competition level.

2. METHODS

2.1. Participants

Sixty-two paddle-tennis players (40 males and 22 females) participated voluntary in this study (27.81 ± 7.04 years of age, 74.91 ± 12.2 kg of weight; 175.4 ± 7.52 cm of height; 24.27 ± 3.11 kg·cm^{-2} of Body Mass Index (BMI; Table 1). They play in different levels of competition (1st – 3rd categories) in Spain. First level is the highest category. Inclusion criteria were that players must be in a National Ranking of Spanish Paddle-Tennis Federation and that players must play between them, in order to compare winners and losers.

Table 1. Characteristics of body composition and others variables.

		Mean ± SD	Min	Max
Age	(years)	27.8 ± 7.04	16	46
Weight	(kg)	74.9 ± 12.2	52.0	99.8
Height	(cm)	175.4 ± 7.52	155.3	190.5
BMI	(kg·cm^{-2})	24.27 ± 3.11	17.78	32.58
EXP	(years)	5.61 ± 4.00	1	19
GT	(hours/week)	1.98 ± 2.73	0	11
ST	(hours/week)	11.76 ± 12.37	1	38
TT	(hours/week)	13.74 ± 12.88	1	46

BMI: Body Mass Index; EXP: Experience; GT: General training; ST: Specific training; TT: Total training

2.2. Instruments

The 65-item version of the Profile of Mood States (POMS) has been performed (McNair, Lorr & Droppleman, 1971). Participants rated each item on a 5-point Likert scale and responded to the instructional set of questions (e.g., "How do you feel right now?") for a state measure of mood. This test contains six scales of mood states (i.e., tension-anxiety; depression-dejection; anger-hostility; fatigue-inertia; vigour-activity; confusion-bewilderment).

2.3. Procedure

The athletes completed POMS questionnaire one hour before competition. This test was performed during five minutes in a room alone, in order to ensure players could be complete correctly. Furthermore, they completed different demographic and training data. The Ethics Committee of the University of Malaga approved this study and the participants signed informed consent forms agreeing to participate in the study.

2.4. Statistical Analyses

Data are presented as Means ± Standard Deviations (SD). Prior to analysis, Kolmogorov-Smirnov test were checked for determining the normality. Kruskal-Wallis test was used to compare differences in the six scales of the mood states (Tension-Anxiety; Depression-Dejection; Anger-Hostility; Fatigue-Inertia; Vigour-Activity; Confusion-Bewilderment). ANOVA with post-hoc Bonferroni adjustment was applied whenever any significant difference was found between them. Furthermore, Rho-Spearman coefficient was used to determine the relationship between psychological variables and competition level, experience, and training hours. The statistical analyses were performed using the software SPSS v. 17.0. The level of significance was set at $p<0.05$.

3. RESULTS

Mood states are shown in Table 2. Depression-Dejection and Anger-Hostility states are higher in C1 (45.63 ± 8.46 and 51.69 ± 9.87 points) than C2 (40.44 ± 3.03 and 45.67 ± 7.85 points; $p<0.05$; respectively). There were no differences in other scales of POMS test, according to the competition level.

Table 2. Kruskal-Wallis test between mood states according to the level of competition

States	L	Mean ± SD	χ^2	*P*
TA	1	41.65 ± 7.90	2,822	0,24
	2	37.56 ± 7.45		
	3	40.15 ± 7.54		
DD	1	45.63 ± 8.46[2]	4.359	0.04
	2	40.44 ± 3.03[1]		
	3	44.62 ± 7.70		
AH	1	51.69 ± 9.87[2]	7.723	0.02
	2	45.67 ± 7.85[1]		
	3	48.12 ± 11.63		
VA	1	50.63 ± 6.73	1.337	0.51
	2	50.89 ± 6.94		
	3	52.03 ± 7.74		
FI	1	42.27 ± 5.49	4.129	0.12
	2	41.67 ± 5.11		
	3	43.44 ± 8.30		
CB	1	33.83 ± 6.49	3.715	0.15
	2	33.33 ± 7.01		
	3	34.12 ± 5.90		

L: Level of competition; TA: Tension-Anxiety; DD: Depression-Dejection; AH: Anger-Hostility; VA: Vigour-Activity; FI: Fatigue-Inertia; CB: Confusion-Bewilderment.

However, players of different level have shown "Iceberg profile" (Figure 1). Vigour-Activity state is higher than 50 points in C1 (50.63 ± 6.73), C2 (50.89 ± 6.94) and C3 (52.03 ± 7.74).

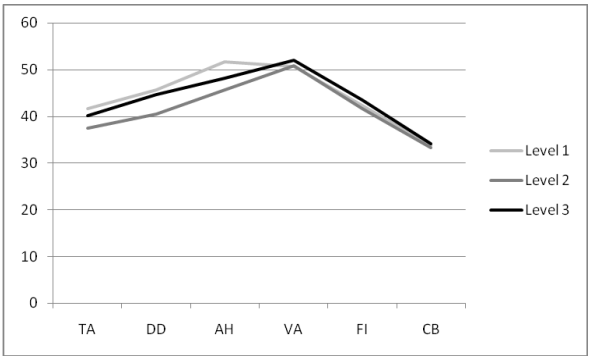

Fig. 1. "Iceberg profile" of the paddle-tennis players.
TA: Tension-Anxiety; DD: Depression-Dejection; AH: Anger-Hostility; VA: Vigour-Activity; FI: Fatigue-Inertia; CB: Confusion-Bewilderment.

In addition, mood states showed medium-low correlations with training variables (Table 3). Firstly, Tension-Anxiety scale show a positive correlation (ρ= 0.28; $p<0.01$) with the experience (in years). Secondly, Anger-Hostility scale has a negative correlation with the level of the competition (ρ= -0.27; $p<0.01$) and positive correlations with general, specific and total trainings (ρ= 0.26, 0.23 and 0.26; $p<0.05$; respectively). Fatigue-Inertia scale has a correlation with specific training (ρ= -0.22; $p<0.05$). Finally, Confusion-Bewilderment scale has negative correlations with specific and total trainings (ρ= -0.33 and -0.35; $p<0.01$; respectively).

Table 3. Spearman coefficients of rank correlations between mood states and competition level, experience, and training hours.

	TA	DD	AH	VA	FI	CB
L	-0.12	-0.12	-0.27**	0.08	-0.01	0.02
EXP	0.28**	0.04	0.19	0.05	-0.03	-0.14
GT	0.14	-0.09	0.26**	-0.10	0.06	-0.02
ST	-0.12	0.11	0.23*	-0.04	-0.22*	-0.33**
TT	-0.10	0.04	0.26*	-0.11	-0.19	-0.35**

* $p<0.05$; ** $p<0.01$; L: Level of the competition; EXP: Experience; GT: General training; ST: Specific training; TT: Total training; TA: Tension-Anxiety; DD: Depression-Dejection; AH: Anger-Hostility; VA: Vigour-Activity; FI: Fatigue-Inertia; CB: Confusion-Bewilderment.

4. DISCUSSION AND CONCLUSIONS

The aim of this study was to analyse the mood states in different paddle-tennis players, according to the performance level.

Firstly, players of different level of competition have an "Iceberg profile", being that Vigour-Activity scale has been higher than 50 points. These results are in agreement with the study of Covassin & Pero (2004) with tennis players, although these athletes belong to level two, similar to our study.

However, negative states of the POMS test such as Depression-Dejection and Anger-Hostility have very high values, namely, C1 players. In a study of Covassin & Pero (2004), players had between 44.83 and 60.25 points in the same scale (Anger-Hostility) in winning and losing tennis players (respectively).

These values could be due to players must travel every week to play at highest level. In this study, among our participants, six players were in the top ten of the Spanish Paddle-Tennis Federation. It causes that "Iceberg profile" could be altered. Rowey, Landers, Kyllo & Etnier (1995) explained that athletes in some sports are not according to "Iceberg Profile" prior to the competition because the negative states are very high. Furthermore, Anger-Hostility scale is affected positively by training time (general, specific and total training). C1 Players must train hard and long to stay in the highest level, so they showed a positive correlation with Tension-Anxiety state (rho: 0.28, $p<0.01$).

It seems that the time of the season affects mood states (Moreno, Parrado & Capdevila, 2013) in different team sports e.g. football, basketball and hockey. Many studies have shown high levels of depression and anger states due to factors unrelated to sports practice (Bar-Eli, Tenenbaum, Elbaz, 1989). Hoffman, Bar-Eli &

Tenenbaum (1999) affirmed that the financial problems of basketball players might have resulted in an increase of anger and depression states. Rowley et al. (1995) have suggested that athletes may indeed perform quite well when angry (for reasons not directly related to their performance). In this study, players could have the same cause. However, in other study, athletes of judo increased their depression states after two consecutive defeats (Montero, 2010). Another cause of the high levels of depression and anger states may be the time of the tournament. This study assessed play-off completely. There are data of the second round, semi-finals, ... In this sense, Chiodo, Tessitore, Cortis, Cibelli, Lupo, Ammendolia, Roses & Capranica (2011) experienced increases in depression and anger states between first and last competition in the same tournament. In addition, a decline of vigour has been experienced.

On the other hand, in another adversary sport such as judo, athletes have also the Tension-Anxiety and Depression-Dejection scales higher than other levels of performance (Serrano, Salvador, González-Bono, Sanchís & Suay, 2000). It seems that, training time (specific and total training) affect Confusion-Bewilderment scale. This relationship is negative, the time training correlates with Confusion-Bewilderment scale. This suggests that, self-confidence could be influenced by training time.

The intermittent pattern of paddle-tennis (and all racket sports) and the numerous stretch-shortening cycle movements explain the fatigue of the players post-match (Girard, Lattier, Micallef & Millet, 2006). Many matches joined a few recovery time between them, can change the mood states of the players.

As main limiting factor is the impossibility to know the fluctuation between mood states. Pre-test with basal data of mood states would have been interesting because athletes are not subject to any physical and mental stress. As other limiting factor of the study is to control the processing time of the test, it seems that could influence the results. In addition, it should provide further data match (victory or defeat) to establish values that are more conclusive. Finally, it includes a test to analyse the self-confidence to check if it has greater predictability in the level of play.

The results of this study provide further evidence to suggest that train only physical and physiologic responses is insufficient. Psychological skills are necessary in order to improve their mood states before to the Tournament. In addition, coaches, physical trainers and managers in general, should know that travel weekly could negatively influence the mental state of the athlete and the Anger-Hostility state is higher while athletes train more hours. It should carry out a study in the future about how to improve mental abilities in racquet sports, in order to decrease the negative mood states.

In conclusion, Paddle-tennis players have adequate psychological conditions prior to the competition as the health “Iceberg Profile” established by Morgan (1985), although players in the highest level of competition show high values in the Anger-Hostility and Depression-Dejection scales. Furthermore, players of different category have the similar “Iceberg Profile”, so others psychological responses would be studied in order to know the variable that determine variance between groups level.

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A Study of Table Tennis Player Sport Passion Effect Mode

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Abstract
Objective: This study is to explore the Table Tennis Player Sport Passion Effect Mode. Method: first, the questionnaire of Sport Passion Effect Mode is designed by referring to the literature. Then item analysis and exploratory factor analysis are used to examine the CR value and structure of the factors. Finally, the confirmatory factor analysis is used to examine the hypothetical measurement model, and the scale's difference validity is also examined. Results: Through the statistical verification of structural equation modelling, the overall model fits well χ^2=94.67, df=62, χ^2/df=1.53, RMSEA=0.047, CFI=0.98. Conclusion: The Sport Passion Effect Mode is an appropriate measurement for empirical study, and the researchers can apply this mode for future research.

Keywords: difference validity, confirmatory factor analysis

1. INTRODUCTION

Vallerand, Blanchard, Mageau, Koestner, Ratelle, Leonard, and Gagne (2003) indicate that passion is an important concept of positive psychology, and results in individuals' preference toward particular events. Consequently, individuals with passion should spend their efforts and time to be involved in those events. Vallerand et al. (2007) assert that the passion concept is derived from the Self-Determination Theory (SDT) of Deci and Ryan (2000) and that individuals are highly motivated when they have great passions. Vallerand et al. (2003) indicate that passion is a psychological intention that enforce individuals to spend a lot of time on whatever events they think are important and show great interest. Vallerand, et al. (2003) further argue that there are two types of passion pattern: harmonious passion and obsessive passion. Harmonious passion could internalize passion into personal identification rather than by some contingencies, and won't affect the other events. Consequently, individuals could fully enjoy the activity or events with open mind, and should experience positive feedbacks, such as becoming more focus or positive from the event or even after. On the other hand, obsessive passion is resulted from external peer pressure or the activity per se, it forces individuals to be involved in the activity or sports. Since individuals are not self-motivated to join the sport, they may lose the coordination ability and even have negative feelings or behaviours. This may result in identification conflict or even push individuals to over participate in certain activities and lose life balance. (See Vallerand et al., 2003)

Previous studies try to investigate what psychological determinants motivate athletes to devote themselves in certain sports for life time, and what positive or negative affections are experienced. Vallerand et al (2007) studied for students of performing arts, pointed out performance of harmonious passion and obsessive passion can be predicted through hard training, and also harmonious passion had higher subjective sense of blessing. And in 2008 they further applied passion to college basketball players. Seeing the performance of the sport, they also found harmonious passion and obsessive passion through hard training would positively predict performance (Vallerand et al. 2008). Li Jiong-Huang, Ji Li-Kang, Peng Han-Ni (2007) envisaged high school athletes for the study objects, and found that sport passion scale had good reliability and validity, and two stable forms of passion could really be distinguished. If players, athletes can upgrade passion for sports engaged, then it has a multiplier effect on the enhancement of sport techniques devoted. Lee Ching-Chan, and Lin Yaw-Feng(2010) use “the movement warm meter”, “the movement motive meter” the achievement studies the tool. This findings confirmed that the movement enthusiasm and the movement motive have highly related, if therefore wants to promote athlete's motive, may also from enhance the contestant movement to begin warmly.

It is not possible for athletes to win the game without strong willpower. The training process is difficult, hard, and includes repeated practice, though the result is very uncertain. Table tennis is one of the extremely defensive sport netting contest that is open and sophisticated. Because the tennis ball is relatively small and bounce back almost immediately in a short distance, both players need to react accurately in a very short time period and to make the judgement about the direction, the turning point, and the next move. A good player must capable of prompt actions. Since it is a very sophisticated game, it takes a long process to cultivate god players. The training program should start from young players who could accumulate skills step by step over long time period. They learn from basic skills, then apply mixed skills under different scenarios, and come out with game strategies. The final step is to develop personal characteristics and apply them in each single game. Athletes must have extremely strong passion, patience, and diligence to go through the whole process, otherwise the length training program is not able to continue. Consequently, we intend to study the passion of table tennis players. This study tries to establish a passion mode to measure the level of players’ passion.

2. METHOD

2.1 Mode design

Our questionnaire refers to Lee (2007) and Vallerand (2003). There are fourteen questions in the survey. Seven questions are about harmonious passion and the other seven questions are about obsessive passion. The total variance is 67.18%implying good validity. The coefficient of Cronbach’s α is 0.93 from the model, implying stable reliability. The result indicates that our mode with harmonious passion and obsessive passion two dimensions is appropriate.

2.2 Approach

Our sample includes professional table tennis players from public and private universities. We have obtained permission from all players and their couches before the survey. Originally, we sent out 250 questionnaires. After deleting those with missing answers and biased repeated answers, we finally collect back 236 completed questionnaires. The return rate is 94.40%.We then conduct confirmatory factor analysis by LLISREL to test the mode's fitness, construct validity, and difference validity

3. RESULTS

3.1 Pre-test of the mode

We use SPSS for Windows 12.0 to run the Item Analysis and Exploratory Factor Analysis after deleting unqualified respondents.

3.1.1 Item analysis

By Resolving Power and internal consistency reliability of our mode, we find that the correlation coefficient of table tennis players' passion is between 0.37 and 0.68 and the cut-off score is between 4.03 and 9.86. In addition, results for all questions are significant, indicating robust discrimination power.

3.1.2 Exploratory factor analysis

We apply Exploratory Factor Analysis in this session. Method of principal and oblique rotations are used to test the validity and factor structure. Question 1 to 7 are related to the first factor, i.e. harmonious passion, and question 8 to 14 are related to the second factor, i.e. obsessive passion. The factor loadings from aforementioned factors vary from 0.66 to 0.86, and from 0.71 to 0.83 respectively. The explained sum of squares are 35.27% and 31.91. Total variance explained is 67.18%.

3.1.3 Tests on mean, standard deviation, skewness, and kurtosis

Our results show that the mean varies between 2.67 to 3.92; the standard deviation varies from 1.10 to 1.51; skewness is from -0.21 to -1.31; and kurtosis is from -.77 to 2.92.Consequenty, the result is close to normal distribution, implying the maximum likelihood approach is appropriate to estimate our interested variables. All statistics are listed in Table 1.

Table 1. Correlation, Mean, Standard Deviation, Skewness, and Kurtosis

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14
X1	1.00	.72	.61	.50	.49	.47	.47	.43	.42	.48	.39	.41	.40	.36
X2	.72	1.00	.69	.65	.51	.61	.53	.48	.54	.49	.46	.50	.45	.38
X3	.61	.69	1.00	.58	.50	.53	.43	.38	.42	.40	.43	.41	.37	.36
X4	.50	.65	.58	1.00	.56	.60	.49	.38	.46	.47	.46	.45	.47	.38
X5	.49	.51	.50	.56	1.00	.61	.50	.43	.42	.44	.32	.36	.38	.35
X6	.47	.61	.53	.60	.61	1.00	.5	.39	.50	.37	.33	.38	.36	.28
X7	.47	.53	.43	.49	.50	.75	1.00	.42	.50	.34	.27	.33	.38	.32
X8	.43	.48	.38	.38	.43	.39	.42	1.00	.82	.77	.48	.66	.66	.70
X9	.42	.54	.42	.46	.42	.50	.50	.82	1.00	.73	.52	.70	.69	.67
X10	.48	.49	.40	.47	.44	.37	.34	.77	.73	1.00	.53	.66	.68	.67
X11	.40	.46	.43	.46	.32	.33	.27	.48	.52	.53	1.00	.62	.55	.59
X12	.41	.50	.41	.45	.36	.38	.33	.66	.70	.66	.62	1.00	.77	.71
X13	.40	.45	.37	.47	.38	.36	.38	.66	.69	.68	.55	.77	1.00	.68
X14	.36	.38	.36	.38	.35	.28	.35	.70	.70	.67	.59	.71	.68	1.00
Mean	3.78	3.92	3.02	3.45	3.59	3.66	3.52	2.78	3.09	2.70	3.18	2.82	2.67	2.67
Std.	1.23	1.10	1.15	1.12	1.12	1.17	1.43	1.43	1.38	1.56	1.44	1.51	1.46	1.39
Skew	-1.31	-.73	-1.04	-.22	-.36	-.28	-.28	-.34	-.49	-.28	-.57	-.29	-.21	-.37
Kurt	2.92	.42	.46	-.77	-.61	-.93	-.93	.04	-.22	-.34	-.09	-.60	-.63	-.33

3.2 The preparation of a formal scale

According to the results of exploratory factor analysis, and then use statistical techniques of confirmatory factor analysis, CFA. This study further validates the theoretical model, as a test for construct reliability of individual variables observed and potential variables, the convergent validity and difference validity situation of individual dimensions. After first test whether the study samples show a normal distribution, I then carry out scale confirmatory factor analysis. Based on 14 topics resulting from the formal test samples, using the software of LISREL 8.52 version, estimate path and adaptability of the measurement mode.

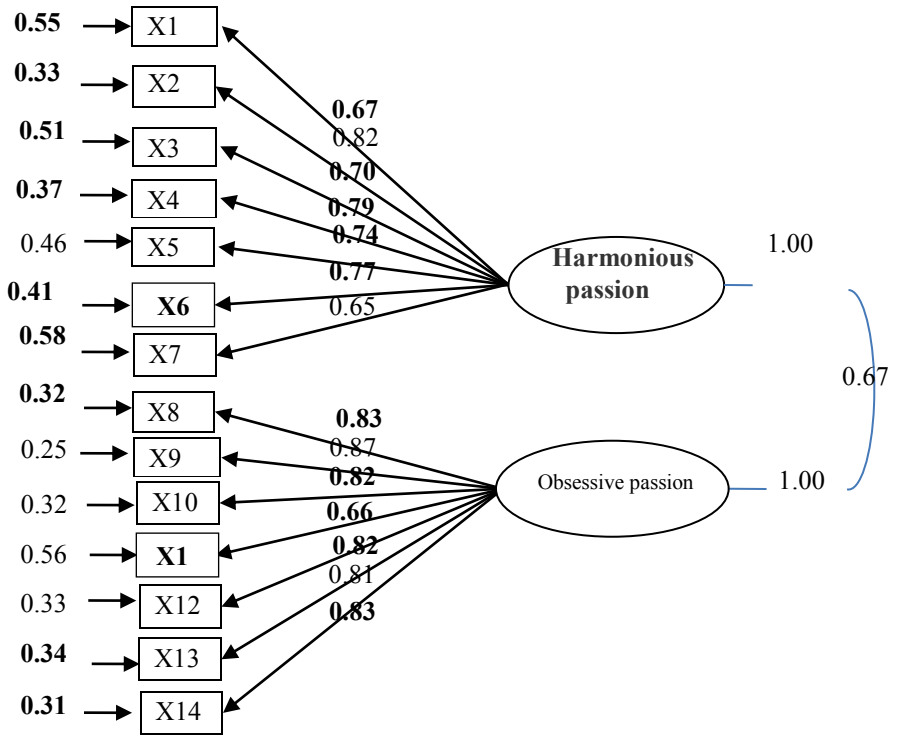

Fig. 1. Sport passion scale first order one two factor oblique mode

3.2.1 The overall mode adaptability test

After confirmatory factor analysis, as far as the overall pattern is concerned, from the perspective of various adaptability indicators, the hypothesis mode of this study can be accepted. All pass the required threshold, displaying mode of this hypothesis is a model quite consistent with the empirical research, as shown in Table 2.

Table 2. The overall scale of the second-order single-factor model adaptability

Measurement mode	χ^2/df	GFI	SRMR	RMSEA	NFI	NNFI	CFI
This study	1.53	0.95	0.042	0.047	0.96	0.97	0.98
The recommended value	1.0-5.0	>0.90	<0.05	<0.08	>0.90	>0.90	>0.90

3.2.2 Construct reliability of measuring variables and potential variables

This study is based on Huang Fang-Ming's statement (2002, 2004) that the reliability of individual variables observed must be greater than 0.20. The reliability test of the potential variables uses construct reliability, of which value must be greater than 0.60.

Reliability evaluation can test a single observation variables and potential variables reliability. All estimated parameters in sport improvement control scale reach a significant level of t values greater than 1.96, and do not show big standard errors. Therefore, sport improvement control scale has good construct reliability, as shown in Table 3.

Table 3. Reliability of individual variables and potential variables

Latent variables	Observed variables	R^2	Combination of reliability
Sport passion			0.91
Harmonious passion	X1	0.45	0.89
	X2	0.67	
	X3	0.49	
	X4	0.62	
	X5	0.55	
	X6	0.59	
	X7	0.42	
Obsessive passion	X8	0.69	0.93
	X9	0.76	
	X10	0.67	
	X11	0.44	
	X12	0.67	
	X13	0.66	
	X14	0.69	

3.2.3 Convergent validity test

In this study, the validity of individual variables is mainly to observe standardized load on the factors variables reflect. From Table 4 "Parameter estimation table of sport passion scale two-factor hypothesis measurement mode" it can be seen that all the standardized coefficients have reached significant level. As Huang Fang-Ming (2004) and Anderson and Gerbing (1991) pointed out that in terms of convergent validity, if the t value was greater than 1.96 and reached a significant level, it could be effectively used as indicator of the factor to which it belonged. Therefore, it had good convergent validity.

Table 4. Parameter estimation table of sport passion scale two-factor hypothesis measurement mode

Parameters	Non-standardized parameter values	Standard errors	*t* values	Standardized parameter values
δ1	0.85	0.08	10.81*	0.67
δ2	0.93	0.07	14.32*	0.82
δ3	0.73	0.06	11.58*	0.70
δ4	0.90	0.06	14.06*	0.79
δ5	0.84	0.07	12.50*	0.74
δ6	0.93	0.07	13.36*	0.77
δ7	0.80	0.08	10.67*	0.65
δ8	0.87	0.08	15.12*	0.83
δ9	0.88	0.08	16.21*	0.87
δ10	0.86	0.09	15.13*	0.82
δ11	0.93	0.09	11.07*	0.66
δ12	0.89	0.09	15.10*	0.82
δ13	0.86	0.08	14.76*	0.81
δ14	0.88	0.08	15.12*	0.83

* $p<.05$.

3.2.4 Difference validity test

In this study, according to Anderson and Gerbing's statement (1988) that used two ways to test the difference validity of potential variables. The first method is to pair two potential variables of the mode into a correlation. In this study, two ways are used to estimate this correlation. The first way is: each time fix one of the correlations, of which value is set to 1.00, and then estimate value of chi-square. The second way is: let a correlation be freely estimated, obtain another chi-square value, and then test the difference between the chi-square values of the fixed and freely estimated correlations. Under the circumstance that the degree of freedom is 1, if this gap after subtraction is greater than 3.84, it indicates the potential variables between the two are different.

The second method is the use of potential variables paired with correlation confidence interval assay method (Jöreskog & Sörbom, 1993). Add two standard deviations to or subtract them from the correlation coefficient. If the confidence interval value does not contain a value of 1.00, then it signifies there is difference validity between potential variables. If containing 1.00, two factors are envisaged as the same factor. If not containing 1.00, it represents two factors can be identified (Anderson & Gerbing, 1988; Jöreskog & Sörbom, 1989).

Pertaining to estimated values related to each variables, the freely estimated difference values of chi-square values and the correlated confidence interval values in sport passion scale, their chi-square difference values have reached significant levels, indicating that there are differences between the mode whose correlation is set to 1.00 amid matched variables and all correlated freely estimated model. That is, mode whose correlation is set to 1.00 and freely estimated correlated model cannot be regarded as reciprocity, showing correlations between potential variables

are different; therefore, the results of the analysis show difference validity can be supported.

In addition, this confidence interval does not show phenomenon that any interval has covered 1.00, so likewise it supports the existence of difference validity between two potential variables, as detailed in Table 5.

Table 5. Each potential variable difference validity in sport passion scale

Latent variables	Harmonious passion
Obsessive passion	0.51 (49.40*) [0.45,0.57]

4. RESULTS AND DISCUSSION

4.1 Table tennis player sport passion scale validation analysis

Table tennis player sport passion scale constructed by this research more appropriately assesses table tennis players' personal preferences and response effects. The research findings of scale obtain high internal consistency and confirmatory factor analysis gets a good overall adaptation assessment and mode overall adaptation. Hierarchical table tennis player sport passion scale of this study covers two large primary dimensions, each of which maintains more than seven questions, in order to avoid bias to any dimension by the scale. The result will be able to assess the relationship of the player sport passion from more all-round angle. The scale of this study takes 14 questions as the full scale. This result is in line with the purpose of sport passion response scale.

In this study, pre-test item analysis and exploratory factor analysis are followed by a second phase of testing and verification. With the advancement of modern statistical techniques and application of structural equation modelling, it can help researchers by way of confirmatory factor analysis make a more rigorous test to the theory of the scale prepared, and become the construction method of scale (Jöreskog & Sörbom, 1993; Huang Fang-Ming, 2004). So the researcher, after the completion of the item analysis and exploratory factor analysis, through structural equation modelling (SEM) again carries out confirmatory factor analysis and construct reliability, convergent validity and difference validity test, to do more rigorous test on the scale preparation.

As a result, it is found that the sport passion scale built by this study is a measurement tool of two aspects, including harmonious passion and obsessive passion two aspects, with appropriate internal consistency and construct validity. At the same time, through confirmatory factor analysis, it is proved that the overall pattern of this scale carries considerable adaptability. In addition, further through difference validity, I test whether the different concepts can be distinguished between individual dimensions. So sport passion by empirical proof supports the application of passion in the context of sports.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 The conclusion

5.1.1 Sport passion scale research results obtain high internal consistency and validation, and get a good assessment of overall adaptation and model overall adaptation in the factor analysis.

5.1.2 Sport passion scale is a measurement tool rather in line with the empirical study. The subsequent researchers can use the scale constructed in this study to do related research.

5.2 Recommendation

The objects of this study are the university table tennis players. In the future use it is suggested to be in contrast with the university table tennis players, whereas for future research junior high school and senior high school groups of table tennis players may be joined in the scale. Research methods can add one more set of samples, as the evaluation purposes of the review efficiency. Besides, we may also explore the verification for measurement identicalness of different male and female groups, to further understand whether sport passion scale can be applied to different aspects.

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Study on the Management Strategy of Liaocheng City Badminton Club

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Abstract: With the acceleration of the development of China's socialization process, China initiates the Nationwide Fitness Program vigorously at this stage. China's sports industry is about to enter the stage of vigorous development. Badminton has so many high quality characteristics and is easy to learn, therefore it will be a rising star in Chinese sports industry. Then how about the development situation of badminton club in small cities of China? This paper takes a third-tier city's badminton club as an example. The results show that Liaocheng badminton clubs are mostly private business, and they are mainly in small scale, located in urban areas, with a membership-based mode of operation and generally good operating efficiency. But the large badminton clubs did not form a distinctive feature. The study found there was a lack of effective promotion, single marketing means, unperfect physical fitness market, out-of-date management philosophy, a single project, unreasonable use of the site and many other reasons. They make the local badminton club face with many problems in the process of development, and there are even some clubs on the verge of non-operating income. In this paper, the writer made some targeted recommendations for Liaocheng badminton club in the status quo. It is expected that this article will bring some inspiration to the development of sport for all in China.

Keywords: Liaocheng, management strategy, badminton club

1. INTRODUCTION

At present, the development of sports in China is rising, but there are still a lot of problems, especially in fitness and entertainment industry. Take the Nirvana in Beijing as an example: It almost called for a cessation of operations because of financial chain fracture in the past. So, we have to focus on the management of club in the stage of development. The development of mass sports in China is still very weak. So, this study focus on the management of Chinese small city badminton club, and chose Liaocheng city as an example.

The results reflect the status of operation and management of Liaocheng badminton club. In view of the present management situation this study puts forward some rational suggestions to promote the development of the club, providing a reference for other small city badminton club.

2. METHODS

2.1 Sample

The data is from five badminton clubs in Dongchangfu District Liaocheng city, including Liaocheng university badminton club, Stadium badminton club, Kangmei badminton club, Railway badminton club and Shunda badminton club. Respondents are managers, coaches and badminton consumers in these clubs. These clubs are located in the urban areas, so that they can effectively represent the management status of Liaocheng badminton club.

2.2 Methods

The methods of literatures, observation, questionnaire survey and interview were used to investigate the operating status of these clubs and to collect opinions for club's improvement from the perspective of consumers. 150 questionnaires were distributed and analysed.

3. RESULTS AND DISCUSSION

3.1 The infrastructure of badminton hall

The number of courts and the supporting facilities are the direct reflection of the business scale. From table 1 we can see Liaocheng university club is the biggest club in this city with six courts, two parks, two changing rooms and two toilets. Judging from the number of courts, the scale of badminton clubs in this city are not very large. Judging from the supporting facilities, the class of the badminton club in this city is low. The data shows that the infrastructure has to be strengthened.

Table 1. The infrastructures of badminton hall

Badminton Hall	Court	Park	Changing room	Bath room	Toilet
Liaocheng university club	6	2	2	0	2
Stadium club	8	0	2	2	2
Kangmei club	4	1	2	0	0
Railway club	4	0	2	0	2
Shunda club	6	0	2	0	0

3.2 Business scope

The scope of business includes several parts. All clubs offer fitness and entertainment services and undertake contests (like companies' games). Most of the clubs have badminton training courses and personal trainers. Some of the clubs also have other fitness projects, like ping-pang, basketball, volleyball and other sports. The Liaocheng university badminton club, Stadium badminton club and Railway badminton club have comprehensive courts. The clubs' business scope meets the needs of consumers and promotes the utilization of resources.

Table 2. The business scope of badminton clubs

Badminton Hall	Undertake game	Train	Snacks	Equipment
Liaocheng university club	√	√	√	√
Stadium club	√			
Kangmei club	√	√	√	√
Railway club	√		√	√
Shunda club	√	√	√	√

3.3 Ways of charging

Each club has its own operating system, way of charging and opening hours. But generally, the opening time is 10:00-22:00 on weekdays and 8:00-22:00 on weekends. We can see the opening hours in table 4. It costs lower on weekdays than that on weekends. Lower price is charged when there's less stream of people. The charging in this city is based on five forms: charging by the hour, charging by a year, charging by a month, charging by times and making a block booking. Most clubs chose charging by a year or by the hour. We can see details of the price in table 3.

The membership card system has a long history. However, this system has faced some serious problems. For example, the charge of Nirvana is too concentrated, so the liquidity is poor, leading to the subsequent operational problems. At last, 8 stores in Beijing were closed, causing the damage of its reputation and the huge loss of consumers. In order to ensure better liquidity, the sale of times card is a good choice for both club and consumers. In order to balance the flow, charging different price between day and night is also very important. But only one club has used this method and charges cheap in the morning.

Table 3. Ways of charging in badminton clubs

Badminton Hall	By hour	Annual card	Month card	Times card	Make a block booking
Liaocheng university club	￥10/2 hours/person (student:￥5/2 hours/person)	￥1200 (student: ￥600)		￥200/25 times	￥30/hour (holiday: ￥40/hour）
Stadium club		￥1200			￥30/hour
Kangmei club		￥1000			￥30/hour
Railway club	￥10/2 hours/person	￥800	￥200		￥30/hour
Shunda club	Morning: ￥5/person	￥800			￥25/hour

Table 4. The opening hours of badminton clubs

Badminton Hall	Opening hours
Liaocheng university club	16:00-22:00 Weekend 8:00-22:00
Stadium club	8:00-21:00
Kangmei club	8:00-22:00
Railway club	8:00-22:00
Shunda club	6:00-22:30

3.4 The characteristics of consumers

The survey revealed that the consumers at age of 18-30 are the most and they accounted for 36%. The consumers at age of 41-50 accounted for 28.7%, while the consumers at age below 18 or above 50 are few. The key reason of the result is because young people have an independent income, and they like fitness and entertainment, and there is a demand for social activities. Middle-aged people have a lot of life and work pressure, they need a way to relax, and improve physical fitness actively to prepare for entering old age. Adolescents under the age of eighteen have higher propensity to consume sports, but they can participate in school sports instead, so the consumption of sports activities is less. Although the old people above fifty have more leisure time, and also have an independent source of income, but the sports activity consumers are less because of the conservative concept of consumption.

Badminton Club's consumer motivation refers to something that can encourage consumer to engage in consume sports. In order to meet the consumers' desire or intentions for sports and their other needs. Consumers' motivation is to build a sound body; look for entertainment, social communication and time killer; pursuing fashion and the others. People of different ages have different emphases on consumer motivation. We can see details of the motivation in table 5.

Table 5. The consumer motivation of badminton club

	Age									
	<18		18-30		31-40		41-50		>50	
	number	Proportion (%)	number	Proportion (%)	number	Proportion (%)	number	Proportion (%)	number	Proportion (%)
Entertainment	3	27.3%	7	13.0%	11	25.6%	19	54.3%	1	14.3%
Build a sound body	5	45.5%	23	42.6%	20	46.5%	10	28.6%	2	28.6%
Social communication	1	9.1%	20	37.0%	8	18.6%	4	11.4%	0	0.0%
Pursuit of fashion	1	9.1%	1	1.9%	2	4.7%	1	2.9%	0	0.0%
Kill time	0	0.0%	1	1.9%	2	4.7%	1	2.9%	4	57.1%
Others	1	9.1%	2	3.7%	0	0.0%	0	0.0%	0	0.0%
Total	11	7.3%	54	36.0%	43	28.7%	35	23.3%	7	4.7%

4. CONCLUSION

4.1 Lack of effective promotion and marketing means

From a practical point of view, many of the local residents do not know the specific location of the club or even don't know there is a badminton club. Most of them play badminton in the outdoor without badminton court. Compared to other more developed regions, the local badminton clubs almost have no publicity measures. They only send some flyers when it opened, and solely rely on consumers' word of mouth recommendations after the opening of the club. So, in this respect, these clubs need to strengthen propaganda to let the public know more about the club. In bad weather, especially fog and haze days, citizens can choose indoor sports activities.

First, clubs can put ads on the big screen in the shopping center or Movie Theater.

Second, hire temporary workers and send flyers in the city center every week. Third, cooperate with the local companies and implement preferential policies to those companies' staff. Finally, maximize the use of new media (Put creative ads on WeChat or Weibo).

4.2 Pay more attention to details and improve the club level

Most clubs do not have bathrooms and some clubs do not even have a toilet, so consumers need to go to the toilet in other place. Many facilities in badminton court are in need of renovation. Add music equipment to improve atmosphere in the club is also desirable. The service attitudes also have a great impact on consumers, so quality training of staff is still very important.

Setting different service projects for different consumer groups is also desirable, in order to meet the different needs of various groups. Setting lounge is necessary. It can let the young consumer groups to talk about work things in the rest of the time, so that the elderly can have a quiet place to rest. Meanwhile the club should also prepare some conventional drugs such as muscle strain medicine. In a word, as a consumer-oriented industry, the warm service and high-quality of the details of court facilities are magic to win customers favour.

4.3 Improve the quality of managers and coaches

Badminton club itself has a small number of coaches, and some clubs do not even have a career coach. Most of the clubs' coach requirements are very low, so they do not have good coach. Good coach can drive consumer desire for learning badminton. The nature of these clubs' coach is somewhat different: some are part-time while some are full-time. But the differences between coaches and training partner are not much. And all the clubs do not have a complete assessment for coaches. Establish cooperation with local schools, make college sports teacher be club' coach and provide internship opportunities for colleges student (especially professional badminton players) can benefit both sides.

4.4 Improve ways of charging

The vast majority of clubs do not charge by hour or times, and all the clubs can apply for an annual card. Charging by hour or times allows more customers to try. When they feel good, they can buy a card for a month or a year. The club can have more opportunities in business, and also can increase the mobility of capital. Differential pricing between day and night and differential pricing between workdays and holidays can play an important role in controlling the number of customers and gain more revenues.

4.5 Make full use of the court

At the peak of consumption, there are not enough courts, so increasing outdoor courts and reduce the price of outdoor courts is desirable, particularly during the day on weekdays (when it has few people in court). The court can be rented to organizations for some activities. And the club can cooperate with schools, like

opening the club in school, so that we can do not to expand the site and also can save money.

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A Study on Sport Enjoyment of Table Tennis

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Abstract: The aim of the present study was to explore the variances in sport enjoyment and personality of students who took the physical class. The Mini-Marker scale of personality and the revised Physical Activity Enjoyment Scale (PACES), which was originally designed to measure college students' involvement in physical activities, was employed. The responses were obtained from 281 students who took the course participated in the date collection. Consequently, analysis of variance technique (ANOVA) test was conducted for each dimension to discover if there is any difference, followed by a Post Hoc test to determine which groups were different. The results of the ANOVA test indicated that there were statistically significant differences between gender, type of college and exercise frequency. For personality and sport enjoyment. Implications are drawn for physical class management and course design.

Keywords: physical education, personality, sport curriculum

1. INTRODUCTION

Despite the brilliant performances by Taiwanese table tennis players, reviewing the development of Taiwan table tennis, there was a period that Taiwan table tennis was unable to join the international community. This was period has set back the development of Taiwan table tennis and was considered as a dark period of Taiwan table tennis. However, after successfully join the International Table Tennis Federation, Taiwan table tennis began to have international exchange opportunities and was able to participate in international competitions. In order to reboot and to enhance a strong competitive advantage, table tennis became Taiwan Olympic Key development projects. Additionally, table tennis was also being promoted in physical activity in all school levels. In order to advocate the sport, it is essential to examine the enjoyment of these courses.

Regular participation in physical activity (PA) has been identified as an important way to prevent obesity. Strategies to promote students' PA participation are, therefore, one of the key components in the treatment of get into the habit of exercise. In addition, participation in regular PA as well as exercise enjoyment and intentions to engage in future exercise may improve psychological well-being (Fox, Rejeski, & Gauvin, 2000). Previous studies have indicated that intrinsic motivation and identified regulation tend to promote PA degrees and enjoyments, and lead to greater intentions of being physically active in after-school activities (Chatzisarantis, Biddle, & Meek, 1997; Glaros & Janelle, 2001).

Enjoyment is positively related to physical activity participation (Bungum, Dowda, Weston, Trost, & Pate, 2000) and frequency (Eime, Young, Harvey, & Payne, 2013). Additionally, PA enjoyment has been identified as a mediator for daily PA participation (Schneider & Cooper, 2011) and exercise behaviour (Baranowski, Anderson, & Carmack, 1998; Wankel, 1993). The important motivation of PA participation for students was funny or interesting (Eather, Morgan, & Lubans, 2013). If there is no enjoyment, the students will soon no longer be involved in PA (De Meester, Aelterman, Cardon, De Bourdeaudhuij, & Haerens, 2014).

Furthermore, previous studies showed that age, gender, urban-rural differences in the correlates of physical activity (Aşçı, Lindwall, Altıntaş, & Edepli Gürsel, 2015; Lee, 2012; Plotnikoff, Mayhew, Birkett, Loucaides, & Fodor, 2004; Stahl & Albert, 2015; Stewart et al., 2006; Vilhjalmsson & Kristjansdottir, 2003). In order to understand the variances in sport enjoyment of students who took the physical class, this research was designed to discuss the differences of students' perceptions of table tennis course. The participants were the students studying in a university of technology.

2. METHODS

The data was analysed as followed. First, the descriptive statistics was used to examine the mean score and standard deviation of revised PACE and Mini-Marker Scale. Second, the independent samples t-test, ANOVA analysis and Scheffe' Post Hoc was employed to examine any significant between gender, type of college and exercise frequency in dimensions of extraversion, agreeable, conscientious, neurotic and openness/intellect.

2.1 Participants

These participants were 281 students who were taking the physical education class in the university. 197 of 281 participants (70.1%) are females. The ages were raged between 18-20 years old and most of the participants were 20 years old (38.6%). Majority of the participants (42.8%) were studied in management school and their frequency of exercise were 2-6 times a week (62.3%).

2.2 Measurements

This Empirical Research was specifically conducted in a table-tennis course. Additionally, a questionnaire with a total number of 56 questions which included attributes of enjoyment and personality. Participants were required to indicate the degree they identified with the statement to rate on a 5-point Likert scale from "1" equal "Strongly Disagree" to "5" equals "Strongly Agree".

Enjoyment

A 16-item revised Physical Activity Enjoyment Scale (PACES) (Moore et al., 2009) was used to determine the extent to which the activity was enjoyed by the participants. The scale included a series of statements which included: I enjoy it, I feel bored, I dislike it, I find it pleasurable, It's no fun at all, It gives me energy, It

makes me sad, It's very pleasant, My body feels good, I get something out of it, It's very exciting, It frustrates me, It's not at all interesting, It gives me a strong feeling of success, It feels good, I feel as though I would rather be doing something else (see Table 1).

Personality

The Mini-Marker Scale (Saucier, 1994) was employed to evaluate the personality of participants. The scale included 40 questions which separate into five dimensions. "Bashful", "Bold", "Energetic", "Extraverted", "Quiet", "Shy", "Talkative" and "Withdrawn" were used to measure the "Extraversion" dimension; "Cold", "Cooperative", "Harsh", "Kind", "Rude", "Sympathetic", "Unsympathetic" and "Warm" were used to measure the "Agreeable" dimension; "Careless", "Disorganized", "Efficient", "Inefficient", "Organized", "Practical", "Sloppy" and "Systematic" were used to measure the "Conscientious" dimension; "Envious", "Fretful", "Jealous", "Moody", "Relaxed", "Temperamental", "Touchy" and "Unenvious" were used to measure the "Neurotic" dimension; "Complex", "Deep", "Creative", "Imaginative", "Intellectual", "Philosophical", "Uncreative" and "Unintellectual" were used to measure the "Openness/Intellect" dimension (see Table 2).

3. RESULTS

In order to make the reversed items comparable to the other items, we will need to reverse score them. In this questionnaire, participants responded to the items using a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). When we reverse-score an item, all the scores in between to become their appropriate opposite (such as "5" into "3", etc.). The mean score of revised Physical Activity Enjoyment Scale (PACES) and Mini-Marker Scale were shown in Table 1 and Table 2.

Table 1. The mean score of revised PACE.

Item: When I am physically active…	mean	Std. Deviation
1. I enjoy it	4.20	0.68
2. I feel bored	3.87	0.75
3. I dislike it	3.90	0.85
4. I find it pleasurable	3.98	0.74
5. It's no fun at all	3.60	0.93
6. It gives me energy	3.99	0.80
7. It makes me sad	4.04	0.80
8. It's very pleasant	3.97	0.79
9. My body feels good	3.95	0.83
10.I get something out of it	3.87	0.84
11.It's very exciting	4.07	0.71
12.It frustrates me	4.00	0.74
13.It's not at all interesting	3.74	0.86
14.It gives me a strong feeling of success	3.53	0.88
15.It feels good	3.85	0.82
16.I feel as though I would rather be doing something else	3.72	0.79

Table 2. The mean score of Mini-Marker Scale.

How Accurately Can You Describe Yourself?	mean	Std. Deviation
Extraversion	3.60	
Bashful	4.00	0.79
Bold	3.77	0.84
Energetic	3.54	0.97
Extraverted	3.95	0.94
Quiet	3.61	0.54
Shy	3.66	0.48
Talkative	2.93	0.25
Withdrawn	3.36	0.86
Agreeable	3.39	
Cold	3.56	0.94
Cooperative	3.53	0.68
Harsh	2.99	0.57
Kind	3.12	0.74
Rude	3.57	0.97
Sympathetic	3.53	0.98
Unsympathetic	3.34	0.64
Warm	3.47	0.97
Conscientious	3.24	
Careless	3.72	0.90
Disorganized	3.34	0.59
Efficient	3.29	0.74
Inefficient	2.74	0.77
Organized	3.35	0.49
Practical	3.39	0.53
Sloppy	3.30	0.82
Systematic	2.80	0.63
Neurotic	3.13	
Envious	3.22	0.62
Fretful	3.25	0.47
Jealous	3.19	0.66
Moody	2.99	0.65
Relaxed	3.28	0.63
Temperamental	3.34	0.85
Touchy	2.91	0.52
Unenvious	2.86	0.72
Openness/Intellect	3.92	
Complex	3.37	0.59
Deep	4.04	0.69
Creative	4.13	0.64
Imaginative	4.02	0.70
Intellectual	3.94	0.77
Philosophical	3.95	0.79
Uncreative	3.95	0.76
Unintellectual	3.97	0.77

As shown in Table 1, the top 5 important items were: "I enjoy it"(m=4.20), "It's very exciting" (m=4.07), "It makes me sad" (reversed item) (m=4.04), "It frustrates me" (reversed item) (m=4.00), and "It gives me energy" (m=3.99), respectively. Among all the items, "It gives me a strong feeling of success" has the lowest average scores (3.53).

As shown in Table 2, on the other hand, the top 5 important items were: "Creative" (m=4.13), "Deep" (m=4.04), "Imaginative" (m=4.02), "Bashful" (m=4.00) and "Unintellectual" (m=3.97), respectively. Among all the items, "Inefficient" has the lowest average scores (2.74).

Overall, the participants had the medium evaluation of enjoyment and personality.

A paired t-test, One-way analysis of variance (ANOVA) and Scheffé Post Hoc Comparison was conducted to evaluate the difference of personality (five dimensions: Extraversion, Agreeable, Conscientious, Neurotic and Openness/Intellect) among gender, type of college and exercise frequency. This test was found to be significant (p<.05) and the result was shown in Table 3.

Table 3. ANOVA of personality dimensions.

variable	Dimension	*t* / F value	Scheffé Post Hoc
Gender	Extraversion	3.852***	-
	Agreeable	4.316***	-
	Conscientious	6.088***	-
	Neurotic	1.556	-
	Openness/Intellect	2.939***	-
Type of College	Extraversion	2.342	-
	Agreeable	2.228	-
	Conscientious	2.759*	No significant difference
	Neurotic	2.794*	No significant difference
	Openness/Intellect	2.738*	No significant difference
Exercise frequency	Extraversion	16.083***	c>a ; c>b
	Agreeable	9.196***	c>a
	Conscientious	7.191***	c>a
	Neurotic	2.521	-
	Openness/Intellect	3.914**	-

Note: * p<.05;** p<.01; *** p<.001;
Exercise frequency: a (once a week); b (2-5 times/ per week); c (over 6 times/per week)

In Table 3 showed the paired t-test and ANOVA of personality dimensions. The results of t-test showed that there was significant gender difference on the dimension of "Extraversion", "Agreeable", "Conscientious" and "Openness/Intellect".

The ANOVA test for type of college, there were significant difference on the dimension of "Conscientious", "Neurotic", and "Openness/Intellect". Further analyses of Scheffé Post Hoc, however, showed that there was no significant difference on all the dimensions.

In the exercise frequency, the ANOVA test showed that there were significant difference on the dimension of "Extraversion", "Agreeable", "Conscientious" and "Openness/Intellect". In the dimension of Extraversion, Scheffé Post Hoc showed that the group of exercise over 6 times per week was significant higher than the group of exercise 2-5 times per week; and the group of exercise over 6 times per week was significant higher than the group of exercise once a week. In the dimension of Agreeable, Scheffé Post Hoc showed that the group of exercise over 6 times per week was significant higher than the group of exercise once a week. In the dimension of Conscientious, Scheffé Post Hoc showed that the group of exercise over 6 times per week was significant higher than the group of exercise once a week. In the dimension of Openness/Intellect, however, Scheffé Post Hoc showed that there was no significant difference on all the dimensions.

4. DISCUSSION

This research was designed to discuss the variances in sport enjoyment and personality of students who took the physical class. A questionnaire with a total number of 56 questions which included attributes of enjoyment and personality. As the result shown, there was significant gender difference on the dimension of "Extraversion", "Agreeable", "Conscientious" and "Openness/Intellect". The results were in agreement with Lee (2012), Stahl and Albert(2015) and Vilhjalmsson and Kristjansdottir (2003). There were significant differences on the dimension of "Conscientious", "Neurotic", and "Openness/Intellect" for the ANOVA test in the type of college. In other words, people from different backgrounds will have significant differences of personality.

In the exercise frequency, there were significant difference on the dimension of "Extraversion", "Agreeable", "Conscientious" and "Openness/Intellect". The results were corresponded with the research which conducted by Fagaras, Radu and Vanvu (2015), Lapa (2015) and Lu, Kim, Dou, & Kumar (2014).

5. CONCLUSION

In sum, the finding of the present study highlights an important issue for the variation in sport enjoyment and personality of university students. *According to the findings, the present stu*dy provided an empirical support for the measures of PA enjoyment and personality for students who took the physical class of table tennis with acceptable difference testing. Additionally, the research results confirmed with previous research that gender and exercise frequency differences in the correlates of physical activity (Aşçı et al., 2015; Fagaras et al., 2015; Lapa, 2015; Lu et al., 2014; Plotnikoff et al., 2004; Radu, Făgăraş, & Vanvu, 2015; Stahl & Albert, 2015; Stewart et al., 2006; Vilhjalmsson & Kristjansdottir, 2003).

There was significant difference between personality according to gender and physical activity frequency. Also, the results showed that students enrolled in different type of college would have no significant difference of personality. The findings of this study have implications for curriculum design as well. The enjoyment

of physical activity was reported for all participants and "I enjoy it" was the priority items of Physical Activity Enjoyment Scale of participants. Therefore, the university should provide information about the benefit of physical activity for health, and opportunity to participate in organized physical activities for students. Future strategies may help students to make exercise a habit and healthy lifestyles.

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Cognition project investigation and analysis before and after the special learning-take students are from Shanghai University of sport majoring in physical education badminton as an example

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Abstract: With Shanghai University of Sport Physical Education Specialty Badminton Talents curtain opened, in the training process, there have been some bad phenomena such as the practice of re-thinking of the students, the theory of light, which is output for future training and have a greater impact. In this paper, literature, questionnaire, mathematical statistics and logical analysis of cognitive, emotional and subjective expectations of learning before and after investigation and analysis to identify factors influencing their special learning to Badminton Training students for the future provide a theoretical basis and reference value and the whole culture of physical education professional development.

Keywords: before and after, physical education major, badminton, learning, cognitive

1. INTRODUCTION

Shanghai University of sport Physical Education Specialty had set up badminton in 2008, from the beginning the big screen badminton professional training. To date, it has been transported to the community for four graduates, the survey feedback, this three graduates of social recognition is relatively good. However, in the training process of development in recent years, we have also found that some of the puzzling phenomenon, in learning, students learn more emphasis on practical, and ignore theoretical aspects of the study. The existence of these phenomena maybe cause future cultivation and output a great deal of adverse effects.

In view of this, by the way of comparing and analysing the difference before and after the study paper to identify factors influencing their special learning, we wish that it provide a theoretical basis and reference for students specializing in badminton and the whole culture of physical education professional training in the future.

2. METHODS

2.1 Sample

Students are from Shanghai University of Sport Physical Education Specialty Badminton grading in 2010 (16), 2011 (16), 2012 (28), 2013 (20), adding up to 80.

Table 1. List of sampling

	Release questionnaire	Recycling questionnaire	valid questionnaires	male	female
frequency	80	76	74	60	14
proportion		95.00%	97.37%	81.08%	18.92%

2.2 Methods

2.2.1 Literature:

According to the study purpose, content, through the China Journal Net, CNKI, books, newspapers and other media, to retrieve "cognitive badminton", "badminton learning" and "teaching badminton" and word frequency were retrieved More than 40 relevant literature, and sorting and summed to provide a theoretical basis for this article.

2.2.2 The questionnaire:

2.2.2.1 Questionnaire Validity

In order to ensure the validity of the questionnaire, many seek expert advice, then make the appropriate changes and additions to the advice and recommendations of experts, the revised invited five experts on the content and structure of the questionnaire will be "more effective", "effective" "general," "less effective", and Validity Assessment "invalid" five grade evaluation system, the questionnaire content validity final form that the efficiency reached 80%, in line with sports scientific standards. The main content of the survey questionnaire Motivation before school, after the project of cognitive and subjective expectations and motivation to participate in school projects cognitive and subjective expectations. The evaluation results are shown in Table 2.

Table 2. Questionnaire validity list (N=5)

	more effective	effective	general	Not	Not very
fre	2	2	1	0	0
pro	40%	40%	20%		

2.2.2.2 Questionnaire Reliability Test

In order to ensure the reliability of the questionnaire, drawn from a survey of students after 40 weeks apart distributed the same questionnaire retest, discriminate based on two questionnaires filled Options and correlation coefficients estimated two research questionnaires R = 0.84, in line with the requirements of statistics, a higher credibility.

2.2.3 Mathematical Statistics

Microsoft Excel and statistical processing of survey data, including the percentage analysis and frequency analysis to produce a corresponding chart.

2.2.4 Logical Analysis

Statistical data collation, research process using inductive logic method, deduction, analogy and comprehensive analysis of the data obtained were analysed and reference Opinion Research Situation and experts deduced corresponding conclusions and on this basis, reasonable proposals.

3. RESULTS AND ANALYSIS

3.1 Admission to the project before cognition

3.1.1 Level of interest in badminton before

Table 3. List level of interest two pairs badminton (N = 74)

	very	interested	general	Not	Not very
frequency	35	34	50	0	0
proportion	47.30%	45.95%	6.76%	0.00%	0.00%

Interest is recognized that a person seeks to master something, to participate in a sport, and has a positive psychological tendency emotional colour. Whether students have learned in sports interest is directly related to their studies, if there is interest in the project, will have a special feeling, this feeling will increase their enthusiasm, and consciously take the initiative to participate in learning, and achieve better results; on the contrary, it will affect their learning. Table 3 shows that 93.24 percent of the students are interested in badminton, badminton explain in their hearts occupy a higher position, which will lay a good premise for their special learning about to enter college.

3.1.2 Admission former badminton basic knowledge of cognition

Table 4. General list of cognitive knowledge badminton three pairs (N = 74)

		Focus competition	Knowing rules and methods	Knowing about technical name
Yes	fre	22	20	23
	pro	29.73%	27.03%	31.08%
No	fre	52	54	51
	pro	70.27%	72.97%	68.92%

Table 5. Origin and history of the four pairs of badminton informed list (N = 74)

	Well	Aware	General	Not	Not very
Fre	3	13	34	22	2
Pro	4.05%	17.57%	45.95%	29.73%	2.70%

Badminton basics is including its origin and development, major events, game rules and methods, tactics and methods of the theory and sports injuries and other

protective. This paper selects the part of the students surveyed their basic knowledge of cognition Badminton, Table 4 shows that most of the students before the school does not know some of the basic technical name (high, hanging, killing the ball), the methods and the game of badminton Rules are less known, only 29.73% of the students to focus on badminton tournament; Table 5 shows that the majority of students enrolled before the origin and history of the development of badminton in general the following stages, accounting for 78.38%, i.e. the majority of its students do not understand the origin and development. In summary, the majority of pre-school students with education specializing in professional badminton zero theoretical foundation based on project knowledge badminton poor situation awareness.

3.1.3 Pre-school participation

Table 6. For a list of the top five channels of entry for badminton (N = 74)

	Network	Others' introduction	Books and newspapers	Radio and TV	Others
Fre	11	16	16	24	7
Pro	14.86%	21.62%	21.62%	32.43%	9.46%

Table 7. List case contact badminton (N = 74)

	systematic study	No systematic study
Frequency	16	58
Proportion	21.62%	78.38%

Table 6 shows that students understand the school before specializing in effective channel badminton more widely, mainly as follows: radio, television, etc. (32.43%), and others to introduce books, newspapers, etc. (21.62% each), network (14.86%), and Other (9.46%). The reason is that students usually spare time on the outside of things to understand social media, the greatest exposure is through radio, television, newspapers and magazines, computer access and understanding manner. In sports, badminton is a sport project content nowadays more and more attention, the media coverage and the degree of attention will be relatively more students in watching TV programs, computer access and reading newspapers and magazines often during natural see related story badminton knowledge and information of some events, along with students to enhance the degree of concern, likeability will gradually increase and improve the understanding of badminton's enthusiasm.

While liking gradually increase, but that does not mean its involvement will positively correlated with Table 7 shows that 78.38 percent of the students enrolled in before and there is no systematic study had badminton, there is only a small part of the students studied, This may be related to the climatic conditions of students, the level of economic development and projects carried out status. In summary, the majority of pre-school students with education specializing in professional badminton skills base zero basis.

3.1.4Motivation survey before admission

Table 8. Cases Motivation list before school (N = 74)

	Frequency	Sort
Personal Interests	40	1
Future employment	28	2
Improve and enhance the skill	23	3
Family and friends affected	20	4
Celebrity	5	5
Good venues and facilities	4	6
Other	2	7

Motivation is a pointer to a goal, desire or intention to stimulate or inhibit certain behaviours, individuals engage in certain activities is to promote internal psychological motivation. The option motivation refers to people in order to meet the needs of a particular sport subjective views of sports activities, it is the people's subjective reflection of objective physical needs. It can be seen, the options for individual sports learning motivation plays a very important role, is the incentive for individuals to participate in sports.

Table 8 shows that the former student enrolment options are more diverse motives, the top four are: personal interests, the impact of future employment, and improve four areas to improve the technology, the impact of family and friends, etc., although these options are more motivated dispersed, but its role cannot be ignored, for admission after learning has an important impact. While the celebrity list later, indicating that students in school before there is a strong sense of self.

3.2 The cognitive situation after admission

3.2.1 Different grade of special cognitive situation of basic theoretical knowledge

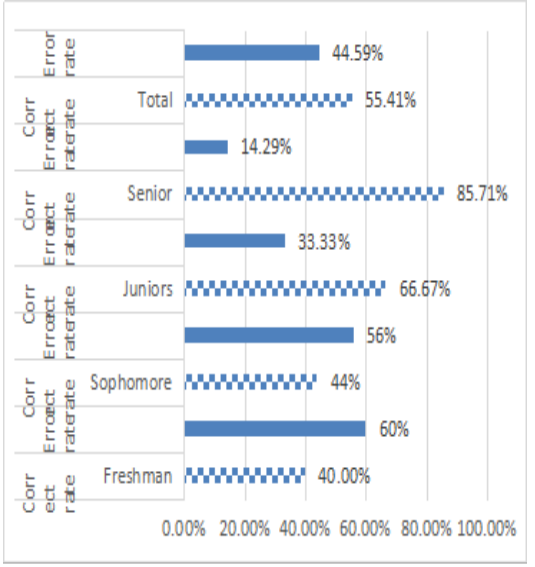

Fig. 1. Modern badminton in when and where and when to join the Olympic Games

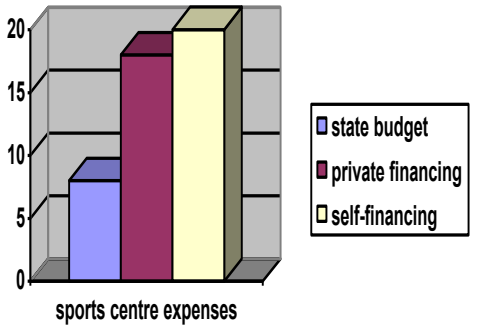

Fig. 2. China badminton movement originated in the crown when "uncrowned king"

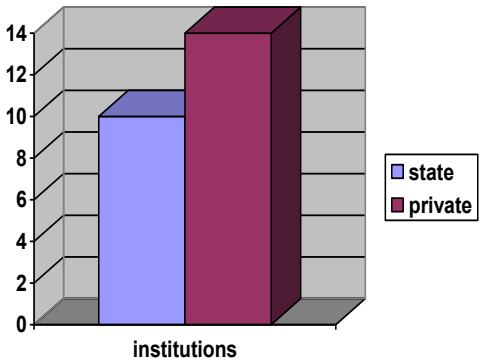

Fig. 3. Main events of modern badminton know name

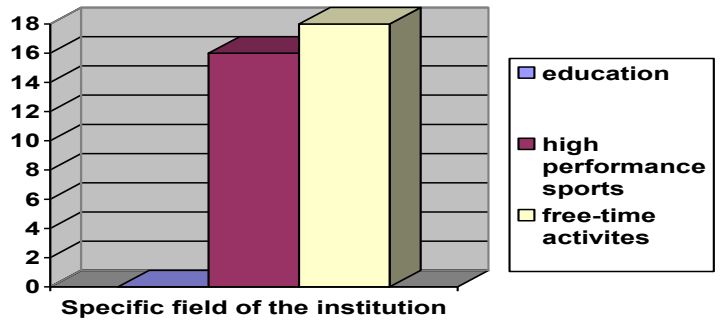

Fig. 4. Cognitive situation of badminton ball technology basic link

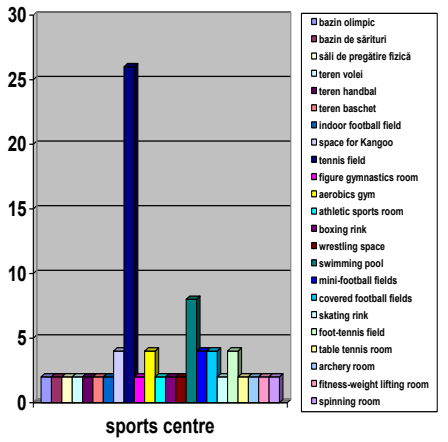

Fig. 5. For badminton techniques according to the position

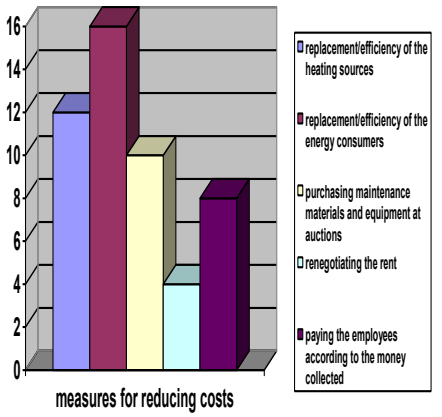

Fig. 6. Cognitive situation of badminton basic footwork

Due to the badminton specialized theory knowledge includes noodles wide, this article only to select part of as investigation object, the Figure 1-6 shows that the special basic knowledge to answer the above, error rates are highest in response to a "when are badminton originated in China, and called the coronation "uncrowned king?". The problem above, accounted for 85.14%, visible special introduction to students in the usual study less on badminton knowledge; Second is in response to a "basic link of badminton ball technology" and "basic footwork badminton", 59.46%, respectively, the two problems is not belong to the topic of higher difficulty, just the easy mixed sex is higher, it also shows that to some extent students majoring in basic theory is not solid, in the usual learning attitude is not steadfast.

Freshman in a high error rate in the answer, and the emergence of this phenomenon is also logical, after all, only by a special study of the term, has large improvement requires theoretical knowledge, it is not practical; Relative to freshman, the sophomore has low error rate, easy to confuse knowledge is still flawed; For junior grade, the error rate is bigger one, two and a certain degree of lower grade, but it still ignored the confusing knowledge to identify; For senior grade, it has completed a complete special courses, are made by a "student" into "prospective teachers" role transformation, a larger one, two, three grade, the theory of knowledge accumulation to a certain degree, error rate is relatively low.

To sum up, with the increase of length of schooling, mastery of knowledge of the basic theory of badminton will gradually improve, to some extent, this also shows that in the lower grade of learning, students tend to ignore the theoretical knowledge of learning, how to improve the junior student's perception of specific basic theory knowledge will be our future thinking question!

3.2.2 The cognition of tactics after admission

3.2.2.1 Perceptions of technology

Table 9. The main technology in table 8 basic technological learning schedule (N = 74)

Technical name	Frequency	Sort
Golf	67	1
Lob	48	2
Serve	43	3
Pick the ball	25	4
Kill the ball	22	5
Push the ball	8	6
Chop	6	7
Flat drive block	2	8
Hook the ball	1	9

Badminton's basic technology according to the position of the ball, can be divided into the forehand, backhand, fit, hand and head technology; According to the spot can be divided into the frontcourt, midfielder, around the back and the field. This paper listed nine basic skills for students to choose from, table 9, according to the basic technology of the study, thinks that the main three basic techniques: golf, lob and serve, the results and the existing teaching professional curriculum has certain relevance.

Table 10. Basic technical learning order list (N = 74)

	Front, midfield, backcourt	Frontcourt, backcourt, midfielder	Backcourt, midfielder, Frontcourt	Backcourt, Frontcourt, midfielder	midfielder, Frontcourt, Backcourt	midfielder, Backcourt, Frontcourt
Fre	12	11	9	39	1	2
Pro	16.22%	14.86%	12.16%	52.70%	1.35%	2.70%

Badminton front technology including the net (rub, pushing, hook, pick, and on) the ball; Backcourt technology generally includes a high ball, lob and kill the ball; Midfielder technology generally includes catches the flat drive over the ball. Table 10 shows, in the heart of the students, the basic technologies of learning sequence should be the back going technology, the technology and midfielder, accounted for 52.70%, while the back high, lifting and smash technology and the name of each different, but the basic structure of the shot, still must be sideways to prepare, racket back, stroke, and with the potential reduction, learn the backcourt technology can effectively reduce the time of the generalization stage movement skills, students quickly grasp the backcourt technology. In the backcourt handling technology, learning combination of field practice, before and after the front technology can effectively improve both the practice effect and can reduce the tedious sexual practice single technology.

3.2.2.2 after the entrance of cognitive tactics

Table 11. The most important aspect of the list in tactics study (N = 74)

	Tactical awareness	Tactical action	Tactical implementation
Frequency	49	14	11
Proportion	66.22%	18.92%	14.86%

Dialectical materialism believed that material determines consciousness, consciousness has a motile reaction to the material. Consciousness is a reflection of the human brain to objective things, the right positive consciousness will promote the development of things, on the other hand, would hinder the development of things. Tactical awareness is refers to the athletes in the process of dry become evil game, accurately judge the situation of the game, random strain, according to actual condition to determine the ability of missile in how to act correctly. The right tactical awareness can be converted into tactical manoeuvres and combined with the characteristics and field athletes, to effectively implement to achieve good results. Table 11 shows that most of the students think in learning tactics, the role of the tactical awareness is very important, accounted for 66.22%, visible, the majority of student's cognition to tactical learning more clear.

3.2.3 The cognition to the competition after admission

Table 12. Cognitive condition of badminton competition schedule (N = 74)

	Race choreography	Judging contest	Referee theory
Fre	32	41	1
Pro	43.24%	55.41%	1.35%

With the popularity of badminton, the improvement of sports socialization, carry out of the general public, sports, badminton competitions are carried out in full swing, which requires more to undertake and organize the competition of talents, in the face of this situation, our body can teach students majoring in meet the demand of the society?

Table 12 shows, most of the students majoring in that face of the cutting ability is the main, accounted for 55.41%, more value into practice; But neglects the importance of and for the referee theory, accounted for only 1.35%, that is relatively difficult to master race in badminton competition theoretical part, accounts for 43.24%. Specialise in the students in the usual competition, therefore, more attention to practice, and neglects the referee theory learning and accumulation, have no enough theory as support, how can in the face of cutting with accurate decisions?

3.2.4 The cognition of badminton sports injury after admission

Table 13. Necessity to prepare and organize activities cognitive situation list (N = 74)

	Very	Necessary	General	Not very	No
Fre	47	18	7	2	0
Pro	63.51%	24.32%	9.46%	2.70%	0.00%

Table 14. One of the more common sports injury parts list (N = 74)

	lower limbs (foot, ankle, knee)	upper limbs, (shoulder, elbow, wrist)	Trunk (waist, lumbosacral region)
Fre	45	25	4
Pro	60.81%	33.78%	5.41%

Table 14, according to undergraduate teaching badminton in body specialty sports injury is common in parts of lower extremities (foot, ankle and knee), accounted for 60.81%, this shows that more than half of the students or had lower limb injury, also from another side in the lower extremities, illustrates the badminton sport demand is higher, the probability of using this site more, should pay attention to protection of the region; Table 13 shows that 63.51% of students think that preparation before class and after class of finishing activities is very necessary, but still more than half of the students have sports injury, this is worth us to preparation before class and after class of finishing activities of quality put forward the question?

Table 15. Prevention and treatment of sports injury list (N = 74)

	Proficient	Slightly	General	Not very	No
Fre	3	26	30	14	1
Pro	4.05%	35.14%	40.54%	18.92%	1.35%

When some injury accident, our students can effectively handle and deal with it? Table 15 indicated that only 39.19% of the students know the simple processing, this part of most of the students for senior students. While 60.81% of students is in the position of don't know or ambiguous. The emergence of this phenomenon, perhaps with our teaching plan has the certain relevance, such as open term lags behind in some subjects.

To sum up, after admission, most of the students understanding of sports injury along with the increase in practice has a certain improvement, but their cognition on the prevention and treatment there is still a large room to improve.

3.2.5 Subjective participation feeling after admission

Table16. After study of the feelings of badminton (N = 74)

	Very relax	Relax	General	Tired	Very tired
Fre	7	15	20	26	6
Pro	9.46%	20.27%	27.03%	35.14%	8.11%

According to table 16, 29.73% of the students think it is relatively easy, there are 43.25% of the students think the sport is more tired, there are 27.03% of the students is a neutral. Because the badminton sport is a movement of body quality request is higher, body function characteristics of each different, accept ability also has difference, feel good about themselves will motivate yourself constantly move forward, on the contrary, self-induction have poor easy to slack off or broken falls ", in the long term, the polarization will show itself.

Table 17. Participation when doubts arise (N = 74)

	Communication between students	Ask the teacher for help	Gather information to solve them self	Nothing definite
Fre	19	37	17	1
Pro	25.68%	50.00%	22.97%	1.35%

Table 17, according to 50% of the students in case of doubt, will take the initiative to ask the teacher, shows that most students have a positive attitude to learning; In addition, there are 25.68% of the students' union can only be solved by the communication between classmates, and by collecting data on their own to solve students accounted for 22.97%, only 1.35% of the students will go away, it shows that the majority of students learning attitude is a positive, but it does not mean that can give up the negative of the students.

To sum up, after the entrance, although most of the students' learning attitude is positive, participate in the initiative is strong, but different each student's physical quality, the ability to accept also have corresponding differences, there are still some students have to exclude laches sentiment, which to a certain extent brings difficulty to the teachers' teaching, how to effectively solve this problem will be our future worth exploring.

3.2.6 Cognitive factors in the influence of special study after admission

Table 18. After admission factors affecting special cognitive learning schedule (N=74)

Factors	Frequency	Proportion
School facilities	58	1
Personal interests and hobbies	50	2
Teacher's teaching and the technical level	47	3
The influence of social	32	4
The requirements of teaching outline	13	5
Others	7	6

Table 18, according to the entrance after affect students special cognitive factors mainly include: the effect of school facilities, personal interests and hobbies, the influence of teachers' teaching and the influence of the technical level and social influence, etc.

In actual interviews survey is consistent with these influence factors, although the school badminton venue facilities are relatively complete, but the except special students in a class can be used free of charge, the rest of the time is for a fee, even for students for half price is favourable, however, for there is no economic sources of students is also a significant overhead, cause the students want to play but nowhere to play, this also to a certain extent, affected the improvement of students' skill level.

In addition, the students' interest in personal and teacher's teaching and the technical level and occupies a large proportion, it is in some sense put forward more higher requirement for teachers, how to maintain and improve the students of higher learning passion, to achieve a better teaching effect.

More can't ignore the influence of the social, the school specialized teaching reform, the influence of the badminton professional talented person's demand also increasingly evident; More worth mentioning is the vigorous development of the mass badminton activity, people have not only satisfied with entertaining, but is a greater demand for badminton skill levels, various badminton training also became popular, also the growing demand for badminton coach, these have become the social factors influencing the students majoring in special cognitive learning.

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Notational analysis of female´s singles badminton matches in Olympic Games in Beijing

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Abstract: The aim of this study was to determine the gestural structure of female´s singles badminton matches in Olympic Games. 36 single´s badminton matches in Olympic Games were selected. Matches were played with the current "rally point scoring" system, where the one who wins the best of 3 games of 21 points is the winner. Official videos recorded by the organizations of the Beijing 2008 Olympic Games were used to carry out the analysis of the matches. Matches were analysed with Kinovea 8.15 software and analysis of all games was done following Anguera´s methods. For strokes the classification proposed by Spanish Badminton Federation was taken as a reference and seven group were selected: a) Forehand low stroke; b) Backhand low stroke; c) Forehand half stroke; d) Backhand half stroke; e) Forehand overhead stroke; f) Backhand overhead stroke; g) High rectified. The results shown a total of 17225 strokes analysed. In turn, strokes volume were: a) 3362 (19,6%); b) 3469 (20,1); c) 1570 (9%); d) 961 (5,5%); e) 5472 (31,8%); f) 191 (1,2%); g) 2200 (12,7%). No studies so far have analysed gestural characteristics of elite badminton, a sport whose practice has spectacularly increased over the last few years. For planning and specific training female badminton these studies are necessary.

Keywords: badminton, notational analysis, competition, female

1. INTRODUCTION

Badminton has increased in popularity since its inclusion as an official sport in the 1992 Olympic Games in Barcelona. Badminton is the execution of sporadic movements of moderate and high intensity, related to repetitive actions of short duration but great intensity, as occurs in other sports with similar characteristics (squash, tennis, and volleyball). These characteristics, together with highly explosive bursts of play, in the case of badminton taking place with high speed and technical skill within an 80m^2 court, serve to illustrate the degree of physical exertion in each match (Cabello and Badillo, 2003).

By the moment and after the rule change occurred in 2006 (BWI, 2006) are various studies that shown an individual badminton game has a variable duration of between 20-40 min and a real time around to 25-37% (Fernandez-Fernandez et al., 2013; Abian et al., 2013; Abian et al., 2014).

In turn, gestural structure implies knowledge of the number and type of strokes along match play. This analysis has important applications that could impact on performance, the knowledge of these data are essential to specificity training (Torres-Luque et al., 2014).

Research about structure gestural, (the optimum performance level players can reach, which should be used as a point of reference for coaches of top players), is still scarce. The aim of this study was to determine the gestural structure of female´s singles badminton matches in Olympic Games.

2. METHOD

36 single´s badminton matches in Olympic Games were selected (76.59% of total matches in competition). Nine matches were deleted (two withdrawal, seven for more than 20 points of different). Matches were played with the current "rally point scoring" system, where the one who wins the best of 3 games of 21 points is the winner. Given the category of the tournament, all participants were the best players in the world at that time. Official videos recorded by the organizations of the Beijing 2008 Olympic Games were used to carry out the analysis of the matches. Matches were analysed with Kinovea 8.15 software and analysis of all games was done following the methods of Anguera (2003). For gestural structure the classification proposed by Spanish Badminton Federation was taken as a reference, although badminton strokes were grouped into seven categories because of simplifying: a) Forehand low stroke (lob, net drop, push); b) Backhand low stroke (lob, net drop, push); c) Forehand half stroke (clear, drop, sweep, tense, brush/kill, lob, push); d) Backhand half stroke (clear, drop, tense, brush/kill, lob, push); e) Forehand overhead stroke (clear, drop, smash); f) Backhand overhead stroke (clear, drop, smash); g) High rectified (clear, drop, smash).

3. RESULTS

The results shown a total of 17225 strokes analysed. In turn, strokes volume were: a) 3362 (19.6%); b) 3469 (20.1); c) 1570 (9%); d) 961 (5.5%); e) 5472 (31.8%); f) 191 (1.2%); g) 2200 (12.7%).

Table 1. Distribution of type strokes by total analysed

	n	Stroke (n)
Forehand low stroke	3362	Lob (1870) Net Drop (1426) Push (66)
Backhand low stroke	3469	Lob (1883) Net Drop (1509) Push (77)
Forehand half stroke	1570	Clear (501) Drop (544) Sweep (42) Tense (367) Brush/kill (21) Lob (39) Push (56)
Backhand half stroke	961	Clear (323) Drop (485) Tense (108) Brush/kill (8) Lob (18) Push (19)
Forehand overhead stroke	5472	Clear (2288) Drop (1364) Smash (1820)
Backhand overhead stroke	191	Clear (114) Drop (67) Smash (10)
High Rectified	2200	Clear (1124) Drop (536) Smash (540)
TOTAL	17225	

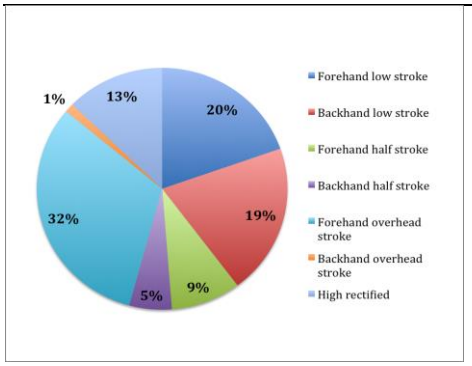

Fig. 1. Distribution of type strokes in percetnage along match play in female singles badminton in Olympic Games in Beijing.

4. DISCUSION

Our knowledge, this is the first study that analyses the gestural structure specifically. Only Abian et al. (2013; 2014) showed that the smash in male badminton players and drop in female are more frequency.

No studies so far have analysed gestural characteristics of elite badminton, a sport whose practice has spectacularly increased over the last few years. For planning and specific training female badminton these studies are necessary.

5. CONCLUSIONS

The most frequent type of strokes were: forehand overhead stroke (32%), backhand low stroke (20%) and forehand low stroke (19%). More specifically, the technical actions: forehand overhead stroke Clear and Smash; and forehand low stroke Lob. For planning and specific training female badminton these studies are necessary.

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Notational analysis of female´s singles badminton matches in relation at stress area

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Abstract: The aim of this study was to determine the gestural structure of female´s singles badminton matches in relation at stress area. 36 single´s badminton matches in Olympic Games were selected. Matches were played with the current "rally point scoring" system, where the one who wins the best of 3 games of 21 points is the winner. Official videos recorded by the organizations of the Beijing 2008 Olympic Games were used to carry out the analysis of the matches. Matches were analysed with Kinovea 8.15 software and analysis of all games was done following the methods of Anguera (2003). 28 types of strokes were selected (Fesba, 2008). Three-stress zone were selected (Fesba, 2008): stress zone; moderate stress; zone without stress. The results showed a total of 17225 strokes analysed. The results shown that predominant stroke that generated stress zone: forehand low stroke net drop (22.7%); Backhand low stroke net drop (22.4%) and Forehand overhead stroke Drop (19.3%). Strokes that generated moderate stress were: Forehand low stroke Net Drop (12.1%); Backhand low stroke (13.4%) and; Forehand overhead stroke Clear (13.8%) and Drop (13.3%). Strokes that generated zone without stress was: Forehand low stroke Lob (13.4%); Backhand low stroke Lob (14.1%); Forehand overhead stroke Clear (15.8%) and Smash (18.2%). These studies are necessary for the technical and tactical planning and specific training in female´s singles badminton matches.

Keywords: badminton, notational analysis, competition, female

1. INTRODUCTION

Gestural structure implies knowledge of the number and type of strokes along match play. This analysis has important applications that could impact on performance, the knowledge of these data are essential to specificity training (Torres-Luque et al., 2014).

Badminton has increased in popularity since its inclusion as an official sport in the 1992 Olympic Games in Barcelona. Badminton is the execution of sporadic movements of moderate and high intensity, related to repetitive actions of short duration but great intensity (Cabello-Manrique and Gonzalez-Badillo, 2003).

By the moment and after the rule change occurred in 2006 (BWI, 2006) are various studies that shown an individual badminton game has a variable duration of

between 20-40 min and a real time around to 25-37% (Fernandez-Fernandez et al., 2013; Abian et al., 2013; Abian et al., 2014).

There are few studies analysing the gestural structure of badminton. There are few studies analysing the gestural structure of badminton and they are very controversial. Cabello-Manrique and Gonzalez-Badillo (2003) showed more actions of short service, while in Olympic badminton player appear smash, drive and drop (Abian et al., 2013; Chen et al., 2011). But even those few who analyse hit areas. Liddle et al. (1996) showed in single and doubles badminton match more strokes in background court (50%) that near of net (25%).

Our knowledge, it is necessary to investigate about strokes and zone of court in single badminton match.

The aim of this study was to determine the gestural structure of female´s singles badminton matches in relation at stress area.

2. METHOD

36 single´s badminton matches in Olympic Games were selected (76.59% of total matches in competition). Nine matches were deleted (two withdrawal, seven for more than 20 points of different). Matches were played with the current "rally point scoring" system, where the one who wins the best of 3 games of 21 points is the winner. Given the category of the tournament, all participants were the best players in the world at that time. Official videos recorded by the organizations of the Beijing 2008 Olympic Games were used to carry out the analysis of the matches. Matches were analysed with Kinovea 8.15 software and analysis of all games was done following the methods of Anguera (2003). Three-stress zone were selected (Fesba, 2008): stress zone; moderate stress; zone without stress (Figure 1). A total of 28 types of stroke were selected (Fesba, 2008): a) Forehand low stroke (lob, net drop, push); b) Backhand low stroke (lob, net drop, push); c) Forehand half stroke (clear, drop, sweep, tense, brush/kill, lob, push); d) Backhand half stroke (clear, drop, tense, brush/kill, lob, push); e) Forehand overhead stroke (clear, drop, smash); f) Backhand overhead stroke (clear, drop, smash); g) High rectified (clear, drop, smash).

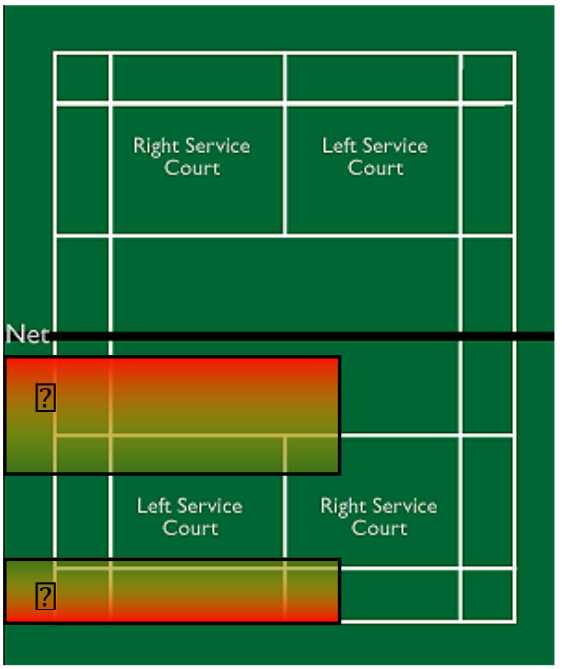

Fig. 1. Badminton court and stress and moderate zone stress area.

3. RESULTS

The results shown a total of 17225 strokes analysed.

Table 1. Distribution of type strokes in relation at zone of badminton court (n=17225)

		Zone without stress (%)	Moderate Stress (%)	Stress zone (%)
Forehand low stroke	Lob	13.4	9.6	3.2
	Net Drop	2.7	12.1	22.7
	Push	0,4	0,4	0.3
Backhand low stroke	Lob	14.1	8.7	3.0
	Net Drop	3.0	13.4	22.4
	Push	0.4%	0.6	0.2
Forehand half stroke	Clear	3.8	2.0	1.1
	Drop	1.1	5.3	7.1
	Sweep	0.1	0.3	0.5
	Tense	3.3	0.6	0.8
	Brush/kill	0.2	0.0	0.0
	Lob	0.3	0.2	0.2
	Push	0.1	0.7	0.5

Backhand half stroke	Clear	2.4	1.2	1.9
	Drop	1.4	4.7	2.8
	Tense	0.8	0.4	0.6
	Brush/kill	0.1	0.0	0.0
	Lob	0.1	0.2	0.1
	Push	0.1	0.2	0.1
Forehand overhead stroke	Clear	15.8	13.8	2.0
	Drop	2.2	13.3	19.3
	Smash	18.2	0.6	0.9
Backhand overhead stroke	Clear	1.1	0.2	0.0
	Drop	0.2	0.6	0.5
	Smash	0.1	0.0	0.0
High Rectified	Clear	8.3	5.5	1.2
	Drop	1.1	5.1	7.2
	Smash	5.4	0.1	0.2

4. DISCUSION

To our knowledge this is the first study to analyse many types of strokes. The strength of this research is the analysis of 28 types of strokes in relation of stress area. We believe that this is new and necessary information for specific training in badminton. Only Liddle et al. (1996) showed in single and doubles badminton match more strokes in background court (50%) that near of net (25%). Others study indicated the frequency of the smash stroke is 30% (Abian-Vicen et al., 2013; Abian et al., 2014). It seems that in higher levels of competition attack or offensive strokes are used more often.

But, there is not studies about influence of stress and moderate zone stress area. However, there are some limitations in this study. We did not consider whether the player was left hand or dominance of the area of stroke. More research is required to further develop this sport's continuous growth.

5. CONCLUSIONS

The stroke that generated stress zone: forehand low stroke net drop (22.7%); Backhand low stroke net drop (22.4%) and Forehand overhead stroke Drop (19.3%). Strokes that generated moderate stress were: Forehand low stroke Net Drop (12.1%); Backhand low stroke (13.4%) and; Forehand overhead stroke Clear (13.8%) and Drop (13.3%). Strokes that generated zone without stress was: Forehand low stroke Lob (13.4%); Backhand low stroke Lob (14.1%); Forehand overhead stroke Clear (15.8%) and Smash (18.2%). These studies are necessary for the technical and tactical planning and specific training in female´s singles badminton matches.

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Analysis of kinematics characteristics on the backhand twist technique for China elite male hand-shake table tennis players

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Abstract: This paper applied the method of sports biomechanical testing and analysis and gave a 3-D kinematic test and analysis on the backhand twist technique of Zhang Jike and Fan Zhendong to reveal the kinematics characteristics and action technique principle of male hand-shake table tennis players, which would lay the foundation of technical movement monitoring and diagnosis system for the excellent table tennis athletes in our country for the future.

Keywords: backhand twist, kinematics, Zhang Jike, Fan Zhendong

1. PREFACE

In the table tennis competition, the athlete athletics' abilities (including technical, tactical, physical, psychological, and IQ, etc.) are determined ultimately by each hitting ball. The quality of hitting ball is mainly determined by the athlete's movement techniques. It is a decision factor that the reasonable and the normative of each technique, which could affect the athletes' results in the future.

The backhand twist technique of Zhang Jike and Fan Zhendong is the best and most reasonable in China national table tennis team. The other players with hand-shake should learn from them. The paper gave a 3-D kinematic test and analysis on the backhand twist technique of Zhang Jike and Fan Zhendong to reveal the kinematics characteristics and action technique principle of male hand-shake table tennis players, which would lay the foundation of technical movement monitoring and diagnosis system for the excellent table tennis athletes in our country for the future.

2. METHODS

2.1 Subjects

The subjects are Zhang Jike and Fan Zhendong, who are the World champion. They are both with right hand-shake grip.-

2.2 Experimental Methods

The backhand twist technique of Zhang Jike and Fan Zhendong were recorded by two high-speed Digital Videos (frequency: 100 Hz) in 2014 Chinese table tennis closed training at Guangzhou.

2.3 Data Processing

Using Dartfish software to extract features screen, mark, marking, picture enlarged and calculate angle.

3. RESULTS AND DISCUSSION

3.1 The action phases

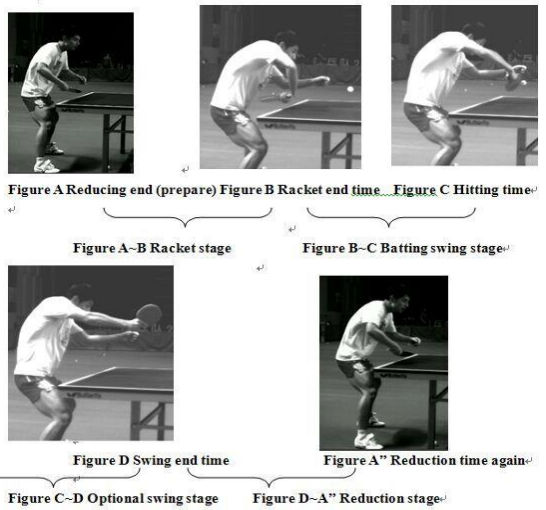


Fig. 1. Four phases of backhand twist action

During the multi-point ball hitting forehand basic technical training, the continuous hitting action could be seen as a cyclical movement. A table tennis swing is a complicated process, in order to facilitate the overall operation of the analysis and research, according to the task and the nature of the action, the complex full strokes can be divided into different phases of action. The critical point of the different operation phases is the hitting character screen.

As shown in figure 1, the five time point are reducing end, racket end time, hitting time, swing end time, reduction time again. The five features of the action time point constitute four phases, which are: the phase of swinging racket backward, the phase of swinging forward and hitting ball, the phase of swinging racket forward after hitting ball and the phase of returning to the original condition.

3.2 The analysis on the phase of swinging racket backward

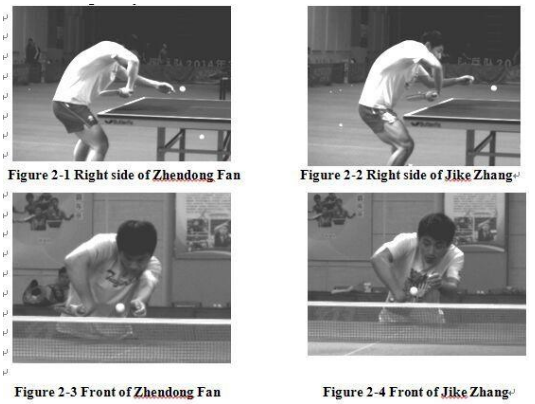


Figure 2-1 Right side of Zhendong Fan

Figure 2-2 Right side of Jike Zhang

Figure 2-3 Front of Zhendong Fan

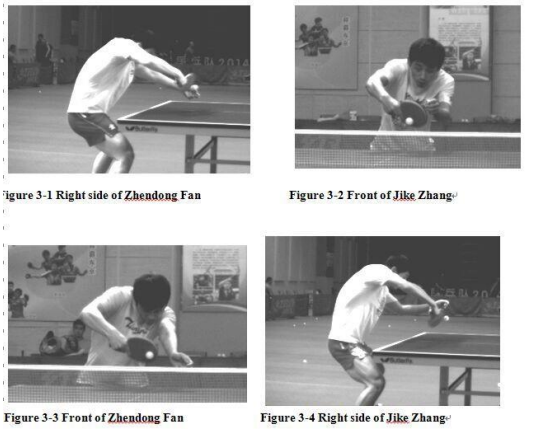
Figure 2-4 Front of Jike Zhang

Fig. 2. Racket back end feature figures

As can be seen from Figure 2, the body postures are similar at the moment of the end of swinging racket backward. Two players' wrists and trucks were twisting fully.

During the phase of swinging racket backward, the greater the degree of the wrist and the trunk, the more elastic potential energy the muscle stores, which not only clap hands with racket to blow out hit space, but also build up the strength to swing. As for the range of swinging racket backward, that of Fan Zhendong was 270 degrees, and that of Zhang Jike was 180 by the calculation of Dartfish software. It suggested that the range of Fan Zhendong's swinging racked of Fan Zhendong was more sufficiently than Zhang Jike.

3.3 The analysis on the phase of swinging forward and hitting ball



igure 3-1 Right side of Zhendong Fan

Figure 3-2 Front of Jike Zhang

Figure 3-3 Front of Zhendong Fan

Figure 3-4 Right side of Jike Zhang

Fig. 3. Hit time feature figures

3.3.1 The timing of hitting ball

The number of pictures that the coming ball rebounded to players to hit the ball time could reflect the hitting time of athletes. Statistical 10 times of the two players' backhand technology, the coming ball rebounded to players to hit the ball time, the average number of pictures, Fan Zhendong was 21.3 (0.213 s), and Zhang Jike was 21.5 (0.215s). By t test, the difference between Fan Zhendong and Zhang Jike was not significant.

Table 1. The time of the ball rebounded to the hitting moment (unit: s), n=10

Time	Fan Zhendong	Zhang Jike
Average	0.213	0.215
Standard Deviation	0.001	0.009

3.3.2 Force direction at the moment of hitting

The force direction of Fan Zhendong and Zhang Jike are relatively similar at the moment of hitting. The racket power forward is bigger than to the right. The body center of gravity is forward,

At the moment of hitting, the fore of Zhang Jike is more reasonable, which is strong, centralized and the speed of swing was fast, while the force of Fan Zhendong sways a little sometimes.

3.3.3 The movement of Shoulder Joint

The shoulders of Zhang Jike and Fan Zhendong are forward and the right shoulders are higher than the left shoulder. The shoulder joint has been under forward pressure, so as to give the forearm and wrist with a stable support in the process of hitting.

3.4 The analysis on the phase of swinging forward after hitting ball

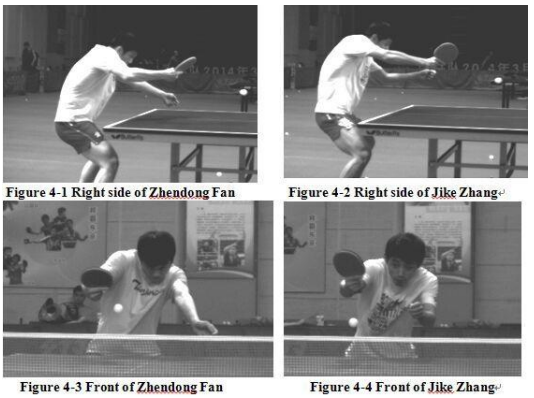


Fig. 4. With the potential swing end phase feature figures

The phase of swinging forward after hitting ball was a continuation of force the after hitting power and was a reduction. The body and arms were in slow motion with the direction of the force until the end time of swinging forward. This phase can indirectly reflect the force direction and the reduction of the speed. As can be seen from figure 4, the posture of the two athletes is basically the same at the end of the swinging forward. The angles of the two players' rackets were moving forward. The right shoulders of two players were higher and more forward than the left shoulder.

4. CONCLUSION

(1) Two players' wrists and trucks were twisting fully. As for the range of swinging racket backward, that of Fan Zhendong was 270 degrees, and that of Zhang Jike was 180 by the calculation of Dartfish software. It suggested that the range of Fan Zhendong's swinging racked of Fan Zhendong was more sufficiently than Zhang Jike during the phase of swinging racket backward.

(2) The shoulders of Zhang Jike and Fan Zhendong are forward and the right shoulders are higher than the left shoulder, and the shoulder joint has been under forward pressure, so as to give the forearm and wrist with a stable support in the process of hitting during the phase of swinging forward and hitting the ball.

(3) At the moment of hitting, the fore of Zhang Jike is more reasonable, which is strong, centralized and the speed of swing was fast, while the force of Fan Zhendong sways a little sometimes.

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The Technique and Tactics Analysis of Fan Zhendong in the Quarterfinal of the 2015 Kuwait Open

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Abstract: This article analyses the techniques and tactics in a match between Fan Zhendong and Chuang Chih-Yuan, using such research methods as literature review, video observation and statistical analysis, etc. According to the research, there are two main styles of Fan's serve, namely the forehand straight short serve with counter side-down spin and the third backhand attack, and the forehand diagonal short serve with side-down spin and the third sideways attack. Most of his receives are backhand twists over the table with the forth backhand and sideways attack to restraint Chuang's serve and attack actively. However, during the confrontation, Fan's actions are rather contained by Chuang thanks to his prompt changes of positions, spins and rhythms.

Keywords: Fan Zhendong, Kuwait Open, technical and tactical analysis

1. INTRODUCTION

Fan Zhendong (1997-), is a table tennis player with Chinese National Table Tennis Team. His great improvements in techniques and tactics in the recent years, such as the technique right-shake-hand fast attack combined with the loops together with his advanced and fierce techniques, have enabled him to stand out among the talented national team young players. He is well known in the world competitions and became a member of the leading players in the national team. His honours include the team champion in 2014 Tokyo World Table Tennis Championships, 2014 Inchon Asian Games, and the men's single champion in the 2014 Nanjing Youth Olympic Games, etc.

Chuang Chih-Yuan was a player with Chinese Taipei table tennis team, who once trained in the Chinese National Youth Table Tennis team in 1993. As he went to Germany in 1999, his technique of the right-shake hand fast attack with loops was combined with the spin and strength from Europeans and the speed from the Asians. He has gained a lot of achievements, including the second place in 2008 Germany Open, the second place in 2011 Switzerland Open and the final eight in 2012 London Olympics.

In the recent years, for his advanced and fierce techniques, the 18-year-old Fan Zhendong has become well known in the world competitions as a member of the leading players in the national team. This study observes the quarterfinal in the 2015

Kuwait Open between Fan and Chuang to work out statistics of Fan's techniques, tactics and scores in this match. According to the statistical analysis of his serve and attack, receive and attack and confrontation, this study will calculate the scoring rate and usage rate in the three sections in order to find Fan's advantages and disadvantages in the techniques and tactics during the match based on the detailed analysis of the three parts. The result of the study is expected to serve as theoretical guidance for his training in future.

2. RESEARCH OBJECTS AND METHODS

2.1 Data used for this study

The data to be used for the present study are centered on Fan's techniques and tactics in the quarterfinal of 2015 Kuwait Open. The result of the match was 4 to 2 (9:11 11:7 9:11 11:6 11:8 11:8)

2.2 Research methods

2.2.1 Literature review

The literature that works as the theoretical basis of this study is collected from Shanghai University Library and China National Knowledge Infrastructure (CNKI), which covers the status quo of technical and tactical study, and the application of the three-section statistical method in the field of sport sciences.

2.2.2 Video observation

Observed is the video of the game between Fan Zhendong and Chuang Chih-Yuan in the quarterfinal of 2015 Kuwait Open. The data generated through the observation is then recorded and analysed, which mainly concerns Fan's serves, receives, and confrontation against his opponent.

2.2.3 Three-section statistical method

The three-section statistical method is widely used in the research of table tennis techniques and tactics. The core principles are as follows:

Scoring rate = section scoring / (section scoring + section losing) × 100%

Usage rate = (section scoring + section losing) / (set scoring + set losing) × 100%

Serve and attack sections represent the first and third strokes respectively. Receive and attack sections represent the second and fourth strokes respectively. The confrontation is the fifth stroke and the strokes that follow[1].

2.2.4 Three-section evaluation method

According to the criterion of three-section evaluation, in the serve and attack section (the first and third strokes), the scoring rate of 70% and above is rated as excellence; 70%-65% is good, and 60% is pass. The usage rate ranges between 25% and 30%. Beyond this range is regarded as either high or low.

In the receive and attack section (the second and fourth strokes), the scoring rate of 50% and above is rated as excellence; 50%-40% is good, and 40-30% is pass. The usage rate ranges between 25% and 30%. Beyond this range is regarded as either high or low.

In the confrontation section, (beginning from the fifth stroke), the scoring rate of 55% and above is rated as excellence, 55%-50% is good, and 50-45% is pass. The usage rate ranges between 45% and 55%. Beyond this range is regarded as either high or low[1].

3. RESULT AND DISCUSSION

3.1 Statistics on Fan's techniques and tactics in the match

Table 1. Fan's performance in the match

	Serve	The third stroke	Receive	The fourth stroke	Confrontation	Total points
Scoring	6	16	15	10	15	62
Loosing	0	8	7	12	22	49
Scoring rate	73.33%		56.82%		40.54%	111+2
Usage rate	27.03%		39.64%		33.33%	

Notes: because of the video problems, the 16th stroke in the second set and the 14th stroke in the fifth set are not in the statistical data.

Table 2. The evaluation of Fan's techniques

	Serve and attack		Receive and attack		Confrontation	
	Scoring rate	Usage rate	Scoring rate	Usage rate	Scoring rate	Usage rate
FAN Zhendong	73.33%	27.03%	56.82%	39.64%	40.54%	33.33%
Sections scoring and loosing	(+22 -8)		(+25 -19)		+15 -22)	
Evaluation	Excellent	Average	Excellent	High	Pass	Low

3.2 Analysing Fan's techniques and tactics in the serve and attack section

As indicated in Table 2, Fan's scoring rate in serve and attack section is 73.33% (Excellent). According to the video, the main reason for Fan's high scoring rate is his forehand counter spin serve. Most of his serves are the forehand counter side-down spin serves with straight short, diagonal short and diagonal long dropping positions. His best serve is forehand straight short serve with counter side-down spin and diagonal long dropping position, as he aced 6 points in the match with these serves. He also gets 12 points in the third attack by taking advantage of his counter spin serve.

In the third stroke attack, Fan's backhand strokes are better than the forehand strokes on several aspects, including stability, speed and spin. As his backhand stokes are changeful with bizarre angles, in the third stroke, he usually uses the backhand attack instead of sideways attack to return the backhand position strokes. He gets 7 points in the match with the backhand attack in the third stroke, which occupies 43.75% of his total points in the third strokes. His advantage in the backhand strokes helps him to control the match with backhand twist over the table and backhand close-racket loops, especially in the first three strokes. However, compared to

Chuang, Fan's forehand attack represents one of his weaknesses. He usually uses forehand short in the third short stroke instead of twist or more active strokes. However, his forehand short could control the rhythms of the match and create chances for his backhand attack.

Also indicated in Table 2, Fan's usage rate of serve and attack is 27.03% (Average). In the first two sets, he gets great advantages in the first three strokes with counter spin serve and high quality serve with backhand attack. However, in the third set, Chuang changes the tactics and controls Fan's forehand and backhand with short strokes. As his backhand attack is suppressed, Fan loses 2 points because of 3 faults in the serve and sideways attack. After that, Chuang continuously uses this tactic to control Fan's serve and attack, because of which Fan only gets 4 points from the third attack in the third, fourth, fifth and sixth sets. Although Fan hits a tie with Chuang in the first four sets by 2 to 2, he loses the first and third sets because of this fault after he is 9 to 10 behind. Based on the above analysis, Fan cannot make effective change after his habits of serve spin and dropping position are found out by his opponent. That's why he could not get more points with serve and attack in the match. It is also the reason that his usage rate in serve and attack section is only 27.03%.

3.3 Analysing Fan's techniques and tactics in the receive and attack section

From Table 2, it can be found that Fan's actions in receive and attack sections are excellent. The scoring rate reaches 56.82% and the usage rate reaches 39.64%. In the match, Fan mainly uses backhand twist over the table with forehand short for the receive. The dropping points focus on the baseline of Chuang's backhand position. During the match, Fan always receives forehand short strokes with backhand twist over the table. He gets total 10 points with backhand twist receives, which occupies 40% of the points from receive and attack. His performance in this section has a vital role to play in his final success of the match. In this match, Chuang uses forehand counter spin serve with forehand back spin and side spin. The dropping positions of his strokes mainly located on Fan's forehand close-net short stroke position. According to the video, Chuang is trying to take advantage of Fan's forehand short strokes to control his receive and attack in the whole match. In the first two sets, this tactic works quite well, which causes Fan's 4 faults in the receive control. However, in the second half of the match, Fan changes his serve tactics and creates several scoring chances through backhand twist with forehand short stroke. Especially in the 6^{th} set, Fan continuously gets 4 points when he is 7:3 and 8:6 behind. He gets 2 points from backhand twist, 1 point from forehand attack, and 1 point from backhand twist. That's why his backhand twist technique is the key point to win this match.

In the fourth stroke, Fan gets 7 points through backhand, which occupies 70% of the forth stroke scoring. He gets 3 points and loses 7 points from forehand or sideways position, which occupies 30% and 58% respectively. According to the data above, Fan's backhand drive and defense are much better than his forehand in the fourth stroke. His backhand drive is fast with strong spins, and the drive position is

close to the table. In the 5th and 6th sets, Fan gets several points by his backhand drive, then settles the victory of the match. However, he, again, makes some faults in the forehand and backhand short receives because of his less changes and lack of control.

3.4 Analysing Fan's techniques and tactics in the confrontation

It can also be found from Table 2 that Fan's scoring rate in confrontation is 40.54% (Average) with the usage rate 33.33%, which is not a great performance for him. He loses 22 points in the confrontation in the forehand and backhand (each 11 points), which occupies 44.90% in the total losing rate. Most of his forehand and backhand scorings in the confrontation are close-table confrontation and the fifth strokes, from which we could figure out that his techniques are not as stable as Chuang in the confrontation. When he could not control the match in the serve and attack or receive and attack sections, Fan gets a little irritable, which causes more faults in the confrontation. According to the video, Fan is not good at long-distance confrontation, and his speed and spin of backhand strokes do not work well. On the contrary, Chuang's tactics in the confrontation is quite clear. He controls Fan with forehand and backhand drives and the changes of the dropping positions to make him give long-distance drives and loses 8 points in backhand diagonal rush. Fan is controlled in the confrontation of the whole match. As such he cannot take full use of his backhand strokes. That is why he is in the disadvantaged condition during the confrontation.

4. CONCLUSION

Based on the above analysis, major findings of this research can be summarized as follows:

(1) Fan is able to use his forehand counter spin serve to score or make chances for the third attack. His third backhand attack is fast with high spin, which helps him get a lot of points in the match. However, in the second half of the match, he is controlled by Chuang and cannot take full use of his serve and attack. Also he fails to control his mentality and is a little irritable in the third stroke of the key point, which causes more faults in the serve and attack and the loss of the key points.

(2) Receive and attack represents his best performance in this match. He repeatedly uses the speed and high side spin of the backhand twist over the table to bring some trouble for Chuang's return. In the whole match, Fan's forth stroke with high speed and spin is stronger than Chuang. However, his forehand receive and the forth attack is weaker than Chuang. With the development of the world table tennis, only those who have perfect techniques and outstanding abilities can have a position in the table tennis circles. Therefore, the study proposes that Fan should pay more attention not only to improving his backhand strokes, but also the attack and defense of his forehand strokes

(3) The confrontation represents one of Fan's weaknesses. In the confrontation, his speed of backhand stroke is restraint by his opponent, which causes more faults

in the backhand and sideways drives. Although his playing style is shake-hand close-table fast attack with loops, he should pay more attention to the techniques and tactics of the long-distance confrontation.

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The «Table Tennis Attitudes Questionnaire» (TTAQ): an instrument to assess the possibilities of implementing table tennis at school

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Abstract: The aim of this study was to evaluate attitudes towards table tennis in Spanish high school teachers. One hundred ninety six Spanish teachers from the Murcia region participated in this study. Two phases were performed: 1. A panel of experts built a theoretical background and the items of a questionnaire. 2. The questionnaire was administered to physical education teachers, and the behaviour of the items was analysed. Five scales were proposed: 'General attitude towards Racket Sports' (four items; α=0.66); 'Facilitators of table tennis implementation' (six items; α=0.72); 'Barriers of table tennis implementation' (six items; α=0.88); 'Benefits of table tennis implementation' (six items; α=0.75). 'Barriers' were significantly higher in men than women (p=0.009), and they were correlated with age (r=0.35; p<0.001). These data suggest that male older teachers might be resistant to implement table tennis at school. If we want to facilitate implementation of table tennis, specific educative programs are needed.

Keywords: attitudes, teachers, high school, implementation, table tennis

1. INTRODUCTION

In Spain, Physical Education is oriented towards the development of abilities that increase the opportunity of student's movement, deepening on motricity knowledge, and assume attitudes, values and norms related to body and motor behaviour.

The possibilities offered by this subject to raise and implement new teaching experiences with intent to integrate and involve students are almost endless. The breadth and plurality of the curriculum allows the incorporation of new methods and ways of dealing with content, designing a resourceful Physical Education, which provide a better teaching quality (Pradas, Rapún, Castellar & Juvillá, 2012).

Traditionally, sport has been used as an educational method, with the aim of extending the number of activities that potentially can be developed in physical education classes. Sport is a fundamental content in the teaching and learning of physical education (Castejón & López, 2002). Moreover, sport is an element able to provide contexts with high educational possibilities for acquiring values and developing attitudes (Gutiérrez, 1995).

The huge expansion of physical activity and sports has contributed to the unstoppable growth of racket sports, becoming a clear alternative to traditional

sports, practiced in the twentieth century (Pradas, 2004). In recent years, racket sports, especially tennis and badminton, have joined to the educational field, and have been considered as popular sports (Hair, 2002), with its own didactic treatment (Louis, 1993), and have been used as a tool or medium in teaching and learning of Physical Education.

Racket sports, applied to the school environment, are ideal physical activities and alternatives to some sport educational programs, sometimes too repetitive and monotonous (Cabello & Torres, 2004).

These sports are characterized by some common principles of action to solve a similar problem, hitting a moving, where the cognitive processes play an extremely important role (Pradas, de Teresa & Vargas, 2005). All these sports (with slight modifications), have the same general technical fundamentals, which are used with the intentionality of hitting an object (in a defensive or offensive way), by an implement (racket), with the concrete tactical principle of driving the moving object to the free space away from the opponent, if the objective is competitive, or keeping it in play as long as possible, if the goal is cooperative (Pradas, 2002).

While the rise of Physical Education and Sport, and specifically for racket sports, is indisputable, there are factors that hinder the educational impulse of table tennis, a sport still considered "minor" (Portch 1977), or less traditional (Lenzen, 1996). Paradoxically, "ping-pong" is considered one of the most practiced sports before including it in the school environment (Gobert, 1994).

There are some experiences in different countries that have introduced table tennis as an educational medium (Aernout & Carlier, 1978; Fougines, 1991; Labusquierre, 1977; Ponert, 1986; Prevot, 1982; Sève, 1991), for populations with special educational needs (Ponert, 1986), and as a teaching aid for Physical Education in developing countries (Arndt, 1985).

However, in Spain, table tennis used as educational content in schools is almost non-existent (Pradas, Herrero & Perez, 2003). In this sense, the objective of this study was to evaluate the attitudes presented by physical education teachers towards using table tennis as a content to achieve the objectives of compulsory secondary education in Spain, trying to discover whether there are differences linked to general socio-demographic characteristics such as gender or age.

2. METHODS

We used a cross-sectional design. Measures were obtained using a self-reported questionnaire.

2.1. Participants

The universe of participants was a high school physical education teacher in Murcia region, Spain (n=384). Non-probabilistic opinion based sampling was conducted. An informal selection procedure was applied in order to recruit expert subjects as a relevant source of information. Subjects were contacted by a workforce

list. The number of participants overcame the criterion for construct validity (Comrey, 1985). Therefore, the sample was adequate in psychometric terms.

2.2. Instruments

Firstly, we asked about general sociodemographic and laboral characteristics to describe the participant sample. Secondly, we constructed a 28-item questionnaire developed by our research group. The items were built by an expert group through consensus, treating to include the main properties of the reference domain. The writing of the items were oriented by a content specification table, which was able to guarantee adjust, conceptual validity and representativity of the theoretical proposal (Table 1).

Subjects had to indicate their degree of agreement for each statement, in a Likert scale, from 1 (totally disagree) to 4 (totally agree).

Table 1. Content specifications

1. Table tennis benefits
2. Table tennis facilitators
3. Table tennis barriers
4. Attitude to racket sports

2.3. Data analysis

We described the sample using means and standard deviations or percentages, depending on the nature of the variables. The contributions of each item were evaluated using item-rest and α coefficient resting each item. Items and scales were described using means and standard deviations. Contrast test were developed according to the gender, using the Mann-Whitney U.

We evaluated possible associations among age and scales through the Pearson correlation coefficient (Martínez-González, 2006). The signification level was 0.05. Data analyses were developed by SPSS-15 package.

Table 2. Characteristics of participants

Age (years)	
Md	31-35
Range Q_1-Q_3	26-30 / 46-50
Sex, male (%)	142 (72.4)
Degree (%)	
PE Diploma	11 (5.6)
PE Grade	147 (75.0)
Other areas Diploma	4 (2.0)
Other areas Grade	31 (15.8)
Others	3 (1.5)
Destination (%)	
Final	117 (59.7)
In expectation	18 (9.2)
In practice	16 (8.2)
Interin	40 (20.4)
Others	5 (2.6)
Responsibility (%)	
Head teacher	2 (1.0)
Director of studies	10 (5.1)
Secretary	3 (1.5)
Department head	73 (37.2)
Tutor	45 (23.0)
Teacher	61 (31.1)
Others	2 (1.0)
Experience (years)	
Md	5-10
Range Q_1-Q_3	<5 / 16-20
Includes table tennis, no (%)	150 (76.5)

Md = Median; Range Q_1-Q_3 = interquartile range; Frequencies and percentages (%)

2.4. Procedure

A researcher explained the objectives of the study to all of the managers of the high schools in Murcia region, Spain. Questionnaires were spread among all the physical education teachers, who showed informed consent to participate. Directors of studies were in charge of the questionnaire collection, using a closed cardboard box, with a unique opening, through which completed questionnaires were introduced.

3. RESULTS

3.1. Characteristics of the sample

The final number of participants were n=196; all of them high school teachers in charge of physical education subjects. The response rate was RR=50.1%.

Table 2 shows the sociodemographic characteristics of the sample. The median age was 31-35 years, being mostly males, graduated in physical education, with final

placement, between 5-10 years of experience, who did not impart table tennis as content.

3.2. Descriptives and reliability

Tables 3, 4, 5 and 6 show a brief version of the items which constitute each scale.

Table 3. 'Table tennis benefits' (α=0.75)

Items	Mn	SD	I-rest	α
Less injuries	3.18	0.70	0.49	0.73
Good for physical problems	3.24	0.62	0.58	0.71
Good for SEN	3.14	0.66	0.56	0.71
Very safe	3.34	0.64	0.46	0.74
Facilitates interest	3.34	0.60	0.45	0.74
Advisable content	3.25	0.61	0.49	0.73

Mn = mean. SD = standard deviation. I-rest = discrimination coefficient. α = Cronbach' α eliminating each item.

Except for the 'attitude to racket sports' scale, the α coefficients were acceptable and all the items contributed to the reliability of their respective scales, with high and positive discriminant values.

Table 4. 'Table tennis facilitators' (α=0.72)

Items	Mn	SD	I-rest	α
Rich learning	3.02	0.60	0.56	0.64
Newness and motivation	2.95	0.70	0.52	0.65
Students demand it	2.67	0.65	0.42	0.68
Disposing facilities	2.79	0.81	0.59	0.61
Known or practiced	2.57	0.67	0.29	0.71
Easy development	2.48	0.63	0.30	0.71

Mn = mean. SD = standard deviation. I-rest = discrimination coefficient. α = Cronbach' α eliminating each item.

Physical education teachers showed high levels of 'table tennis benefits' (Table 3), and 'table tennis facilitators' (Table 4), while low levels of 'barriers for application' (Table 4). On the other hand, they showed a positive 'attitude to racket sports' (Table 6).

Table 5. 'Barriers for application' (α=0.88)

Items	Mn	SD	I-rest	α
Does not bring richness	1.47	0.60	0.67	0.86
Dangerous	1.76	0.63	0.60	0.87
Not motivating	1.46	0.56	0.73	0.85
impaired equipment	1.79	0.63	0.70	0.85
Not demanded	1.80	0.62	0.69	0.85
Not known	1.65	0.60	0.70	0.85

Mn = mean. SD = standard deviation. I-rest = discrimination coefficient. α = Cronbach' α eliminating each item.

Table 6. 'Attitude to racket sports' (α=0.66)

Items	Mn	SD	I-rest	α
Very advisable	3.69	0.53	0.48	0.53
Many benefits	3.65	0.51	0.54	0.50
Very popular	3.18	0.60	0.34	0.62
Needed legislative support	2.98	0.68	0.35	0.63

Mn = mean. SD = standard deviation. I-rest = discrimination coefficient. α = Cronbach' α eliminating each item.

3.3. Contrast according to gender and age

The levels of 'barriers for application' were significantly higher ($p = 0.009$) in males (Md = 10.30; SD = 2.93) than females (Md = 9.04; SD = 2.55). There were no differences in other scales. It was observed significant associations between age and 'barriers for application' ($r = 0.35$; $p < 0.001$). There were no significant associations with the rest of scales.

4. DISCUSSION

The most taught contents in Physical Education classes are related to sports (Napper-Owen, 1999 Matanin & Collier, 2003; Salina & Viciana, 2001). However, table tennis is not one of the sports that are traditionally used in Spanish high school.

Several studies indicate that practicing a small number of sports in physical education classes reduces the number of creative and spontaneous experiences of students (Brousse, Villalón & Molina, 1999), creating a decrease of interest in the subjects (Serra, 2006; Moreno & Hellín, 2006). In addition, professionals of Physical Education increasingly demand the introduction of new sports (Cabello & Carazo, 2001). Considering these facts, one might consider table tennis as a sport that would help to improve teaching contents.

In general, teachers consider that introducing racket sports and table tennis at school could be of interest. It has been already said that this game does not present any danger (Lehman, 1987; Herrero & Pradas, 2009), being highly recommended

(Muhr, 1997) and easy to use in physical education (Hernández, 1998). Moreover, it offers a new possibility of movement for students (Balster, 1986).

However, teachers say there are certain barriers to incorporate table tennis in physical education classes. The main problems seem to be the absence of adequate facilities in schools, the few specific materials available, as well as insufficient knowledge and didactic training to teach this content.

If we think about some of the encountered difficulties, we can recognize that sports facilities of Spanish schools are built to the practice of activities that have usually been or are used in physical education, i.e. team sports (Castejón, 2004). That is why physical education teachers make use of those sports in which they feel safer, because they have more knowledge or pedagogical training; because it carries a minimal waste of time or lower organization difficulties; or because they have the necessary resources, facilities and materials (Robles, 2005). This could be related to the poor development of this sport at school, where teachers only implement table tennis if they have a certain physical space and a sufficient number of tables.

Teachers, as a result of their lack of didactic training, do not take into consideration that there are a number of preliminary activities related to this sport (shovel-ball contact, discovery of paths and effects, evolution around space, etc.) that can be performed outside the physical context of the table (Pradas, 2002; Pradas, 2004; Herrero & Pradas, 2009; Herrero, Pradas & Beamonte, 2009). In these activities, general facilities and materials from physical education sessions to progress in learning, are used, up to game situations performed on the table surface (Herrero et al., 2009), with a greater technical and tactical component more oriented toward mastery of skills in this sport specialty (Pradas, Castellar, Herrero & Cachón, 2014).

Very few centers have covered table tennis facilities, a factor that limits the practice, as teachers highlight. However, there are currently outside tables, very strong, ready to stand the test of time and the weather elements. Furthermore, table tennis in education does not need to have strictly regulatory materials (Muhr, 1997). Game elements can be adapted by replacing conventional tables and networks by alternative materials as school desks and books.

In summary, the conditions for the development of this sport in the curriculum of the physical education classes are minimal (Pradas et al., 2003). Table tennis presents very simple rules and materials, which can be modified and adapted to any environment and educational situation (Pradas et al., 2014).

5. CONCLUSIONS

The teachers believe that racket sports in general, and table tennis in particular, are very popular and recommended for physical education classes because of the benefits they produce (physical, psychological and social), although they note that this sport needs more legislative support.

Table tennis as an educational content is a sport that arouses great interest among the students, and it could get increase student motivation and wealth of learning in physical education.

The fundamental problems posed by Physical Education teachers to include table tennis as educational content focuses on the lack of a training curriculum to teach properly this sport and the absence of specific facilities and materials.

Male Spanish teachers present more barriers than women to develop table tennis in Physical Education classes. With increasing age of teachers also increases resistance to impart table tennis as educational content. If we want to implement table tennis at secondary school in Spain we must focus specially on developing positive attitudes and didactic skills among male elderly teachers.

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The Technical and Tactic Analysis of Zhang Jike's Performance in Paris World Table Tennis Championships - Zhang Jike VS Baum

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Abstract: The study adopted the methods of literature review and mathematic statistics to analyse the techniques and tactics performed by Zhang Jike and Patrick Baum on 2013 Paris World Table Tennis Championships. The study holds that Zhang mainly served inside-out service, in addition to the side back/top spin service, which created opportunities for the attack after service in the third strike. He received with backhand twist pulling the ball to the opponent's side, which easily won the advantage and scored accordingly. During the topspin confrontation, he changed the playing style by playing the ball to the opponent's forehand position while abruptly attacking to the opponent's backhand position, in addition to the changes of spin and rhythm, thus he produced great pressure on the opponent.

Keywords: table tennis, Zhang Jike, Baum Patrick, World Table Tennis Championships, technical and tactic analysis

1. INTRODUCTION

Zhang Jike, the famous Chinese table tennis player, won the grand slam, when he got the champions in 2011 World Championships, 2011 World Cup and 2012 London Olympics. Zhang performed extraordinary well in 2013 Paris World Table Tennis Championships and won the champion for Men's Singles. Baum starts at the age of 6 and plays table tennis left-handed with handshake. He uses the style of loop with fast attack, with a strong capability of confrontation on both forehand and backhand. He played against Zhang Jike after beating Ovtcharov in 2013 Paris World Table Tennis Championships. The study analysed Zhang's playing against Baum in 2013 Paris World Championships, trying to provide some scientific basis for his future technical and tactic training.

2. RESEARCH OBJECTS AND METHODS

2.1 Research objects

The study selected Zhang Jike's 3 important matches in the championships in Paris - the quarter finals Zhang Jike VS Baum with a 4-1 score (9:11, 11:6, 12:10, 11:2, 11:3).

2.2 Research methods

The study accepted the opinions from the general coach of the national team, selected the important international competitions and consulted literatures on table tennis techniques and tactics analysis. It adopted the traditional method of 3-section statistics by calculating the scoring rate and the utility rate of Zhang's first/third strike and second/fourth strike, as well as the confrontation section [1][2].

Scoring rate = section scoring/ (section scoring + section loss) *100%

Utility rate = (section scoring + section loss) / (whole scoring + whole loss)*100%

3. RESULT AND DISCUSSION

3.1Technique and tactic analysis

Table 1. The 3-section technique and tactic statistics by Zhang Jike VS Baum

Zhang Jike	service	3rd strike	receive	Fourth strike	confrontation	final
scoring	4	17	6	8	19	54
loss	-	3	3	8	18	32
Scoring rate	87.5%		56%		51.35%	%
Utility rate	27.91%		29.07%		43.02%	

Table 2. The 3-section technique and tactic statistics by Baum VS Zhang Jike

Baum	service	3rd strike	receive	Fourth strike	confrontation	final
scoring	3	8	3	7	11	32
loss	-	6	4	17	27	54
Scoring rate	63.71%		32.26%		28.95%	%
Utility rate	19.77%		36.05%		44.19%	

3.2The analysis of the service and attack after service stage (the 1st and 3rd strike) by Zhang Jike and Baum

For Zhang Jike (+21，-3), there was a scoring rate of87.5% and utility rate of 27.91%at the service and attack after service stage (the 1st and 3rd strike), respectively, showing his strength at the serve. He mainly used forehand inside-out spin, bringing a great pressure on the opponent, in that it can not only easily won the advantage and score accordingly, but create opportunities for the attack after service in the third strike. In addition, he played side top/back spin/non-spin) or fast long ball, thus to form a complete system of service tactics. Zhang's loss is mainly on the out-of-table play when serving ball, and he was also easily attacked after the service.

Baum(+11, -6) got a scoring rate of 63.71%and utility rate of 19.77% at the service and attack after service stage (the 1st and 3rd strike), respectively. His service focused on three placements: middle short for the most, followed by half out-of-table and forehand short. As for the side spin service, the change of success and failure was half and half; while his inside-out spin gained obvious advantage. On the other hand, he did not well in turning body at the attack after service. There was a more percentage of forehand service for him with strong power and spin, which produced certain lethality. He could give the sudden flick serve inside the table, pull the ball fast at half out of the table and exert force on the ball outside the table. However, his weakness was in the following 3 aspects: he played balls violently yet unstably at attack after service, which brought many errors in forehand flick serve. Worse is when he flicked the non-spin short ball from the opponent, out-of-bounds balls appeared. And he had poor capability in topspin tackling from the opponent.

3.3 The analysis of the receive and attack stage (the 2nd and 4th strike) by Zhang Jike and Baum

For Zhang Jike (+14, -11), there was a scoring rate of 56%and utility rate of 29.07%at the stage of the receive and attack stage (the 2nd and 4th strike), respectively. Zhang tended to play the ball in the diagonal or straight line with backhand twist pull, in addition to the flick inside the table with forehand as well as smashing the ball half outside the court which owned a strong-spin low loop. His losses were mainly attacking failures, ball controlling failures and being attacked.

For Baum (+10, -21), there was a scoring rate of 32.26% and utility rate of 36.05% at the stage of the receive and attack stage (the 2nd and 4th strike), respectively. Baum's receive was fast but unstable, thus leading to many gains and losses. He liked to use forehand to flick ball to the opponent's forehand direction when he stood in the middle of the table; his smash always had a strong spin and so did the half out-table ball. On the other, he can flick the ball with backhand even better and tended to use backhand when standing in the middle of the court. In addition, he was capable of attacking the long ball with backhand. He played table tennis violently but changelessly. He lacked correct pre-judgment toward the middle forehand short ball thus produced many failures. His forehand smash and chop were strong but unstable. Finally, he lacked the ability of attacking inside table with backhand owing to the poor techniques of twist pull.

3.4 The analysis of the confrontation stage (after the 4th strike) by Zhang Jike and Baum

At the confrontation stage, Zhang Jike (+19,-18) owned a scoring rate of 51.35% and utility rate of 43.02%, respectively. His play presents 4 combinations, that is, the combination of spin, strength and speed; the combination of threat and stability; the combination of the ability and the placement change; and the perfect combination of strong attack, active confrontation and defense. Especially during the topspin confrontation period, he played the ball to the opponent's forehand position while abruptly attacking it to the opponent's backhand position, breaking through the

opponent's two straight lines from the forehand position, which produced great pressure on the opponent. Zhang's losses lie in the too-close standing stance, blindly fast speed and changeless placement.

At the confrontation stage, Baum (+11,-27) owned a scoring rate of 28.95% and utility rate of 44.19%, respectively. He presented an excellence at this stage by fast and unstable play, with some failures but not serious. He was capable of tactic changes. For example, he played the ball to the opponent's forehand position while abruptly attacking to the opponent's backhand position. At the position of near the court, he can give constant forehand smash in fast straight line. Also he can use backhand to drive the ball with force very well. On the other, he defended poorly in the middle close-to-table with forehand. He was incapable of the spin and the follow-up after the flick. In addition, he did not well in the backhand twist pull.

4. CONCLUSION

4.1 Zhang owned a strong spirit of winning in the matches, combined with a long duration of excitement point and comprehensive strength. During the process, he played the style of violent attack as well as the reason and patience. All of them contributed to his success.

4.2 Zhang adopted inside out service to fit the back-top spin, which created opportunities for the attack after service in the third strike. He received with backhand twist pulling the ball to the opponent's side, which easily won the advantage and score accordingly. During the topspin confrontation, he changed the playing by playing the ball to the opponent's forehand position while abruptly attacking to the opponent's backhand position, in addition to the changes of spin and rhythm, thus he produced great pressure on the opponent. When meeting with strong resistance, Zhang tended to responded slowly, which could create difficulty for himself.

4.3 Baum possessed a rich and comprehensive tactics with an active consciousness of success. His first three strikes were performed very well, in that he played violently and actively in receive and service. In the confrontation stage, he played with fast speed, flexible placement and changeable tactics. His weakness is in his unstable receiving, change-phobic and defense ability for forehand middle position.

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A Study of Table Tennis Athletes' cohesion, and performance

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Abstract: This study is to discuss the relationship among table tennis athletes' cohesion, patience, and performance. Method: College table tennis athletes were selected to participate in the study. Convenient sampling was used in the selection of subjects. Canonical correlation and multiple regression analysis were used to analyse data. Results: Through the canonical correlation and multiple regression analysis, the results displayed that there were positive correlation among "team cooperation" and "team adaptation" in the dimension of team cohesion and "great effort" and "endure pain" in the dimension of "patience." Besides, "great effort" and "resistance to pressure" were the most important factor to predict performance. With the independent samples t-test analysis, there was no statistical significant difference between table tennis athletes' gender and team cohesion. Therefore, improving table tennis athletes' cohesion will increase athletes' patience, and then enhance sport performance. Combining each other can enhance the performance of table tennis.

Keywords: resistance to pressure, great effort

1. INTRODUCTION

1.1 Research Background

LeUnes and Nation (1989) pointed out that table tennis is a mixed and cooperated teams. It needs the presence of team cohesion when team cohesion is higher, and less members of team are willing to leave the team. Team cohesion refers to the members of the team in order to achieve a common goal unites the forces. When the higher team cohesion, team members also belong to team pay more effort and solidarity to complete a common goal. Especially when faced with the important critical moment of the game, team cohesion is often a key factor in determining the success or failure (Min Xiong Zheng, Yi-Min Liu, 1991). Carron (1982) proposed the concept of team cohesion mode, where cohesion is considered intervening variables between sports teams and athletic performance, and cohesion may also continue to campaign team of athletic performance, stability, and satisfaction and team sports affected.

Hardiness is a psychological level, in the face of the challenges presented by a

reaction patterns, including the mental, emotional, physical variety-oriented, but also showing the individual in the face of the challenge of efficient response to relevant situations. Many studies had found that if the tenacity of athletes' strength stronger, then the better their athletic performance (Wen Long Chen, 2001; Xiu Ya Fu, 2005); and foreign scholars have also found that the mental toughness that elite athletes possess many of the characteristics of the project (Gould, Dieffenbach, & Moffett, 2002). Therefore, mental toughness was one of very important psychological characters for sports athletes. Jones, Hanton, and Connaughton (2002) believe that sports strong mental toughness must have the following personality traits: 1. self-confidence; 2. desire; 3. motivation; 4. concentration; 5. anti-stress; 6. can afford and control of pain and hard work. Huang Chong Ru (2003) thought people with strong mental toughness had such behaviour characteristics as following:

(a)No matter why situations, able to maintain a high degree of focus
(b)Can bear physiological pain
(c)Self-discipline
(d)Searching for perfection and established goals
(e)Higher self-confidence
(f)Strong willpower to win the game

Adapt to stress.

Huang Chong Ru (2003) thought that mental toughness can generated through the learning process, so strengthening the mental training of athletes can enhance their athletic performance.

Table tennis movement distance is short, change quickly, high confrontation, and the complexity of the sport. Both athletes need to face small ball, fast movement, and multi-change to judge the direction of the ball and body rotation in place, and to make a comeback action requirements (Ming Yuan Wang, Shu Man Chen, Jun Fa Huang, 2010). Therefore, table tennis needs more attention and instant quick technical operations. There is no skilled technical and tactical performance really difficult to have good results.

To have a skilled technical needs tactical training hard in addition to relying on weekdays. Besides, it is necessary to have good psychological quality, and to develop a good athlete whose growth process is long. If athletes did some psychological resilience in the face of sports training weekday's hard training, they cannot have a heart persist beyond. There are some factors will affect both athletes' performance and sport development, like the attitude in training, not enough motivation to actively participate in the exercise. If it cannot continue to strengthen players' engage in behaviour and attitude sports training, it will have an impact on the training effect.

Gould, Dieffenbach, and Moffett, (2002) also mentioned that the mental toughness is an essential characteristics for an elite athletes. Therefore, for a sport athlete, mental toughness is a very important psychological factor. The purposes of this study are to discuss what is table tennis athletes' mental toughness? Are there differences in athletes' academic performance? How important is team cohesion and

mental toughness for a table tennis athlete?

1.2 Research purposes

This study aimed to explore the relationship among the team cohesion and mental toughness and academic performance, as follows:

(a) To understand the differences between the team cohesion and mental toughness
(b) To understand the relevant relationship between table tennis athletes' team cohesion and mental toughness.
(c) To investigate the relationship among table tennis athletes' team cohesion, mental toughness, and athletes' performance.

2. METHOD

2.1Research Objects

In this study, college level Open group table tennis athletes are the research objects, through the assistance and cooperation of the 2014 National College Cup Association and each college team. The questionnaires were submitted to each team after the game, and questionnaires were submitted from May 17, 2014 to May 21, 2014 during the 2014 National College Cup competition. Convenience sampling survey was used to gather relevant information, a total of 250 questionnaires were issued to the subjects. There were a total of 236 valid questionnaires, the effective response rate was 94.40%, of which there were 156 males and accounting for 66.1%; there were 80 females and accounting for 33.9%.

2.2Research tool

2.2.1 Team cohesion scale

The research team cohesion scale is derived from Wu Hui Qing (2001) and Chen Wen Jon (2005) as a measure of team cohesion scale tool, with the need of this study to be made a new version. There were a total of four potential variables and twelve questions of measurement. The entire amount of explained variance was 58.90%, internal consistency coefficients were in the "teamwork" 0.93, "interpersonal affinity" 0.86, "the team adapt" 0.86, and "interpersonal attraction." 0.87. This study were collected each score by Likert scale, which is from very satisfied, satisfied, average, dissatisfied, very dissatisfied, were given 5, 4, 3, 2, 1 score.

2.2.2 Mental toughness scale

In this study, the mental toughness scale referred to Huang Chong Ru (2004) prepared special sport mental toughness characters as a measure of mental toughness tools. There were a total of two variables and potential twelve questions of measurement. The entire explained variance was 57.12%, and internal consistency coefficients was "active struggle" 0.93, "resistant to stress" 0.93, and "endure the pain" 0.86.

2.2.3 Pilot study

This research had pilot study of team cohesion and mental toughness. Purposive sampling of 105 college students, pilot study was used independent samples t-test analysis. Then item analysis test was to identify whether the degree of the scale, and to verify the exploratory factor analysis, and to understand the factors structure.

2.2.4 Reliability and validity

2.2.4.1 Identification scale analysis

There were a total of 236 valid questionnaires; the effective response rate was 94.40%. In the facet of team cohesion scale, the decision value between the various questions (t = 12.94 ~ 18.90, p < .001); in the facet of mental toughness scale, the decision value between the various questions (t = 1 9 .14 ~ 2 4 .80, p <.001) and the correlation coefficient between (r =. 57 ~. 81, p <.001).

2.2.4.2 Validity

This study was used exploratory factor analysis (EFA) to test the validity of the scale of this study. Factor analysis used principal component analysis to extract the factors. Eigen Values over 1 and factor loadings over .5 were as the standard choice of construct validity (Ming-long Wu, 2000).

Team cohesion scale after factor analysis was developed into the four factors facets: "teamwork", "interpersonal affinity", "team adapt«, and "interpersonal Attraction." Factor loadings were referred to. 71 ~ 8 0, between 52 ~ .7 5, 61 ~. 81, 2 and .8 .6 0. 64 ~. 75, characteristic values were 7.86, 4.13, 3.75 and 3.71, explained variance respectively, 23.82%, 12.50%, 11.35% and 11.23%, the cumulative amount of explained variance were 23.82%, 36.32%, 47.67% and 58.90%.

Mental Toughness scale after factor analysis developed into three dimensions: "active struggle", "crush resistance" and "tough injury pain." Factor loadings ranged between .61 to .80 and .62 to .84; characteristic values were 8.08, 6.79, and 3.41; Explained variance were 25.25%, 21.20%, and 10.67%; the cumulative explained variance were 25.25%, respectively, 46.46 % and 57.12%.

2.2.4.3 Reliability

Team cohesion scale and Mental Toughness scale were use Cronbach's α internal consistency to measure whether the content tends to be consistency and stability. According to Nunnally (1978) recommendations, Cronbach's α coefficient over 0.7 or more was good reliability. Team cohesion scale Cronbach's α was0.93, 0.8 6 0.86 and 0. 87; sports Mental Toughness scale Cronbach's α were .9 3, .93 and .8 6.

In this study, the team cohesion scale and mental toughness scale were analysed through factor analysis, construct validity and reliability analysis. The results of this study had found that identify, validity and reliability aspects had passed rigorous tests to show this research tool is quite reliable.

2.2.5 Data analysis

This study was using SPSS version 12.0 statistical software to analyse data processing, and a significant level of statistical tests were all set to α = .05.

3. RESULTS AND DISCUSSION

3.1 The differences between the various variables of team cohesion and mental toughness

3.1.1 Each team cohesion difference variables

3.1.1.1 Comparison of different gender differences in team cohesion

That different between gender of table tennis athlete and team cohesion was at table one. The e independent samples t-test analysis found that different gender of table tennis athletes did not have significant result.

The result had similar with the researches from Qiu Wang Zhang (2002), Lin Chin Shan (2002), Chen Jun Xun (2014), Jiang, Yi De, Chen, Shu-Man, YE, Jhih-Sian (2001), Tastan (2013). Tastan (2013) pointed to the psychological differences between the gender in terms of participation in exercise, mostly male than female athletes prefer a competitive activity that itself has a high athletic ability and physical strength. Tastan (2013) study also pointed out those male athletes for competition, victory and defeat opponents, there will be a strong recognition; and female athletes to interact with a strong cohesion between teammates recognized. The results obtained are shown in Table 1 as below.

Table 1. Gender independent sample t test

Facets name	Sex	Mean	Standard deviation	t value	p value
Team adaptability	Male	4.11	0.40	2.12	.191
	Female	4.18	0.52		
Interpersonal affinity	Male	4.01	0.52	1.77	.878
	Female	3.88	0.62		
Interpersonal attraction	Male	4.09	0.41	.48	.475
	Female	4.12	0.47		
Teamwork	Male	4.03	0.39	.77	.765
	Female	4.10	0.31		

3.1.1.2 Different results compare differences in team cohesion

From Table 2 that the different grades of table tennis athletes in team cohesion different scale scores, and the ANOVA analysis found that the different grades of table tennis athletes in team cohesion "interpersonal affinity" reached significant differences. There were no different on Scheffe Post hoc comparisons. The study results was similar to Li Si Fan (2013), Lin Zemin, Cai Yu Qing (2012), Huang Hui Zhi (2008), Wu Jung Hoon, Jane Jia Jun, GUO Shao (2011), Chen Bo Lien (2008) study is noted the best results over a significant difference in the team cohesion, The results were shown in Table 2.

Table 2. Different Score One-way ANOVA analysis

Facets name	Variables	Mean	SD	Analysis of variance					
				variation	Deviation	df	Mean Square	F	P
Team Adapt Ability	Varsity	4.11	0.57	Between Groups	179.61	3	59.87	1.09	.356
	National High School team	3.97	0.62	Within Group	12798.19	232	55.17	1.01	.388
	National College School Team	3.97	0.53	Total	12977.80	235			
	National Team	4.15	0.45						
Interpersonal affinity	Varsity	3.86	0.64	Between Groups	66.41	3	22.14	2.66	.049*
	National High School team	3.61	0.71	Within Group	5078.24	232	21.89		
	National College School Team	3.71	0.71	Total	5144.66	235			
	National Team	3.82	0.84						
Interpersonal attract	Varsity	3.84	0.52	Between Groups	106.62	3	35.54	1.412	.240
	National High School team	3.92	0.53	Within Group	3094.92	232	13.34		
	National College School Team	4.04	0.42	Total	3201.54	235			
	National Team	4.12	0.48						
Team cohesion	Varsity	4.06	0.51	Between Groups	51.44	3	17.15		
	National High School team	4.11	0.55	Within Group	2816.34	232	12.14		
	National College School Team	3.98	0.61	Total	2867.78	235			
	National Team	4.13	0.53						

*p<.05 1. Varsity; 2. National High School team; 3. National College School Team; 4. National Team

3.1.2 Mental toughness difference

3.1.2.1 Different between genders in sports Mental Toughness

From Table 3, that different gender of table tennis athletes in the mental toughness had different scores by independent t test analysis. The result found that different gender on mental toughness did not reach significant differences. Lin Yan Chi (2011) studied subjects who participated in triathlon athletes, and found that there was no inference between pressure and mental toughness in sport. Therefore, different gender did not have differences with mental toughness. The results are shown in Table 3.

Table 3. Gender and mental toughness independent t-test analysis

Facets name	Sex	Mean	Standard deviation	t value	p value
Active struggle	Male	4.17	0.56	3.45	.577
	Female	4.11	0.61		
Resistance to stress	Male	4.03	0.66	2.29	.280
	Female	4.15	0.52		
Endure injury pain	Male	4.03	0.57	1.22	.814
	Female	4.08	0.58		

3.1.2.2 Different between score in sports Mental Toughness

From the results in Table 4, there were difference between mental toughness and table tennis athletes' score. From the result for one-way ANOVA analysis of variance, it was found that there was significant difference between sports psychology "resistance to stress" and different score. There were no different on Scheffe' Post hoc comparisons. Wang Cheng Min (2008), Fang, Tong-Sian (2009), Li Jing, Liu He (2009) studied that the stronger and better athletic performance had better resistance to stress. The results are shown in Table 4.

Table 4. Different Score One-way ANOVA analysis

Facets name	Variables	Mean	SD	Analysis of variance					
				variation	Deviation	df	Mean Square	F	P
Active struggle	Varsity	4.14	0.79	Between Groups	136.23	3	45.41	.62	.606
	National High School team	4.08	0.58	Within Group	17140.97	232	73.88		
	National College School Team	3.96	0.69	Total	17277.20	235			
	National Team	3.85	0.74						
Endure injury pain	Varsity	4.14	0.59	Between Groups	610.92	3	203.64	3.17	.025*
	National High School team	4.08	0.58	Within Group	14924.71	232	64.33		
	National College School Team	3.97	0.67	Total	15535.63	235			
	National Team	3.95	0.73						
Resistance to stress	Varsity	4.32	0.45	Between Groups	39.74	3	13.25	1.28	.283
	National High School team	4.14	0.48	Within Group	24.4.54	232	10.36		
	National College School Team	3.98	0.71	Total	2444.28	235			
	National Team	3.97	0.74						

*p<.05 1. Varsity; 2. National High School team; 3. National College School Team; 4. National Team

3.1.3 Different between team cohesion in sports Mental Toughness

In this study, the factors of team cohesion dimensions as the control variables (X variables), and the factors of psychological resilience dimensions as criterion variables (Y variables), and the control variables include: "the team to adapt",

"teamwork", "interpersonal attraction ", and" interpersonal affinity"; criterion variables included:" active struggle, " " tough injury pain " and " resistance to stress ". By analysis of the results in Table 5 found two pairs of typical correlation analysis, the first coefficient of canonical correlation analysis and canonical correlation coefficient of the second pair, reached significant levels ($p < .001$), the first of Wilk's Λ Value of 32, the typical correlation coefficient was .76, and the amount of variation in the value of 82.34%, in addition to the second pair of Wilk's Λ Value of 77, the typical correlation coefficient was .48, and the amount of variation in the value of 17.53%. Therefore, using the first and second pair of canonical correlation can effectively explain the control variables and criterion variables related, and therefore sports team cohesion and mental toughness were correlated. Team cohesion and sports-related mental toughness typical results, as shown in Table 5.

Table 5. Team cohesion and sports-related mental toughness typical results

Typical Related	Eigenvalues	Eigenvalues explained The percentage of variance	Cumulative variation Percentage amount	Typical phase Logarithmic relationship	Canonical Correlation Squared coefficient	Wilk's Λ	F	Pvalues
1	1.39	82.34	82.34	.76	.58	.32	27.03	.000***
	.29	17.53	99.86	.48	.23	.77	10.72	.000***

***$p < .001$

Control variables' first typical variables (χ^1) can explain the first typical variables (η^1) 58.2% of the total variance, while the first criterion variables typical variables (η^1) can be explained 54.58% of the total variance of standard variables; control variables overlap with criterion variables was 31.77%, which is the control variables through the first pair of typical variables (χ^1 and η^1), can be explained by 31.77% of the total variance of variables. The other control variables second typical variables (χ^2) can explain 29.0% of the total variance of the second criterion variables typical variables (η^2) while the second criterion variables typical variables (η^2) can be 5.38% of the total variance, it is controlled by a second pair of variables typical variables (χ^2 and η^2), 5.38% of the total effect can be explained by variation in the amount of standard variables.

In a typical sports-related team cohesion and mental toughness of (χ^1) related to the highest bidder for the team to adapt its structure facto .949, followed by teamwork, structure factor .830. In criterion variables in a typical factor (η^1) is closely related to those of active struggle, the structure factor is .962, followed by tough injury pain structure factor is .679. A typical load typical load criterion variables and control variables have the same positive and negative mark, showing a positive correlation with each other. The results showed, table tennis athletes of team cohesion "team to adapt" and "teamwork" and the mental toughness "active struggle" related to "tough injury pain" from canonical correlation analysis can be seen in table tennis players' team cohesion "team to adapt" and "teamwork" mental toughness "positive struggle" and "tough injury pain" is higher. This section clearly illustrates the importance of team cohesion on mental toughness in sport; the table

tennis athletes' team cohesion reflects the importance of mental toughness feelings, team cohesion and mental toughness canonical correlation analysis summary, as shown in Table 6.

Table 6. Mental toughness and team cohesion correlation analysis

Control variables		Typical factors	Criterion variables	Typical factors	
(X variables)	χ_1	χ_2	(Y variables)	η_1	η_2
Adaptation team	.949	-.297	Active struggle	.962	-.080
Interpersonal affinity	.777	.513	Resistance to stress	.501	.825
Interpersonal Attraction	.778	.361	Tough injury pain	.679	-.139
Teamwork	.830	.001			
Extraction percentage	69.98	12.05	Extraction percentage	54.59	23.54
variation	40.72	2.76	variation	31.77	5.38
		ρ^2	.582 .29		
		ρ	.000*** .000***		

***p< .001

3.1.4 Team cohesion and mental toughness in sport performance validation results

In this study, the team cohesion had four factors facets "team to adapt", "interpersonal affinity", "teamwork" and "interpersonal Attraction" and sports psychology mental toughness had three factors facets "active struggle", "resistance to stress "" tough injury pain. " as a predictor variables (Predictor), and to the best academic performance as a criterion variables, and regression test to predict the impact of the seven variables on the criterion variables.

The results in Table six found seven variables in predicting a "crush resistance" and "active struggle" have reached a significant level (p <.001), said the results have a statistical regression meaning, VIF values are also no less than 10. Multiple correlation coefficient is .225, and the table two variables can be combined to predict the performance of the best results of 22.5% of the variance. From the above results that, in the facets of table tennis athletes' team cohesion seven variables, two variables reach significant differences: "crush resistance" and "active struggle." These two variants can effectively predict the best academic performance. Table tennis athletes' team cohesion and mental toughness can predict the performance of the best results, with "crush resistance" is a very important factor in predicting the performance of the best results. The findings were similar to the studies of Wang Cheng Man (2008), Li Jing, Liu He (2009), Lin Yan Chi (2011) Wang Cheng Man (2008) found that athletes with outstanding sports achievements had better pressure resistance than others. Li Jing, Liu He (2009) explored the young athletes mental toughness characteristics of its object of study is the Chinese youth-oriented sports and different players. The result found: Master Grade (international) players crush resistance than in the primary, secondary players; Lin Yan Chi (2011) pointed out that technical studies, the stronger the better athletic performance of athletes whose strong compression; Senior athletes participate in training longer had more positive compression is, so that athletes need to have the basic techniques and

tactics, and the psychological aspects of sport caused mental toughness was important factor of chasing good sport performance. Connaughton (2008) pointed out that mental toughness is excellent athletes possess many of the characteristics.

Table 7 is the team cohesion and mental toughness regression analysis as following:

Table 7. Team cohesion and mental toughness regression analysis

Change the order of items selected	Multi-phase		Change the order of items selected	Multi-phase		Change the order of items selected	Multi-phase
1.Resistance to stress	.174	.030	.030	7.339	.174	2.709***	1.00
2. Active struggle	.225	.050	.020	4.910	.151	2.216***	1.137

***p< .001

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

4.1.1 There were not significant differences between table tennis athletes' team cohesion and different genders; there were significant difference between different scores and team cohesion "interpersonal affinity"; there were no significant difference between different gender and "mental toughness"; there were significant difference between different scores and mental toughness "resistance to stress."

4.1.2 Table tennis athletes' team cohesion "adaptation team " and "teamwork" and the mental toughness "active struggle" and "endure injury pain" were related. When the team cohesion "adaptation team" and "teamwork" is higher, mental toughness "positive struggle" and "endure injury pain," is higher. It clearly stated the importance of team cohesion and sports mental toughness.

4.1.3 Table tennis athletes' mental toughness is an important predictive factor of the best academic performance, mental toughness in sport "resistance to stress" and "active struggle" are important factors in the performance of the best results.

4.2 Recommendations

According to the results from this study, it is recommended table tennis team coach and teachers should pay attention to the athletes' mental toughness, to improve their performance of the best results.

Sports performance was the result from athletes' daily and hard training process, through participation in training programs and competitions. It is suggested that table tennis team coaches and teachers needed to increase mental toughness training on daily practicing process; that can help table tennis athletes' sport performance.

Connaughton, Hanton, Jones, and Wadey (2008) pointed out that the movement of mental toughness has been considered a good psychological techniques. The importance training stage of the athletes' sports career was that the training of mental toughness in the early stages was better than in late stage. Related studies found that mental toughness in sport is not only genetically acquired, it can have learned through learning and education (Jones, 1982).

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Scientific Support for Chinese Elite Table Tennis Players Preparing for Important International Competitions

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Abstract: One of the important factors which contribute to great performance from Chinese table tennis players is the scientific support. The study chose some of the achievements from 2008 until now as examples to introduce the scientific support for Chinese elite table tennis players preparing for Olympic and World Title Competitions. The main studies and results are as following. (1) Completion and application of table tennis techniques & tactics diagnosis and feedback methods. (2) Influence on speed, spin, techniques & tactics from inorganic glue. (3) Examples of effect observation on striking colourful balls and the speed test of plastic balls. (4) Influences caused by the plastic ball on friction coefficient between the racket and the ball. Our studies make positive contributions in improving Chinese table tennis players' scientific training level.

Keywords: scientific support, table tennis player, technique and tactics, inorganic glue, plastic ball

1. PREFACE

One of the important factors which contribute to great performance from Chinese table tennis players is the scientific support. This system is of great help during the preparation for participation in international and Olympic events.

This scientific support is part of Chinese elite table tennis players' training& competition system, and is also a backbone that keeps this system operating healthily. Factors that evoke this scientific support originate from the strategic and tactical needs during practice and competitive matches. These are reflected through participants, facilities, equipment and many other aspects.

The expression of "scientific support for Chinese elite table tennis players preparing for Olympic and important international competitions" means: taking all various scientific measures to guarantee the scientific training and to enable players to fulfil their match tasks. Its format is mainly *scientific research and scientific services* which aim at coping with problems incurred in players' training and competitions.

Scientific research means: overcoming key problems and issues through scientific research and activities concerned.

Scientific services means: scientific services offered for specific objects.

Scientific research contains scientific services, and scientific services contain scientific research.

2. BASIC IDEAS OF SCIENTIFIC RESEARCH AND SERVICES

The fundamental principles of scientific research and services are: systematic and long-term study on the training practice of Chinese table tennis team, conducting effective scientific research and services according to the needs and problems that players and coaches come across and providing reference for coaches to conduct scientific training.

The main contents of scientific research and services include:

1) Winning principles of table tennis competitions.
2) Diagnosis on players' capacity for physical training and competition and their overall physical capacity level.
3) Diagnosis on players' technique training and technique level.
4) Diagnosis on players' tactic training& tactic level.
5) Players' psychological training and adjustment.
6) Biological supervision on players' training load.
7) Inspection and evaluation on players' health level.
8) Construction of data based on training and matches.
9) Prevention and cure on players' injuries.

Among these, research on the techniques & tactics of the players are the key point, because technique & tactic capability is the most important part within the competence structure of elite table tennis players. The five elements which help to provide the Chinese table tennis teams with consecutive successes are; quickness, spin, accuracy, fierce and change, and the Methods employed by scientific research and services mainly include the general methods and specific methods of philosophy, natural science and social science. Major methods are: literature review, investigation method, summary of experience, thinking method, observation method, experimental methods, empirical method, case study, information & technology method among others.

The scientific research and services aiming at Chinese elite table tennis players preparing for Olympic and international important competitions originate from the real practice of athletic training. Its technical route is shown in Figure 1.

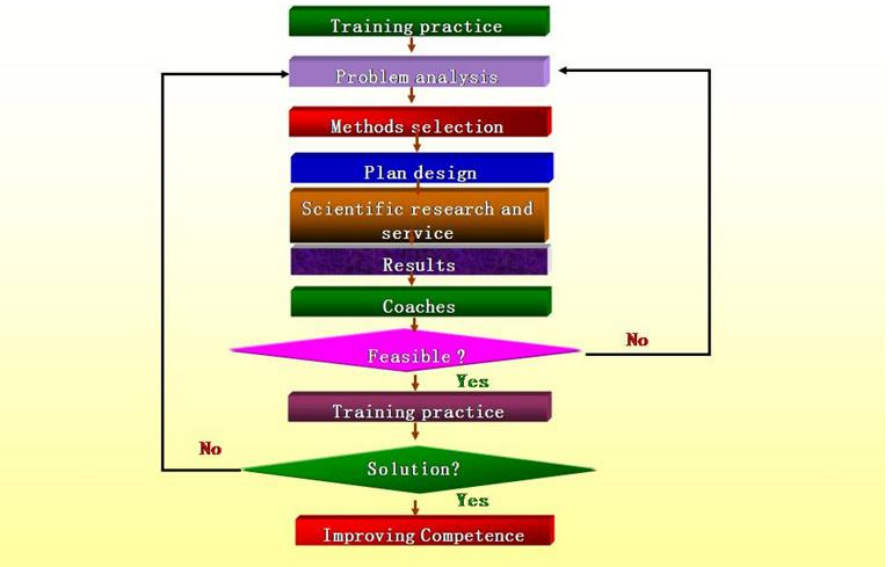

Fig. 1. Technical Route of the project

3 EXAMPLES OF SCIENTIFIC RESEARCH AND SERVICES

Due to limited time, it's impossible for this report to introduce many of the early achievements made from the research and practices in the tight bond between Chinese researchers and coaches such as: research on the winning elements of table tennis competitions, empirical study on the spin of table tennis, empirical study on the quick attack playing style of pen-holder with sandwich rubbers, empirical study on backhand attack of pen-holders, empirical study on speed and spin caused by balls of various diameter & weight, empirical study on table tennis service and so on. So this report just chooses some of the achievements from 2008 until now as examples to introduce the scientific support for Chinese elite table tennis players preparing for Olympic and World Title Competitions.

3.1 Completion and application of table tennis techniques & tactics diagnosis and feedback methods

It mainly uses Simi-Scout techniques & tactics analysis and feedback software, inheriting the base of Chinese traditional "Three Stages Analysis", to further study, enrich and complete table tennis techniques & tactics on its method of analysis, contents, indicators, measures, format of feedback results and so on, which makes table tennis techniques & tactics live video analysis and feedback come true. Its working interface is shown as Figure 2.

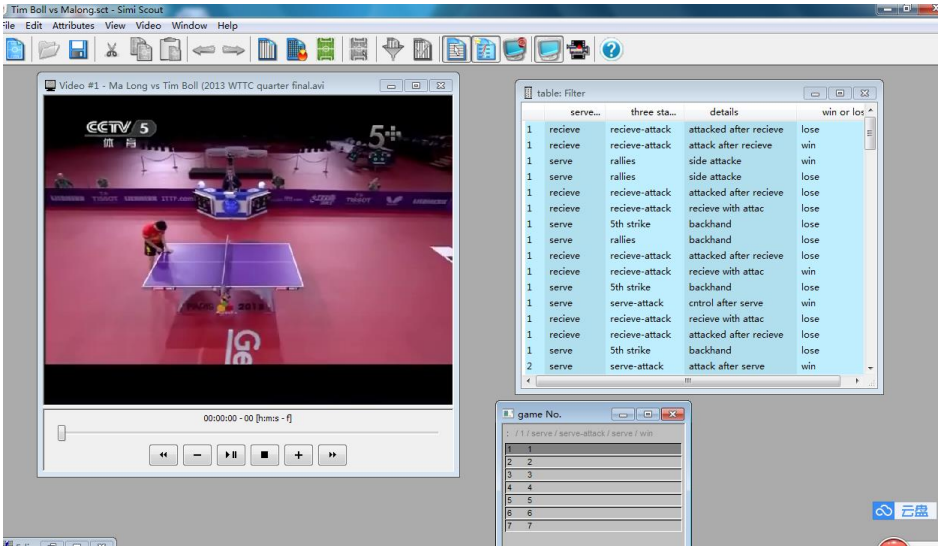

Fig. 2. Interface of techniques & tactics analysis

There are 5 steps to conduct techniques & tactics diagnosis and quick feedback:

1) Match videos collection;
2) Constructing Techniques & tactics analysis model;
3) Marking and identifying competing techniques & tactics;
4) Statistics analysis on the results of techniques & tactics;
5) Comprehensive diagnosis.

Among the 5 steps above, construction of the techniques & tactics analysis model is the core. According to different analysis objectives, we have established over 20 kinds of techniques & tactics analysis models. The two types of feedback are synchronous feedback and detailed analysis. Each type of feedback has its own analysis models for singles and doubles matches, general models of different playing styles, specific models of key players' playing features and so on. Synchronous feedback is a simple version of detailed analysis which can provide live feedback for the on-going match focusing on its major techniques & tactics by analysing statistics, results, and videos. Below are several examples for brief introduction. Techniques & tactics analysis model of "Three Stages Analysis" was shown as Figure 3.

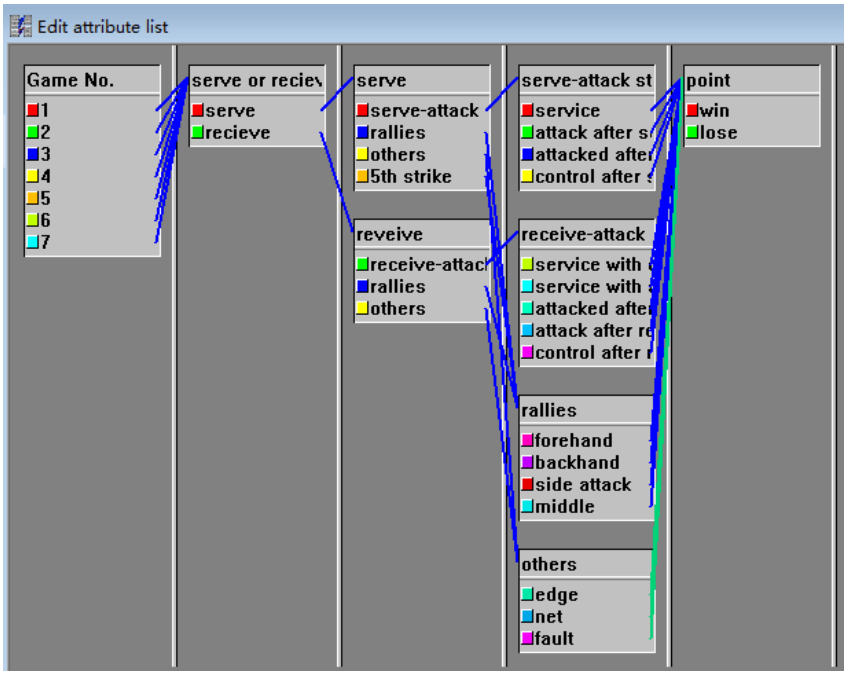

Fig. 3. Example of techniques & tactics analysis interface

Using the diagnosis and analysis methods mentioned above, we finished by tracking the analysis of the important world level competitions of Chinese players and their major competitors. According to the results, effective techniques & tactics, weakness, preference of ball path, techniques & tactics changing principles, counter tactics and other contents are picked out and highlighted. These results are often provided to players and coaches through text report or power-point, becoming important references for their strategic decision making in participating competitions and aiding in the training process should changes to techniques be needed. Take analysis of Wang Nan VS Jin Zhong (2008 World Table Tennis Championship) as an example:

The result of this match is Wang Nan lost 1:3. As we can see from the data, the major reason why Wang lost is due to her bad performance in the service stage. One weakness among the factors is: Wang lost 3 direct points through striking backhand loop towards the backhand of the opponent while receiving; lost 1 point being attacked after her own attacking in receiving; lost 1 point again in the following backhand battle; all these total 5 points counts 18.5% of the points lost in her receiving stage (-27).

Table 1. General "Three Stages Analysis" of Wang Nan VS Jin Zhong

	win	lose	total	Using rate	Scoring rate
Service-attack Stage (1st, 3rd, 5th strike)	19	10	29	36.2%	65.5%
Receive-attack stage (2nd, 4th, 6th strike)	9	23	32	40.0%	28.1%
Rallies stage /7th, 8th and strikes afterwards)	11	8	19	23.8%	57.9%
Total	39	41	80	100.0%	

3.2. Influence on speed, spin, techniques & tactics from inorganic glue

After the 2008 Beijing Olympic Games, Inorganic Glue was allowed to be used which directly affected the performance of players' techniques & tactics. In order to let players and coaches clearly aware of this change, we immediately conducted research about its influence on speed, spin, techniques & tactics when used. Through experiment and comparison, the Chinese table tennis team got data support for their anecdotal knowledge about inorganic glue and made counter measures in time.

3.2.1Influence on speed and spin by inorganic glue

To study influence on speed and spin by inorganic glue, we employed a high-speed camera (250 f/s) and a normal-speed camera (25 f/s), using them under the best possible same conditions. We collected striking data (image capture and analysis) from 3 Chinese players using organic glue and inorganic glue respectively. The experiment format sees the coach sending out multiple balls (black and white balls or balls with black streaks), striking at least 20 balls for each technique and players are asked to strike a straight line. One hour is designed for each testing player (including rest). Techniques tested are forehand smash, service (backspin, long/short), chop (short drop/ long push), loops (against backspin by strike "accelerate loop", or by strike "high-spin loop", and strike loops against ball with topspin), chopping (chopping against accelerate loop, high-spin loop) and so on. The image capture system used for kinematics analysis was Simi Motion while the data is treated by statistic measures such as One Way ANOVA (T test).

Table2 and Table 3 show some major results.

Table 2. Spin of accelerate loop against top spin balls (revolutions/sec)

Player	glue	times	average	SD	Max	Min	T-Test
Nie Wei	Inorganic	28	122.0	7.0	137.5	109.4	$p<0.05$
	organic	28	127.6	6.7	137.5	112.5	
Wen Jia	Inorganic	19	117.8	6.3	125.0	112.5	$p<0.05$
	organic	18	128.0	7.1	140.6	112.5	

Table 3. Speed of accelerate loops against top spin balls (m/s)

Player	glue	times	ave	SD	max	min	Reduce number	Reduce rate	T-test
Nie Wei	inorganic	27	16.1	0.6	16.9	15.4	0.6	3.3%	$p<0.05$
	organic	19	16.7	0.5	17.6	15.7			
Wen Jia	inorganic	19	15.1	0.7	16.1	13.6	0.4	2.9%	$p<0.05$
	organic	19	15.5	0.6	17.0	14.4			

Results of this experiment clearly show that the speed and spin has been reduced by using inorganic glue compared with that of the organic glue. Specific results are listed below:

Firstly, the forehand chop against the accelerate loop shows that the spin decreases significantly, however, the decrease in speed is not as significant.

Secondly, the strike accelerates loop and high-spin loop against balls with back spin and top spin respectively shows that the speed and spin both decrease significantly.

Thirdly, the results for a forehand strike with pimples-out rubber, the ball speed have no significant change.

Fourthly, the results for using pimples-in rubber for backhand backspin service show that the ball speed and spin have no significant change.

Next, the results show that the height of curvature and length are both decreased.

3.2.2Influences from inorganic glue on table tennis techniques & tactics

To further study the influences from inorganic glue on table tennis techniques & tactics, this research has analysed 18 world level matches: 8 matches with inorganic glues and 10 with organic glue.

The comparative analysis mainly starts with analysing playing styles. That is to say, to make a comparison between two types of playing styles in terms of match statistics. The first type are matches of “offence VS offence” which means the opposing players’ playing style is “loop and fast attack”; the second type is “offence VS chopping” which means our player is “loop and fast attack style” and the opponent is chopping style. The Chinese players choosing to exemplify “loop and fast attack” are Ding Ning, Guo Yue, Guo Yan, Wang Nan, Zhang Yingning to name but a few. Some of the foreign players choosing to exemplify the “loop and fast attack” are Feng Tianwei, Tie Yana and Tamara Boros. Foreign players choosing to exemplify the

chopping style are Park Mi Young and Kim Kyung-ah. The data for comparison has gone through statistic process and testing software such as Wilcoxon test, Mann-Whitney U test and so on.

Table 4 and 5 are the main results for further explanation.

Table 4. "Offence VS Offence" Data Comparison of Chinese Players

Three Stages	Indicators	glue	average	SD	Change rate	P value
Service-attack stage (1st, 3rd, 5th strike)	Using rate	Organic	43.31%	3.26%	5.30%	0.273
		Inorganic	41.01%	2.73%		
	Scoring rate	Organic	63.38%	11.03%	7.88%	0.465
		Inorganic	68.37%	11.55%		
Receive-attack stage (2nd, 4th, 6th strike)	Using rate	Organic	42.03%	2.07%	2.18%	0.715
		Inorganic	41.12%	4.25%		
	Scoring rate	Organic	57.39%	4.40%	3.96%	0.715
		Inorganic	59.66%	12.21%		
Rallies stage (7th, 8th and strikes afterwards)	Using rate	Organic	14.66%	4.96%	21.90%	0.144
		Inorganic	17.87%	5.98%		
	Scoring rate	Organic	43.77%	7.43%	23.55%	0.144
		Inorganic	54.08%	9.76%		

Table 5. "Offence VS Chop" Data comparison of Chinese players

Three Stages	Indicators	glue	average	SD	Change rate	P value
Service-attack stage (1st, 3rd, 5th strike)	Using rate	Organic	26.78%	5.38%	25.51%	0.043
		Inorganic	19.95%	3.40%		
	Scoring rate	Organic	57.23%	5.18%	7.61%	0.773
		Inorganic	52.87%	10.50%		
Receive-attack stage (2nd, 4th, 6th strike)	Using rate	Organic	25.17%	6.20%	8.96%	0.773
		Inorganic	27.42%	4.14%		
	Scoring rate	Organic	56.22%	6.68%	26.14%	0.043
		Inorganic	41.53%	5.96%		
Rallies stage (7th, 8th and strikes afterwards)	Using rate	Organic	48.06%	9.76%	9.53%	0.564
		Inorganic	52.64%	7.26%		
	Scoring rate	Organic	62.79%	3.85%	12.43%	0.149
		Inorganic	54.99%	7.34%		

The main results of this experiment are: firstly, compared with the era of organic glue, the era of inorganic glue has increased the percentage of players using a rate of "offence VS offence" during the stalemate stage, and no obvious change in "offence VS chop". Secondly, in matches of "offence VS offence", the using rate of service-attack stage decreases, no big change in receiving-attack stage, and increases in stalemate stage. Thirdly, in matches of "offence VS chop", the using rate of receiving-attack decreases significantly; no big change in that of the receiving-attack stage. There is an increase in the stalemate stage but it is not significant.

3.2.3 Contending strategy in the era of inorganic glue

According to the results above, we come up with the counter strategy listed below:

1) The premise to improve an effective tactic combination is to improve the quality of the technique.

When striking, if the player wants to reach the same speed and spin as the era of organic glue, the force exerted from the racket to the ball must be increased. To do this, there are two aspects for consideration. First, enhance basic strength training. Second, continue to improve and adjust technique to increase striking strength. The technical routes for operation are:

- Increase movement range properly;
- Pay attention to active explosive force;
- Higher the gravity center properly when striking.

2) The main decisive stage of scoring and winning is still within "the first three strikes".

3) The stability and threat of the 2nd strike and the 4th strike during receiving rounds are highly related to a win or lose score.

4) The key area of contending during the stalemate stage is the awareness of ball placement and ability.

One of the technique advantages that enable the Chinese team to achieve great wins is the awareness of ball placement. In the era of inorganic glue, placement plays a pivotal role in the tactic construction of the stalemate stage.

About change of ball placement, the following awareness must be improved in real practice:

- Small triangle awareness (a right triangle area form by connecting the center point of the net and center points on the side line);
- Awareness of breakthrough from forehand;
- Awareness of half-long ball;
- Continue to emphasize the use of both straight lines.

3.3. Experiments of the latest changes of table tennis

July 1st 2014, ITTF changes the ball material from celuloid to plastic and increases the diameter of the ball at the same time. This is part of the new reform precedent by ITTF which includes changing the ball from small to big, introduced an 11 point system, no hidden service, the use of inorganic glue and other new laws. It's not hard to imagine that changing the balls material will bring many changes to the sport of table tennis. For the Chinese team, not only do we need to prepare for the change, but also need to provide suggestions for the future reform and development. In order to increase the ornamental value of table tennis, CTTA comes up with the suggestion of a "colourful ball". The effect that this colourful ball can bring and how to find the best color mixtures are the key to this reform.

Thus, we conducted 3 experiments according to the latest reform.One experiment is to observe the visual effect of striking a colorful ball; the second one is to study the influence on speed and spin brought by the use of plastic balls; and the third experiment is about the influence on friction between the racket and a plastic

ball. These experiments are to provide data support for further reform and development of table tennis.The colorful balls used in the experiment are also plastic to maintain reliable results.

3.3.1 Examples of effect observation on striking colourful balls and the speed test of plastic balls

The current balls (white) that are used have a lack of marks which makes it hard for television broadcast to fully show the spin feature of table tennis matches and it's even harder for spectators to capture and experience the spin glamour of table tennis by their own eyes. In order to improve the watching value of table tennis matches, CTTA takes the initiative to bring about some changes by introducing colorful balls.

Figure 4 shows several options for colorful balls.

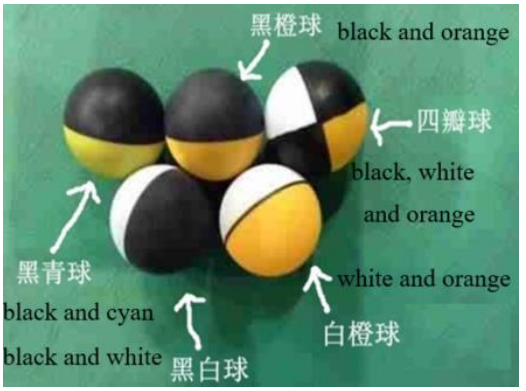

Fig. 4. Several options for colourful balls

We conducted experiments on black and white balls in 2010 and adpoted it in that year's Level B competition. Feedback from players was that the black and white ball made them dizzy and even caused their eyes to tear.. Finally the use of black and white ball was canceled.

For players, it would be comfortable to use balls with only one color; for spectators, the more significant the blend of colors, the clearer it is to watch. Therefore, we need to find a balance between the two.

The purpose of this experiment is to choose an option which not only fufills the improvement of entertainment value for spectators but also one that is well accepted by players for CTTA. We test the speed and spin at the same time to find an option that is beneficial to the sport as a whole.

Methods of this experiment:

1) Simulating formal matches (real matches in venue).

2) China Central Television simulate a live broadcast.

3) Surveys: send out questionaires to 8 players, 10 officiating umpires, 292 spectators and 112 TV spectators.

4) Kinematics test: after finishing the experiment above, 3 high-speed cameras (two cameras: 100 f/s; one camera 500 f/s) are used for capturing the image and kinematics analysis on 4 male players' forehand loop against backspin balls. This is the video we handed in to ITTF; let's have a look at the effect of the colorful balls.

The main results of this experiment are:

First, the white and orange ball with a black streak is an optimistic option which improves watching value. No significant changes are made to the initial speed when struck.

Second, after flying and reaching the opponent's court, there is a significant decrease in speed for plastic balls.

Thirdly, there is no significant difference in the spin after striking.

CTTA has adopted these results and handed the in to ITTF.

The chosen colorful ball was adopted in 2014 China Table Tennis Super League's final rounds of competition and the 12th Chinese Students Sports Meetings. Maybe in the not too distant future, this colorful ball will become the reform direction of table tennis.

3.3.2 Influences caused by the plastic ball on friction coefficient between the racket and the ball

Chinese elite table tennis players feel that it's hard to reach the same speed with a plastic ball and the plastic ball is relatively unstable while flying compared with the ball used before and they want to know the reason. For this, we conducted experiments about the influences caused by using the plastic ball, measuring the friction coefficient between the racket and the ball. We then conducted an experiment on the roughness of the balls surface.

The experiment is conducted in Tinghua University's national key laboratory. We employed UMT-2 multi-funtional friction testers (widely used in material friction and abrasion research) and three dimensional white light interference surface topography (equipped with optical microscope and various oculars, a high-definition camera capable of auto focus adjustment to test 752×480 data points, mainly used to measure the roughness of surface and polishing suface textures) to test plastic balls and celuloid balls.

Balls adopted in the experiment are: 20 Celuloid DHS three star balls and twenty 40+ plastic DHS three star balls.

Four types of rubbers were adopted in experiment: pimples in (DHS Hurricane3), pimples out (TSP), raw pimples out(TSP) and long pimples(TSP). Each piece of rubber is cut into four small pieces.

Blade adopted in experiment: one DHS Hurricane Wang blade, also cut into four small pieces.

Ball fixture adopted: fix the ball with rackets which rub the ball back and forth. Test 3 points on each ball, and five times for each type of balls.

Table 6. Friction coefficient of different rubbers and balls (n=15)

Rubber type	Celluloid ball	40+plastic ball	Decreasing amount
Pimples in (DHS HURRICANE3)	1.717	1.669	0.038
Raw pimples out(TSP)	0.727	0.722	0.005
Pimples out(TSP)	0.551	0.547	0.004
Long pimples(TSP)	0.500	0.499	0.001

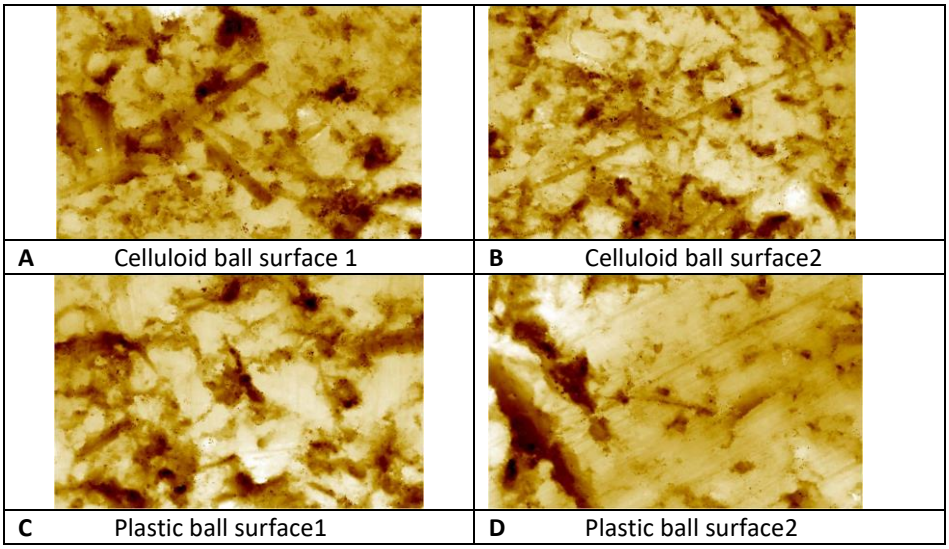

Fig. 5. Roughness of ball surfaces

Table 7. Roughness of ball surfaces value (μm，n=15)

	Celluloid ball	40+plastic ball
avergae	3.677	2.834
SD	0.051	0.568

Table 4, Figure 5 and Table 7 are some resutls of this experiment.

The main results were:

1) The change in ball material impacts pimples in rubber the most. Due to the adoption of plastic ball, the friction and coefficient between racket and ball decreased which lead to a 3.25% deduction of spin.

2) The use of plastic balls had very little impact on the pimples out rubber, raw pimples rubber and long pimples rubber.

3) The results for the coefficiency of friction between ball and racket showed: pimples in rubber> raw pimples rubber>pimples out rubber> long pimples rubber.

4) Plastic balls' roughness of surface is relatively lower than that of the celluloid balls.

5) Plastic balls' surface average evenness is less than that of the celluloid balls. Therefore, hitting different points of a plastic ball may cause some difference, and the plastic ball appears to be fluctuating when flying.

4. SUMMARY

Objectively speaking, one of the most important factors that enable Chinese table tennis players to achieve a great performance is the scientific support serving for the preparation of participating in the Olympic and world title competitions, which make positive contributions in improving Chinese table tennis players' scientific training level.

However, the current methods and technology cannot fully resolve the problems in real athletic training and practice. Thorough resolutions depend on the breakthrough of theories and the advancement of technology. It also depends on our understanding of the problems which exist in table tennis training and competitions, our understanding of the principles of this sporting event, our innovative awareness and our relentless hard work.

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The interdisciplinary training team cooperation in China Table Tennis Team

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Abstract: For a long time, the Chinese table tennis team has made brilliant achievements in the world table tennis. It is a typical representative of the Chinese athletics team and a proud of Chinese people. Behind the gold medal are a scientific training, system management and integration of all resources creatively. This article summarizes and refines the effect and experience of the using of compound training cooperation by the expert interview method, experience method, etc.. The study was aimed to enrich table tennis theory system, as well as to provide practical reference to other competitive sports team.

Keywords: table tennis team of the People's Republic of China, compound, training team

1. PREFACE

For a long time, the Chinese table tennis team has made brilliant achievements in the world table tennis. It is a typical representative of the Chinese athletics team and a proud of Chinese people. Behind the gold medal are a scientific training, system management and integration of all resources creatively. Ahead of other sports, the Chinese table tennis team has already raised the concept of compound training team. In the continuous practice and constant innovation of this training mode, it has been proved as an effective organization form, and contains the profound connotation and speculative.

2. RESEARCH METHODS

2.1 Expert Interview Method

For more in-depth understanding of the Chinese table tennis team complex training team operation mode, the cooperation form, safeguard measures and so on. In this paper, the China's State General Administration of Sport Ping Yu center of sports management center, the leadership of the national team coach coaches and scientific researchers and medical staff for the interview.

2.2 experience method

As a member of the national table tennis coaches' team, first-hand experience provides the best practices to the research of this topic.

3. RESSULTS AND ANALYSIS

3.1 The Goal of Chinese Table Tennis Complex Training Team

Common goal is the basis of the Chinese table tennis team compound training team work. It provides the impetus for the development of the team and energy makes all of the team members to share learning results and experience and forms a powerful cohesion.

'Third Entrepreneurship Program for Chinese Table Tennis' clearly states: National table tennis team is to maintain the table tennis tournament sport in the world leading position, to get a good mark in the Olympic Games and other international competition, win honour for our country. Achieve this overall objective is to strengthen teamwork training complex to form a national human, material and financial resources for the carrier to research scientists and medical personnel to help, relying on education for athletes to achieve scientific training.

3.2 Organizational Structure of Chinese Table Tennis Complex Training Team

Complex training team is the inevitable outcome of scientific and technological progress and the innovation and development in sports training. Its comprehensive integration and competition in all areas related to human resources, science and training as the goal, continuing to explore the law of development of competitive projects, to improve the players' athletic ability and level of competition purposes.

As shown in Figure 1, Chinese table tennis team training complex team practiced is the head coach of the team in charge under the leadership committee, mainly by the Commission team, head coach, women coach, manager, coaching staff, researchers, medical personnel and officers components. Its clear division of responsibilities clear, smooth operation.

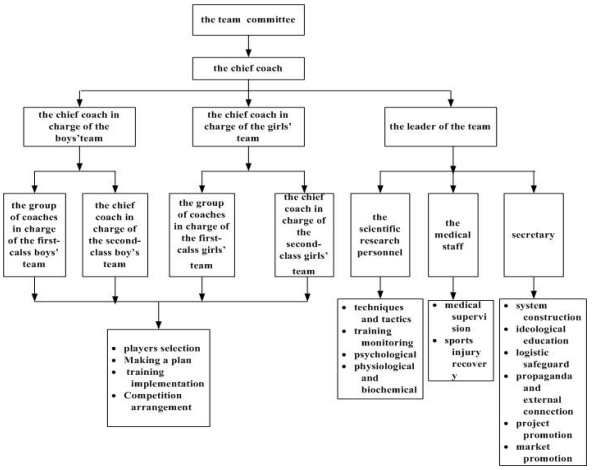

Fig. 1. Organizational structure of Chinese table tennis complex training team

3.3 Operating Mode of Chinese Table Tennis Team Complex Training Team

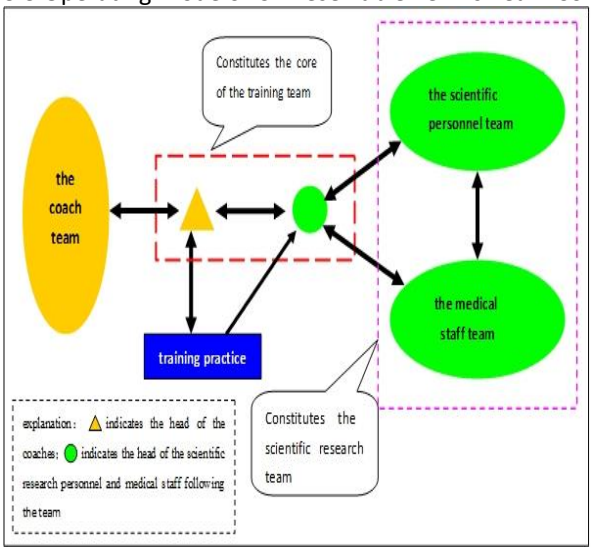

Fig. 2. Complex training team cooperation

Scientific research team and the manager are the core and body of the Chinese table tennis complex training team. In the course of scientific research personnel and coaches teamwork, they are cross-cutting both in terms of personnel and work teams, rather than isolated. The head coach is not only the team leader, but also the participant in the research team. He is the hub of the team running. Only in this way can we make targeted research, make the combination of scientific research and sports training and maximize the benefits of scientific research, as shown in Figure 2.

Scientific research team and medical team personnel through real-time monitoring process and effect in sports training, access to information, analysis the results and Suggestions to scientific research. After communication between scientific director and manager, they get sports training scheme to training team for specific implementation. From national table tennis team operation mode of the compound training team (as shown in Figure 3) can be seen that only sports training practice with the arrow to the scientific research team and medical team is a one-way, other are two-way arrow. It is need to emphasize that in the process of cooperation according to the working process and procedures. The most importantly is the two-way communication and exchanges. This is compound signature characteristics of training team operation obtain good effect.

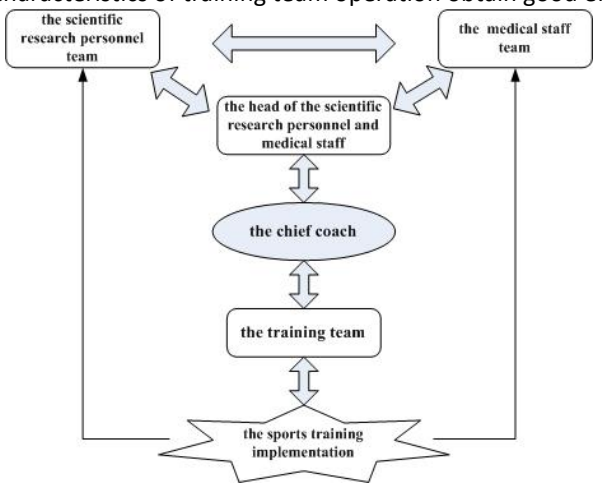

Fig. 3. Complex training team operating mode

3.4 Organization and Management Mode of Chinese Table Tennis Complex Training Team

Management has become the first era Integrated power of knowledge economy, no matter goals and performance, other system resources and organizations, management have played a decisive role. Sports team management is through the reasonable management structure, proper management mode and perfect incentive mechanism to coordinate the relationship between team members, encourage team members to do its just, to create a good environment to obtain excellent results for athletes. The Chinese table tennis team compound training team organization management mode is mainly manifested in the following four aspects: (1) advanced organization and management concept; (2) the reasonable organization and management agencies; (3) brainstorming decision-making idea; (4) management system perfect, the team discipline.

3.5 Scientific Training of Chinese Table Tennis Complex Training Team

Scientific training is an every important magic weapon to keep the table tennis team on the top of the world. Scientific training reflected in all aspects of the training process, such as training arrangements, methods and means of using advanced equipment grounds and the like. National table tennis team training concept mainly displays in study hard, realistic, high standard, strict science. Since the 1960 s, the Chinese table tennis team insist on highly centralized training system, brings together the various approaches of high level athletes to form "small world" ping-pong, created the good training condition, in the room, board, health care and logistics service have given the full protection. Secondly, as a scientific training arrangements, "Three training principle", "simulated training" means, "men help women practice" training methods, "to match with practice" training methods, make it possible that the table tennis technical training successful experience and scientific knowledge can become an effective training program and arrangements.

3.6 Deep Structure of Organization Culture of Chinese Table Tennis Complex Training Team

3.6.1 The Supreme Goal of Parsing of Chinese Table Tennis Complex Training Team

For the Chinese table tennis team, their highest goal is only success without failure. Even the Chinese table tennis team goal has become a kind of "hidden rules" -- allowing any international competition, the goal has always been a champion, and the runner-up means failure. The team's work revolves around this goal, regardless of experience any hardship, no matter what kind of contradictory problems, can be properly resolved in a timely manner under the condition of achieving the overall goal of the premise.

3.6.2 Analysis of Team Values of Chinese Table Tennis Complex Training Team

Values of the Chinese table tennis team is the whole basic belief in the Chinese table tennis team management activities to achieve the Chinese table tennis team' highest goals. It is philosophical thinking of the Chinese table tennis team leader for the long-term development targets of the Chinese table tennis team, the Chinese table tennis team management policy and development strategy and strategy. To China's table tennis athletes, coaches, the spirit of patriotism from beginning to end is the team consists of the mainstream. Whether in training or in the competition, they are able to transcend personal emotions, beyond the success or failure of the gain and loss, link his own business to national revitalization, and from this link to obtain inexhaustible strength.

3.6.3 Team Spirit of Chinese Table Tennis Complex Training Team

Chinese table tennis players always put the passion for the country and the world, to the four winds, glory for the country in the first place. This country is the highest, never-say-die spirit is important foundation of the Chinese table tennis team go today.

4. CONCLUSION AND SUGGESTIONS

4.1 Conclusion

(1) Goals of Chinese table tennis team complex training team: National table tennis team is to get good results in the Olympic Games and other international competition, win honour for our country. The highest goal of the motherland is only success without failure.

(2) Chinese table tennis team complex training team's organizational structure: The practice is a team committee under the leadership of the general manager responsibility system, all level members a clear division of responsibilities, the responsibility is clear, smooth operation.

(3) The operation mode of the Chinese table tennis team compound training team: The core and main body is coaching and the scientific research team. During the cooperation of coaching team and co-researchers, these two teams intersect with each other in terms of personnel and work.

(4) The organization management mode of Chinese table tennis team compound training team: With advanced management concept; Reasonable organization and management agencies; Brainstorm decision-making idea; Perfect management system and strict discipline.

(5) Patriotism is always the mainstream spirit of the Chinese table tennis team. It is the backbone of the team self-improvement, changing.

(6) The Chinese table tennis team complex training team follows the principle of scientific training. It is an important guarantee that Chinese table tennis keep undefeated long-term trend situation for a long time

4.2 Suggestion

(1) National table tennis complex training team, in the area of scientific research, should base on the existing development train of thought, use high-tech means, continuous innovation and make it real to play the role of guidance and enlightenment to training game.

(2) In terms of physical training, we should strengthen the combination of table tennis and practicability, employ, select and train the new type of professionals that adapt to the project development and improvement.

(3) In terms of medical work, integrate physical fitness, treatment, rehabilitation, prevention, establishing appraisal system, and strengthen learning and training.

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The establishment of the three-phase technique and tactic analysis model for the players with the playing style of chop-and-attack

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Abstract: Based on the classic three phases technique and tactics indicator system, using Simi-Scout techniques & tactics analysis and feedback software, according to the characteristic of the players with the playing style of chop-and-attack, this paper set up three phases technique and tactic analysis model of the players with the playing style of chop-and-attack.

Keywords: the playing style of chop-and-attack, three phase technique and tactic analysis method, model

1. PREFACE

There are 5 steps to conduct techniques & tactics diagnosis and quick feedback. Firstly, Match videos collection; secondly, Constructing a Techniques & tactics analysis model; Thirdly, Marking and identifying competing techniques & tactics; fourthly, Statistics analysis on the results of techniques & tactics; Finally, Comprehensive diagnosis. Among the 5 steps above, construction of the techniques & tactics analysis model is of higher importance and is the core of maintaining a good performance.

Most current studies focus on the playing style of attack, and few researches have been conducted on that of chop-and-attack, which are only limited in techniques & tactics analysis. There are nearly no reports to be found on the three phases' technique and tactic analysis model of the players with the playing style of chop-and-attack. There are lots of indicators in table tennis technique and tactic. The starting point of analysis and diagnosis in technique and tactic should be according to the actual situation: time, space, status and power, etc. Evaluation of each rally contains the technology, lines, placement, effect elements, the cohesion between the rally, the rally itself, and the time of the ball in the whole period. Based on the classic three phases technique and tactics indicator system, according to the characteristic of the players with the playing style of chop-and-attack, the paper had chosen the analysis indicators to meet the requirements for the real situation in technique and tactic step by step, and built an indicator database. The paper aims to straighten out the relationship between the indicators, forming a reticular structure, then set up three phases technique and tactic analysis model of the players with the playing style of chop-and-attack.

2. RESEARCH METHODS

Using Simi Scout technique and tactics video analysis software, combined with the classic three-phase technique and tactics analysis method.

3. RESEARCH RESULTS

3.1 Establish three phases technique and tactic analysis model of the players with the playing style of chop-and-attack.

3.1.1 Analyse the practical problems in the match and training

The purpose of this step is to find what the real issues are and make it a priority. When we get an understanding of the current demand and the type of problems then we can confirm whether there is the necessity and feasibility of diagnosis. This step is a highly complicated process and a combination of scientific research and training; it not only needs researchers who have deep observation and experience in sports practice, but also needs the cooperation of coaches and high awareness and understanding of the diagnosis. Thus, we can ensure the efficient operation of the system. There are lots of technique and tactic analysis methods for the playing style of chop-and-attack, analysing the technical movements and tactics of the world's best attacking players; Muramatsu Yuto, Joo Se-Hyuk, Kim Kyung-ah, Wu yang in major tournaments around the world. These methods can sum up the characteristics of the playing style of chop-and-attack and develop scientific analysis indicators.

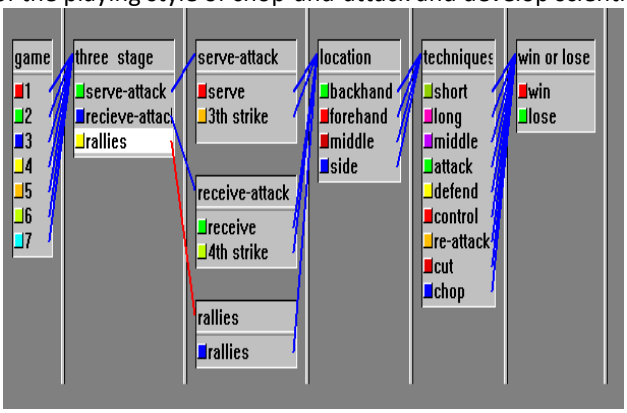

Fig. 1. Technique and tactic analysis model of the players with the playing style of chop-and-attack

3.1.2 Establish indicators

According to the technique and tactic characteristics of table tennis players with the playing style of chop-and-attack，Selecting analysis indicators of the technique and tactic of meeting the requirements of actual combat，Setting up a corresponding index library (shown in Figure 1). It contains six levels of technique and tactic indicators. The first level was the number of games played, the second was three-phase, the third was a per phase indicator, the fourth was location; the

fifth was the specific techniques, and the sixth was win or lose. Thus, each point could be judged by the six levels.

The first indicators were the number of games. The games are for seven innings and four wins. It includes seven sub indicators, which were the first game, the second game……and the seventh game.

The second indicators were three-phase, which mainly included serve and attack phase, receive and attack phase and the rallies phase.

The third, fourth and fifth level indicators we reach are phase and specific technique. It mainly includes：

（1）The sub indicators in serve and attack phase including serve (short, half-long, long), control after serve (cut, split or push), attack after serve (over the table, long shot), chop after serve (forehand, backhand).

（2）The sub indicators in receive and attack phase included control in receive (cut, split and push), attack in receive (over the table, long shot), chop in receive (forehand, backhand), attack after receive (forehand, backhand), control or defense after receive (forehand, backhand), chop after receive (forehand, backhand).

（3）The sub indicators in the phase of sustained rally included turning to attack (forehand, backhand and pivot), passivity (forehand, backhand and pivot) and chop (forehand, backhand and pivot).

The sixth indicators were “win or lose”. It included win and lose.

3.1.3 Establish a network diagram

After rationalizing the relationships between selected indicators and clear logical relations, establish a network structure diagram step by step, set up technical and tactical model of the playing style of chop-and-attack.

3.1.4 Debugging and modification

After setting up technical and tactical model initially, we need debugging and revision in the technical and tactical in practice. It experienced the process from simple to complex and then from complex to simple process, and the technical and tactical analysis model of the playing style of chop-and-attack could be formed.

3.2 The application of technical and tactical analysis model for the playing style of chop-and-attack

Using Simi-Scout techniques & tactics analysis and feedback software and tactical analysis model, we studied the technical and tactical components between Muramatsu Yuto and Fan Zhendong during the 2014 Asian Games team competition. The semi-final result was 1 to 3. Muramatsu Yuto is a chopper star in Japan; his playing style is the playing style of chop-and-attack. The main statistical results are shown in tables 1 to 8.

Table 1. The data of three-phase of Yuto Muramatsu

	win	lose	sub	usage	scoring rate
serve and attack phase	8	5	13	24.5%	61.5%
receive and attack phase	1	7	8	15.1%	12.5%
rally phase	11	21	32	60.40%	34.4%
subtotal	20	33	53	100.0%	37.7%

Table 2. The data of Yuto Muramatsu in Serve and attack phase

	win	lose	sub
serve	4	0	4
serve and attack	4	5	9
subtotal	8	5	13

Table 3. The data of Yuto Muramatsu in the third strike

	win	lose	sub
receive and control	0	0	0
receive and chop	1	1	2
the third strike with forehand chop	0	0	0
the third strike with backhand chop	3	4	7
subtotal	4	5	9

Table 4. The data of Yuto Muramatsu in receive and attack phase

	win	lose	sub
the second strike	0	2	2
the fourth strike	1	5	6
sub	1	7	8

Table 5. The data of Yuto Muramatsu in the second strike

	win	lose	sub
receive with forehand chop	0	0	0
receive with backhand chop	0	2	2
receive with attack	0	0	0
receive with control	0	0	0
subtotal	0	2	2

Table 6. The data of Yuto Muramatsu in the fourth strike

	win	lose	sub		
Attack after receive	forehand		0	0	0
	backhand		0	0	0
Attack after defend	forehand		0	1	1
	backhand		0	0	0
Attack after chop	forehand chop		0	1	1
	backhand chop		1	3	4
Subtotal			1	5	6

Table 7. The data of Yuto Muramatsu in rally phase

	win	lose	sub
the fifth strike	0	0	0
offensive	3		6
passive rallies	0	4	4
chop	8	14	22
subtotal	11	21	32

Table 8. The losing points' locations data of Yuto Muramatsu in rallies phase

	win	lose	sub
forehand	2	11	13
backhand	8	10	18
sideways	1	0	1
subtotal	11	21	32

From Table 1 to Table 8, the following were summed up.

(1) Yuto Muramatsu's serve had high quality. The drop point and rotation of the ball had a lot of changes. His serve was mainly at the backhand half-length court and long serve, combined with forehand deviation centerline short serve. He had some ability to attack after serve.

(2) His receive used backhand chopping techniques more while his chops long and short were used less. The drop point of receive was mainly in the opponent's backhand.

(3) Yuto Muramatsu had the ability to change from defensive to attack with huge threat of force in the rallies phase, which made him score directly, but his error rate was high. His backhand chopping defense was good, and his forehand rally ability is poor.

4. CONCLUSION

Based on the classic three phases technique and tactics indicator system, according to the characteristic of the players with the playing style of chop-and-attack, the paper had chosen the analysis indicators to meet the requirements for the real situation in technique and tactic step by step, in order to build an indicator database. The paper aimed to straighten out the relationship between the indicators, forming a reticular structure, then set up three phases' technique and tactic analysis model of the players with the playing style of chop-and-attack. By using the analysis model we analysed the match between Muramatsu and Zhang Jike, which showed that the playing style of chop-and-attack in three sections of the technical and tactical analysis model is feasible and effective.

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Comparative Study on the Development Characteristics of Chinese Male Table Tennis Technique and Tactic across the Olympic Period

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Abstract: In almost five years from 2010 to 2014, which belongs to the cross-Olympic period in China's competitive sport process, as well as the adaptation period for table tannis going into the inorganic era, especially after the baptism of the London Olympics, we come up with this question that how does inorganic glue make changes to table tennis? Through a comparative study on the technical and tactical development characteristics of male table tennis during 5 years of adaptation of the inorganic era from 2010 to 2014, an in-depth analysis on the similarity and difference between overall and individual characteristics will be made in this paper, in order to make reference for the corresponding countermeasure that how to cope with the further changes of new material brought to table tennis. Conclusions of this research will be as follows: The overall development of competitive level is complementary and relatively stable. Tactical level of attacking serve is in a good range, and will have more space to make improvement. Tactical level of receiving serve is the most prominent characteristic, and actually there is no significant difference between the two styles, which can be further improved through three-stage of diagnostic tools. However, the stalemate playing is still relatively weak and should be strengthened as soon as possible.

Keywords: period, table tennis, technical and tactics, inorganic glue era

Since 2000, International Table Tennis Federation (ITTF) has made three significant reforms on the table tennis sport. In face of these reforms, numerous table tennis staff in China have performed extensive countermeasure researches, in the fields of athletic selections and cultivation, innovation of technical equipment, organizing of contest organization and training, and innovation of table tennis clubs etc., in terms of the potential changes of the modifications of the regulations and rules. In addition, further modifications also have been made according to practical situations of adapting to the new table tennis rules and regulations. And these effective countermeasure adjustments can be conducive to the sustainable development of China's table tennis. In the process of practising these countermeasures, the development and changes of the technical and tactical characteristics is the important reference for guiding and verifying the rationality of the strategy. Since Sep. 1, 2008, it has been six years since table tennis has entered inorganic era with the forbidden of organic glue.And within these six years, from the

transition phase in the beginning to the current adaptive phase,the techniques and tactics of our Chinese male table tennis has gone through a development and change process. Therefore, we conduct a comparative study in terms of the development of table tennis techniques and tactics of the following four world champions from year 2010-year 2014: Jike Zhang, Long Ma, Xin Xu and Hao Wang.

1. STUDY OBJECT AND METHOD

1.1 Study Object: Hao Wang, Xin XU, Jike Zhang and Long Ma.

These world champions had taken 131 competitions from 2010 to 2014, including World Cup, World Table Tennis Championship, Final of ITTF World Tour, the Asian Games and London 2012 Olympic Games, etc.

1.2 Study Method

1.2.1 Video Statistical Method: we have collected statistical data from the above 131 games with "3-sections indicator evaluation method." 3-sections indicator evaluation method is a common and very important statistical method in table tennis scientific researches. By analysing the scoring rate and usage rate in the serve attack phase, ball attach phase and stalemate stage, the features of techniques and tactics of the athletics can be evaluated. The specific evaluative criteria have been displayed in Table 1.

Table 1. The 3-sections technology assessment standard of table tennis singles match

Three section		Scoring rate %	Usage rate %
Serve attack phase	Excellent	70	25-30
	Good	65	
	Pass	60	
Ball attack phase	Excellent	50	15-25
	Good	40	
	Pass	30	
Stalemate stage	Excellent	55	45-55
	Good	50	
	Pass	45	

1.2.2 *Logical analysis method*: Analyse the features of techniques and tactics of the four champions combining with the law of motion of table tennis and the effect of regulation changes.

1.2.3 Contrast Method: make comparisons among the four world champions' statistical results, overall changing characteristics of techniques and tactics, and evaluative criteria. Then corresponding conclusion can be made.

2. RESULTS AND ANALYSIS

2.1 Technique and tactics index analysis in serve attack phase

From the comparisons among the trends of scoring rate in Figure 1, the overall fluctuation of scoring rate was small and was in a good assessment criterion. The average value was 64.39%. There was a delining trend from 2010 to 2014. No occlusion serve and inorganic glue led to a decrease in the force of the stroke, and all of these had influence of the third attacking threat, which led to the failure of improvement on the first three attacking advantage in the inorganic era. Hao Wang and Long Ma had highest and second highest fluctuation rates, but the scoring rate of Long Ma was higher than the overall average values and he had the highest average scoring rate (68.76%). The trend of Jike Zhang was declining and his scoring rate was lower than the average scoring rate in the recent three years. The average value was in the passing level, mainly because Jike Zhang often used side of screw technology, with the opponent's gradual adaption of this new stimulation, the threat correspondingly reduced. As the representative of using traditional straight play, Xin Xu had shown a tread of steady upward in the serve attack phase.

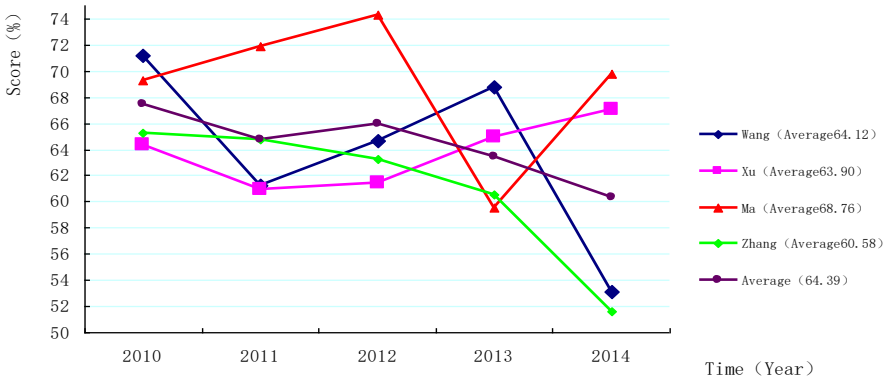

Fig 1 Serve attack stage scoring rate trends contrast

From the comparisons among the trends of usage rate in Figure 2, the overall usage rate fluctuation was relatively small and had the trend of increasing in these years. This shows that in the inorganic era, due to the elasticity and hardness of the equipment, speed and strength of striking ball decreases. And this results in players' more obvious tactical intention in the first three attacking, more active in practising, and trying to finish the competition in the first tree attacking. These four players except Xin Xu who showed larger fluctuation in 2012, all performed steadily.

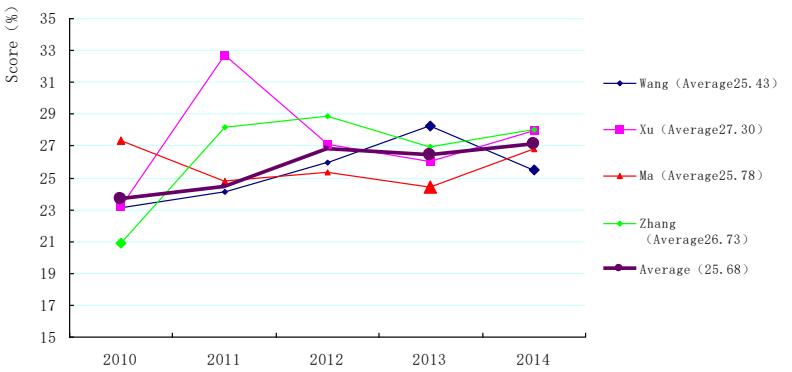

Figure 2 Attack after service phase contrast usage trends

2.2 Technique and tactics index analysis in the ball attack phase

From Figure 3, we can see that the influence on three reforms to promote the tactics to grab more vicious active stage had been further proved, and the overall score was always above the good level, which was up to 52.61% and showed an upward trend. The average level of four world champions had basically reached an outstanding stage of the evaluation criteria. Among them, the handshake grip player had a good receiving ability. Especially, Jike Zhang's side of screw receiving is the most prominent, and his receiving phase ability did not appear larger fluctuation, which reflected the absolute strength of Grand Slam winner. Even the most volatile of Xin Xu, his lowest level was still very good. This showed that, no matter using the penholder grip or handshake grip, the tactical thinking of return of service stage was mainly to take the initiative and efficient attack.

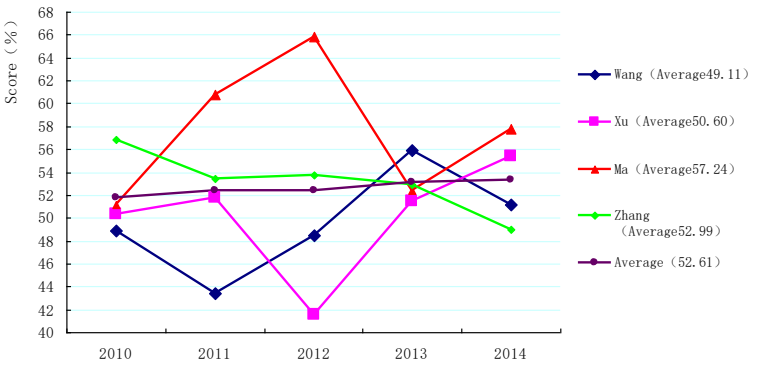

Figure 3 The ball attack stage scoring rate trends contrast

From Figure 4, we can observe that the usage rate, as same as scoring rate, was absolutely higher than the excellent evaluation criterion. The average usage rate was

32.86%, which was 8% higher than the excellent evaluation criterion. Under the influence of service threat reduction, return of service means diversification and proactive awareness of return of serve, the features of technique and tactics of our athletes had changed significantly. This further triggered our introspection on timeliness of old evaluation criteria. There are two noteworthy points. First, the use rate of penholder grip players was slightly higher than the handshake grip players, because as the development of side of screw with penholder grip，the penholder player were more willing to end the game in the first four rounds to avoid of dragging the game into a stalemate. Second, compared with the development trend of usage rate in serve attack phase, the usage rate of ball attack phase showed considerable fluctuation. This reflects that as a resistant sport playing through the net, table tennis' phase was largely affected by the influence by the opponent's serve. This in some way showed the importance of serve technique. Jike Zhang and Hao Wang mastered substantially the skill of side of screw and their usage rates were basically above the average level, and this further illustrated the advanced technology of return of service was the best guarantee of supporting return of service attacking tactics.

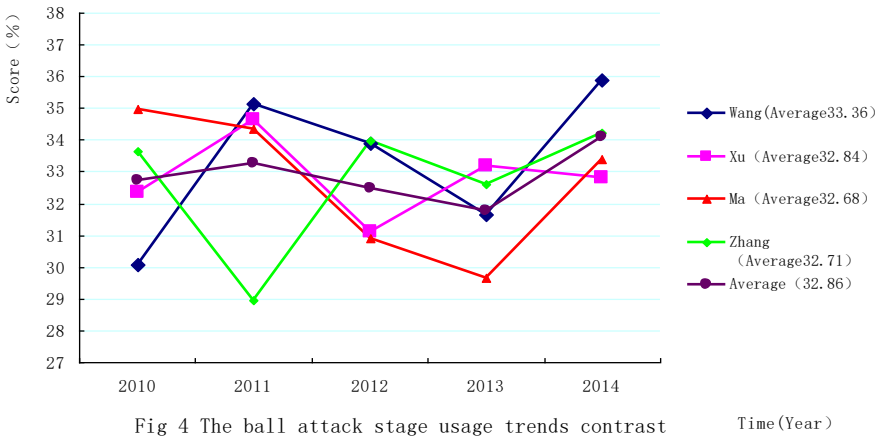

Fig 4 The ball attack stage usage trends contrast

2.3 Technique and tactics index analysis in the stalemate stage

The stalemate phase is an important aspect in table tennis game, and it also reflects the perfect combination of strength and beauty of sport. Entering the inorganic era, the greatly reducing hardness and elasticity of racket rubber has affected speed, power and spin of striking the ball, and further increases the proportion and rounds numbers of the stalemate ball. All these have given table tennis more ornamental and confrontational, thus help to promote this sport in the world.

From Figure 5, we can observe that the scoring rate in the stalemate phase had the highest fluctuation, and the overall average value was 44.65% which was lower

than the pass level of evaluation criterion. Though handshake grip player acted better than penholder grip player in the average level, but both of the data were only higher than the passing level. Stalemate ability which was different from dexterity and fierce in serve attack phase and ball attack phase was mainly influenced by athletes' strength, footwork and physical agility, among which, physical agility was the key element. Compared with the European players, the strength and the confrontation capacity from the middle-long table of our athletes were relatively less. Especially during intense competition and the influence of age, physical agility was more likely to affect stalemate ability. In 2014, removing the factors of usage rate dropping, some events had begun to use new material balls, and the diameter and quality of table tennis balls were increasing. Thus these asked for a higher demand of striking quality during stalemate phase and resulted in the downward trend of the scoring rate of the four players.

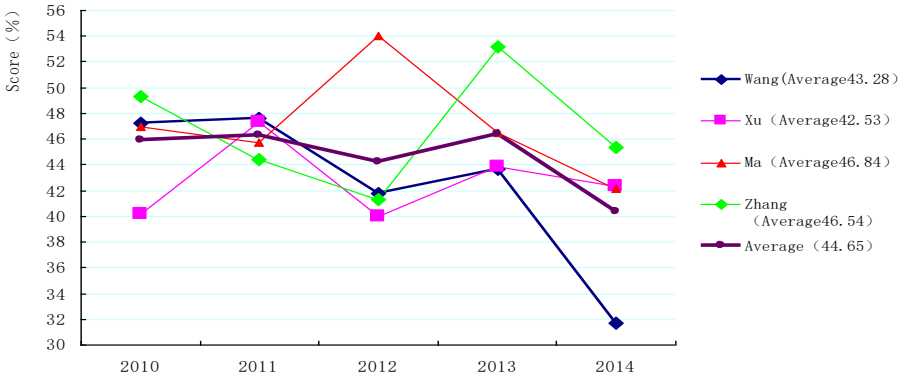

Fig 5 Stalemate scoring rate trends contrast

The overall usage rate and individual usage rate in the stalemate phase was obviously lower than the standards of evaluation criteria. The overall usage rate here was 41.05% which was 4% lower than the standard evaluation criterion (45%). Xin Xu's average usage rate (39.99%) was lower than the two handshake grip players, and this was related to his play style. Most penholder grip players lost points in the first four rounds. Restricted by his backhand ability and his less handling with fierce and stability in the stalemate phase, thus led to the scoring situation against its usage situation. But Hao Wang's usage rate was quite similar to the handshake grip players and the fluctuation was small, and all these reflected his profound foundation of penholder straight skill and the importance of the skill to the penholer players which we should pay attention to in the future. Long Ma's ability of forehand and backhand was quite balanced, meanwhile his ability of middle-long table attack can compete with European players, and the fluctuation of usage rate was small. Although Jike Zhang's average usage rate of 40.56% was under the evaluation criteria, but he had a good combination of fierce and stability in the stalemate phase

and he used reasonable tactics, so that the changing trend of scoring rate was consistent with the usage rate, and he achieved relatively high efficient tactical effect in the stalemate phase.

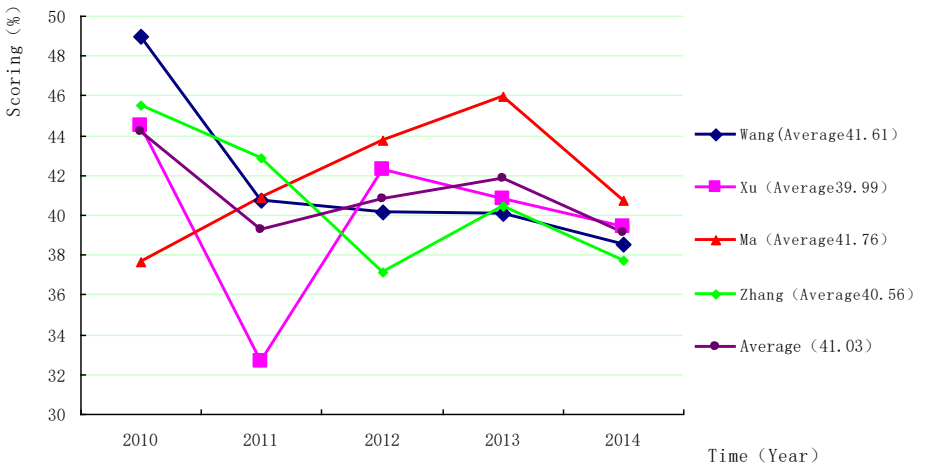

Fig 6 Stalemate segment usage trends contrast

With the regulation innovation and the application of new material balls, the ratios of stalemate balls will keep increasing. It will be a significant challenge for our table tennis teams with relatively weak technique and tactics in the stalemate stage.

3. CONCLUSIONS AND SUGGESTIONS

3.1 Conclusions

1. In recent five years, the overall scoring rate of serve and attack phase was in a good evaluation range with small fluctuation, but influenced by the factors like no-hiding service, the decrease of hitting power in inorganic times and the tactics perfection of return of service, China's traditional advantage of the first three rounds did not have a further improvement, and showed slightly downward trend.

2. The overall levels of scoring and usage rate in the phase of attack after receiving were higher than the excellent level of evaluation criteria in these five years. The right 2/3 table side twist as the representative of effective return of service tactics has become a mainstream.

3. In the previous five years, the overall levels of scoring and usage rate in the stalemate phase were lower than the overall evaluation criteria of the passing level and physical agility has become an important factor affecting the stalemate ablility. With the further deepening of the rules reform, the stalemate technical and tactical level has become an important aspect of athletes' competitive level.

4. In a whole, the development trend of three-stage scoring and usage rates showed complementary features and ensured the stability of overall Chinese male table tennis levels.

3.2 Suggestions

1. Further adjust the attitude. Starting from the new characteristics of rule changes like three major reforms and new material balls, we should carefully follow competitive laws of table tennis, and constantly improve the training methods and means which is more suitable for the inorganic era, like quality of service, diversification of return of service means, physical agility's improvement, etc.

2. Strengthen ideological, political and psychological education. As the deepening of international sports career and the industrialized sport career within our country, the question of how to make athletes face the fierce competition and the constantly changing rules becomes particularly important.

3. Strengthen research. The the technical and tactical indicators in the phase of attack after receiving has undergone great changes. Using the evaluation of three-stage indicators to diagnose athletes' state and how to make a further improvement, and how to overcome the reduction of rubber hardness and elasticity brought by inorganic glue, and all of these above things are the directions we should put effort on in the next step.

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The Influence of Ball Velocities and Stimulus-Response Compatibilities on the Reaction and Movement Times of Primary School Soft Tennis Athletes

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Abstract: The purposes of this study are to perceive the effects of ball velocities and stimulus-response compatibilities on volley reaction and movement times of soft tennis players in primary school. The training group contains 37 boys and girls from Grades 3- 6 in Gushan Elementary School in Kaohsiung County and Linluo Elementary School in Pingtung County. They are between the ages 9.5 and 11.48 years, the heights 133.37 and 151.05 cm, and weights 30.03 and 45.45 kg. The independent variables of this study are the different ball velocities and stimulus-response compatibilities; the dependent variables are the athletes' Reaction Times (RT), Premotor RT, Motor RT, and Movement Times. With the Laboratory Virtual Instrument Workbench software (LABview), an accelerometer, infrared-inductance, and Electromyography (10000Hz) and so on, we gathered the premotor RT, motor RT, and movement times under different speeds of the soft tennis balls. We tested the calculating system SPSS.14 with 2 - way ANOVA, and the results of the study are as follows: 1. Different ball velocities and the existence of stimulus-response compatibilities do not affect the athlete's RT, premotor RT, or motor RT and movement times. 2. The influences of different velocities on the RT, premotor RT, and motor RT are above the statistical significance level; that is, the RT, premotor RT, and Motor RT of the participants who volley the ball at a fast velocity are faster than those of the ones who volley the ball at a slow velocity. However, the influence of different velocities on the movement times is below the statistical significance level; in other words, there is no difference between the MT of different velocities. 3. The influence of stimulus-response compatibility on the premotor RT is above the statistical significance level, so the premotor RT of the participants performing a backhand volley (no stimulus-response compatibility) are faster than that of participants performing a forehand volley (stimulus-response compatible). However, the influence of stimulus-response compatibility on the RT, motor RT, and movement time is below the statistical significance level; in other words, there are no differences in the effects of stimulus-response compatibility on the RT, Motor RT, or movement times..

Keywords: velocity, stimulus-response compatibility, soft tennis, reaction time, movement time

1. INTRODUCTION

Motor skills are obtained through practice, and are a product of muscle transmission, awareness, and movement. More specifically, it is the ability to process information, react to outside stimuli, and learn the muscle movements necessary for the sport. Reaction is the response rate (quick, slow) to stimuli and signals. The type of stimuli and the complexity of the reaction required will influence the response rate. For both closed and open motor skills, each individual's reaction time (RT) and ability to perform are highly intertwined. In order to win competitions, athletes must move aggressively and obtain faster speed of movement in the stadiums, decreasing their reaction time (Y. F. Lin, 1996; Neo, Pauwels & Poorter, 1987). Motor skills include accuracy, power, and continuity. In soft tennis, success requires continuous motion. One needs to practice set motions repeatedly as well as quickly and accurately, matched with exercises that build muscle strength, speed, and reaction, in order to display superior soft tennis motor abilities. A soft tennis coach must understand the differences in the athletes' reaction rates to effectively formulate such a training strategy.

Reaction time is the key to success in soft tennis. After the opponent tosses the ball, the player needs to quickly and accurately determine the ball's direction, height, and relation to the net. Then, he or she needs to use quick footwork to move to the location most advantageous for returning the hit. This vastly decreases the probability of missing the ball. Therefore, quick and accurate footwork, induced by reaction time, is the key to success in soft tennis (Y. K. Chang, 1986; S. M. Chang, 1984). Y. L. Lai (1997) points out that there are many changing tasks associated with intercepting balls, and that they must be done close to the net and the opponent, making it one of the most challenging motor skills in competition. Because the player must intercept the ball before it hits the ground, he or she needs an even quicker reaction time. Yet in soft tennis, intercepting the ball near the net is an effective weapon for and the key to gaining points. Whether or not the player can react against changing ball velocities from the opponent and intercept the ball near the net depends on the speed of his or her reaction time and movement time. In fact, in any play with an opponent, the player needs to react quickly. As his/her reaction rate determines his/her success in the competition, he/she needs to improve his/her reaction rate through targeted exercises. Enhancing reaction time is the foundation of training, and sufficient reaction time is necessary to even begin learning motor skills.

Most of the relevant existing literature focuses on developing motor skills in adults, and few authors have researched motor skill development in elementary-school aged children. However, we see in many sports that athletes start training at a young age, so it is worth examining reaction time and movement time in elementary-school aged children (C. H. Lin, 1996; Y. F. Lin, 1996; T. M. Hung, D.Y. Fong, 2003; T. M. Hung, 2001; W. G. Xu, 1997; Z. P. Wen, C. H. Lin 1998; Chia, Tu, 2008; Z. G. Liu, 2001a; Z. G. Liu, 2001b; Y. L. Lai, 1997; W. C. Su, Y. F. Lin, 2004; Grouios, 1991; Kato et al., 2004; Magill, 2007; Neo, Pauwels & Poorter, 1987;

Schmidt, 1988; Williams & Walmsley, 2000). Therefore, from theories and empirical evidence within the literature, we can see the following:

1. According to previous research on transmitter reception, we have seen that in order to increase athletic performance, we must do the following: utilize sensory cues, decrease the time needed to process stimulation, and increase the speed at which decisions are made. Through training, one can acquire motor skills and increase the ability to plan one's reaction. The more familiar an athlete is with the movements, the quicker his/her output time. From the time of external stimulation until the movement starts, the nerves and muscles quickly coordinate to achieve a reaction. This reaction also helps develop the athlete's physiological and psychological potential. The shorter the reaction time, the stronger his/her adaptability and flexibility. Reaction time can be categorized into two types: Premotor Reaction Time and Motor Reaction Time. The factors that impact reaction time include internal ones (individual differences, awareness, reaction capabilities, reaction methods, foresight, length of preparation time, emotional state, anticipation, etc.) and external ones (type, strength, length, and complexity of external stimulations, etc.). External stimulations are easier to handle on the athlete's dominant side (stimulus-response compatibility) and harder to handle on the non-dominant side (lack of stimulus-response compatibility). This is because compared to the non-dominant side, the dominant side can move more quickly and accurately. The order of the stimulus-response influences the processing speed, thus influencing the reaction time.

2. Athletes face incoming balls at a variety of speeds, so their reaction times for each ball differ. The quick-moving balls force athletes to have faster reaction times than the slow-moving balls. This shows that the speed of the incoming ball will impact reaction times. In addition, when incoming balls appear from different directions, athletes react faster to the balls coming from their right side as opposed to the ones coming from their left. This means that the athlete's dominant side reacts faster. Under various speeds of incoming balls, outstanding athletes have faster reaction rates than subpar athletes.

3. During soft tennis competitions, if the position at which the athlete hits the ball is closer to the net, then the athlete can hit the ball relatively earlier and more quickly, so his/her probability of winning increases. When the athlete moves closer to the net in response to aggressive actions from his/her opponents, the athlete should initiate with his/her right foot in order to cover the greatest distance in the shortest amount of time. The factors to successful defense include: keeping eyes fixed on the direction of the ball, steady footwork, and good judgement. They also include attentiveness to the ball's position, height, distance, direction, as well as the time before the racket hits the ball, the angle by which it hits, and the area at which it will land. The ability to quickly and accurately determine the direction and movement of the ball influences the speed of the reaction.

4. Differences in gender and age are associated with different stimulus- response times. Athletes have faster premotor RT and reaction times than non-athletes; the non-dominant hand's premotor RT is faster than the dominant hand, but the motor

time of the non-dominant hand is slower than that of the dominant hand. The muscle coordination of outstanding athletes is better than that of beginning athletes. Outstanding athletes move more slowly but have better reaction times.

So, according to existing literature, reaction times and speed of movement influences athletic performance. But in reality, whether the differences in the speed of the incoming ball and the compatibility of the stimulus-response influence the response rate and speed of movement of primary school athletes in soft tennis is yet to be determined. Therefore, the purpose of this analysis is to, through experimental studies, provide coaches with scientific grounding for training sessions and considerations for specialized soft tennis training. So the purpose of this research is grounded in analysing how different ball velocities and stimulus-response compatibilities influence the following: reaction time (RT), premotor and motor RT, and movement times.

2. DEFINITIONS

1. Velocity: The velocity is measured with infrared-inductance as the ball leaves the tennis ball machine. This study focuses on two different ball speeds: 1) Quick-moving: 100km/hr±0.9km/hr, and 2) Slow-moving: 60km/hr±1.1km/hr.
2. Stimulus-response compatibility (S-R): Stimulus-response compatibility exists when external stimulations correspond to the player's responses. In this study, stimulus-response is compatible if the player senses the ball coming from the right, and he/she uses his/her right hand and foot to prepare a forehand volley. Stimulus-response is not compatible when the player senses the ball coming from the left and prepares a backhand volley from the left, but moves his/her right foot.
3. Soft Tennis Volley: Volleying is the act of rebounding an incoming ball before the ball hits the ground (L. Z. Lin, 1983). This experiment examines volleying from the perspective of whether or not there is stimulus-response compatibility.
4. Reaction Time: Reaction time (RT) refers to the time from receiving the stimulus to the time the player starts reacting. Note that it does not include the actual movement, but refers to the time before the movement starts. Reaction time (RT) includes premotor RT and motor RT. In this study, we start measuring reaction time from when the ball leaves the tennis ball machine, passes through the infrared-inductance, to the start of the player's movement (as measured by an accelerometer).
5. Movement Time: Movement time refers to the time from the beginning of a reaction to the end of the movement. In this study, it is the time the athlete prepares a volley to when the ball bounces off the racquet, as measured by an accelerometer.
6. Premotor RT: Premotor RT refers to the time from receiving visual stimulation to transferring the signals from nerves to muscles to starting the movement. In this study, we measure it by when the ball leaves the tennis ball machine, passes through the infrared-inductance, to the start of muscle movement. The start of muscle movement is measured by an electromyography (EMG).

7. Motor RT: Motor RT refers to the time from the muscles receiving the signal to their actual movement. In this study, actual movement is defined by when the muscle prepares to volley, and is measured by an EMG and accelerometer.

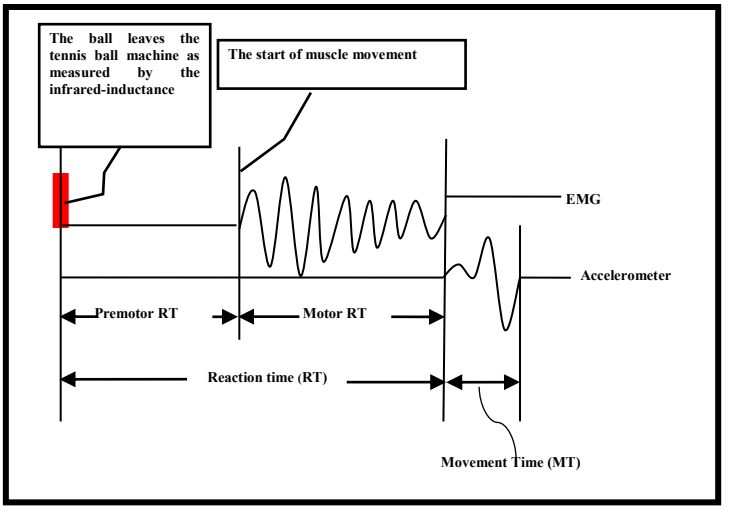

Fig. 1. Reaction Time, Premotor RT, Motor RT, Movement Time (Adopted from Y. F. Lin, 1999, P59)

3. Method

1. Experimental Blueprint: This experiment examines the relationship between the stimulus-response compatibility and reaction times, as well as the stimulus-response compatibility and movement times, of primary school soft tennis athletes. These are measured through the fast and slow balls that leaves the tennis-ball machine, as shown in Figure 2.

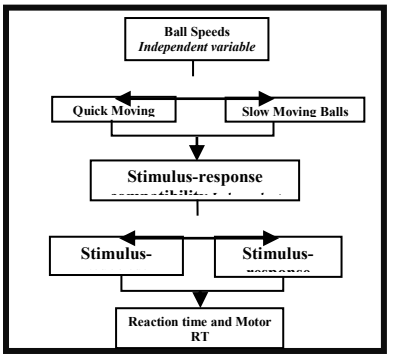

Fig. 2. Experimental Blueprint

2. Experiment: In this research, independent variable A refers to the quick and slow moving balls (ball velocity), and independent variable B refers to stimulus-response (in)compatibility. We examined each participant's stimulus-response compatibility from the perspective of each of the dependent variables: Premotor RT, Motor RT, RT, and MT, under the two different ball speeds. This was done using 2-way ANOVA.
3. Sample Population: This experiment examined a total of 37 right-handed soft-tennis athletes between the ages 9.5 and 11.48, the heights 133.37 and 151.05 cm, and weights 30.03 and 45.45 kg. These participants are from Taiwan Kaohsiung Cishan-Gushan Elementary School and Pingtung Linluo Elementary School. They were all informed and read the research purpose with parental agreement.

4. Equipment

a. Equipment: 1 LabVIEW Analog Signal Adaptor, 1 Accelerometer, 1 Racquet, 4 Sets of Electrodes, 1 Electro diagnostic Machine, 2 Ball Machines, 100 Soft-tennis Balls, infrared-inductance, 1 Digital Camera, 1 Computer.

b. Procedure:

i. First, we mounted the accelerometer on the soft tennis racquet. Then we connected it with an electro diagnostic machine to the analogy signal adaptor, and obtained the data from the computer using the software LabVIEW.
ii. Second, we mounted the infrared-inductance at the mouth of the tennis-ball machine, where the balls leave the machine. Then we connected it with an electro diagnostic machine to the analogue signal adaptor and obtained the time the ball left the tennis-ball machine using the computer and the software LabVIEW. This time was used as the start of the stimulus.
iii. To prevent the players from anticipating the stimulus, we covered the start button of the tennis-ball machine with a blanket.
iv. We connected the sets of electrodes from the electro diagnostic machine to the player's right brachial deltoid and hamstrings. We then connected the wires of these receptors to the analogue signal adaptor and the power adaptor, which transferred the data to the computer's LabVIEW software.
v. Lastly, we transformed the data in LabVIEW, which was in the form of signals, to numbers that could be analysed.

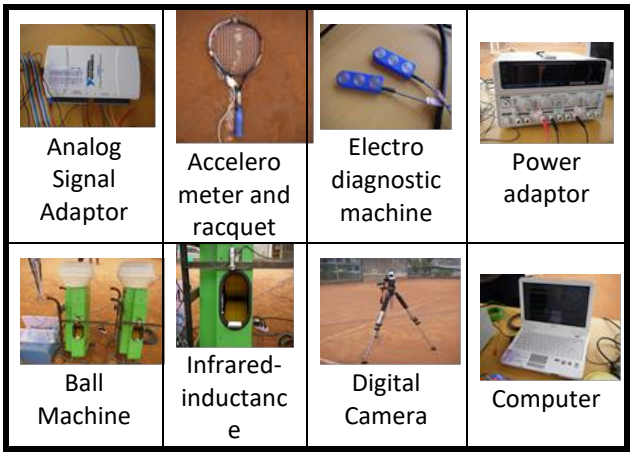

Fig. 3. Equipment

5. Data Organization and Analysis

a. Data Organization

i. As implied above, this experiment uses the software LabVIEW to collect data.

ii. This experiment compares the stimulus-response compatibilities of primary school soft tennis athletes. It does this by obtaining the reaction and movement times for each player under situations of different stimulus-responses and ball velocities.

b. Data Analysis

i. This experiment statistically analyses and compares the collected data using SPSS.14.

ii. These methodologies are appropriate for our hypothesis. Our independent variables are different ball velocities and stimulus-response compatibilities, and our dependent variables are each player's premotor RT, motor RT, reaction time, and movement times. We tested their relationships with 2-way ANOVA at 95% statistical significance ($\alpha = .05$).

4. RESULTS

This experiment obtains the effects of stimulus-response compatibility on primary school soft tennis athletes' RT, premotor RT, motor RT, and movement times. This is done with an accelerometer and EMG using the LabVIEW software, with the electromyography at a frequency of 10000 Hz. The SPSS.14 software performs the statistical analysis using 2-way ANOVA.

Table 1. The Effects of Ball Velocities and Stimulus-Reactor Compatibility on Premotor RT, Motor RT, Reaction Time, Movement Time

Independent Variables	Ball Velocity (A)	Slow-moving Balls (a1)		Quick-moving Balls (a2)		
Dependent Variables	Stimulus-Respond Compatibility (B)	Compatible (b1)	Not compatible (b2)	Compatible (b1)	Not compatible (b2)	Total
Reaction Time	M	574.54	552.32	385.97	387.24	475.0
	SD	67.75	61.5	76.53	104.88	102.4
Premotor RT	M	416.7	393.97	261.24	241.92	328.4
	SD	72.43	70.01	54.54	76.03	89.60
Motor RT	M	150.54	152.22	117.16	139	139.7
	SD	62.25	46.11	43.26	69.17	16.15
Movement Time	M	155.32	156.35	156.78	168.43	159.2
	SD	53.65	53.21	63.93	53.55	6.17

Unit: ms: n=37

Table 2. The Effects of Different Ball Velocities on Premotor RT, Motor RT, Reaction Time, Movement Time

	Independent Variables			
Dependent Variables		Slow-moving Balls (a1)	Quick-moving Balls (a2)	Total
Reaction Time	M	563.43	386.61	475.02
	SD	65.22	91.81	78.51
Premotor RT	M	405.33	251.58	328.45
	SD	71.66	66.43	69.045
Motor RT	M	151.38	128.08	139.73
	SD	54.41	58.33	56.37
Movement Time	M	155.83	162.6	159.215
	SD	53.07	58.32	55.695

Unit: ms: n=37

Table 3. The Effects of Stimulus-Reactor Compatibility on Premotor RT, Motor RT, Reaction Time, Movement Time

		Compatible (b1)	Incompatible (b2)	Total
Reaction Time	M	480.25	469.78	475.01
	SD	119.00	119.15	119.07
Premotor RT	M	338.97	317.94	328.45
	SD	100.89	105.48	103.18
Motor RT	M	133.85	145.60	139.72
	SD	55.82	58.76	57.29
Movement Time	M	156.05	162.39	159.22
	SD	58.08	53.35	55.71

Unit: ms: n=37

I. The effects of different ball velocities and stimulus-response compatibilities on reaction times

Table 4. Analysis of Variance of Reaction Time

Source	SS	df	MS	F
Sample population (S)	427.08	36	11.86	
Ball velocity (A)	1156.87	1	1156.87	463.67*
S*A	317.37	36	8.82	
Stimulus-response compatibility (B)	4.06	1	4.06	1.63
S*B	73.99	36	2.05	
Interaction (A*B)	5.1	1	5.1	2.05
S*A*B	89.82	36	2.5	
Total	2074.31	147		

*P < .05

As seen in Table 4, the interaction effects of ball velocity and stimulus-response compatibility on reaction times are not statistically significant. This means that there is no evidence of relationship between the interaction of ball velocity, stimulus-response compatibility, and reaction times. However, there is statistical significance between the ball velocity and reaction time (F=463.67, p<0.05), which means that different ball speeds result in different reaction times. On the other hand, there is no statistical significance between stimulus-response compatibility and reaction time (F=1.63, P>0.05), so there is no statistical evidence that different stimulus-response compatibility do not result in different reaction times.

A discussion on the statistical significance of the effects of ball velocities on reaction time: as seen in Table 2, the reaction times under quick-moving balls (386.61 ms) are faster than the reaction time under slow-moving balls (563.43 ms). This result is consistent with Z. G. Liu (2001)'s conclusion that athletes facing quick-moving balls react more quickly than athletes facing slow-moving balls. This shows that the speed of incoming balls influences reaction rates. Reaction time refers to the time between when the participant receives the stimulus and prepares to volley. The quicker the ball, the quicker the participant prepares to volley. Therefore, the reaction time in response to quick-moving balls is faster than that in response to slow-moving balls. Based on this information, ball velocity influences the volley reaction times of primary school soft tennis athletes. From Schmidt's (1988) perspective of the three stages for neural processing of information for motor output, the instant the balls leave the tennis-ball machine, participants use their five-senses to convert the stimulus into nerve signals. These signals travel to the brain (stimulus identification). The players then use previous experience to determine whether to perform a forehand or backhand volley (response selection). Then the muscles respond and perform the best volleying action (response programming). Because of long-term training, the participants have already developed muscle memory, so they automatically respond using their previously

learned skills when the ball leaves the tennis-ball machine. Therefore, the participants are able to react appropriately to different ball velocities. This is consistent with Henry Holt's (1983) principles of memory.

Reaction times consist of premotor RT and motor RT. The effects of ball velocity on reaction times are statistically significant because the effects of ball velocity on premotor RT are also statistically significant. Through this, we understand the factors that influence reaction time; besides the factors already mentioned by Magill (2007) and Y. F. Lin (1995, 1996), etc. the premotor RT is also a factor. This is because premotor RT influences reaction time due to the athlete's visual judgement, individual decisions, neural network conduction, and the starting point of muscle movement.

II. How the differences in ball velocity and Stimulus-response compatibility (S-R) influence Premotor RT and Motor RT.

Table 5. Analysis of Variance of Premotor RT

Source	SS	df	MS	F
Sample population(S)	378.91	36	10.78	
Ball velocity (A)	874.72	1	874.72	698.8*
S*A	186	36	5.16	
Stimulus-response compatibility (B)	16.36	1	16.36	13.07*
S*B	61.6	36	1.71	
Interaction (A*B)	0.1	1	0.1	0.09
S*A*B	45.06	36	1.25	
Total	1571.75	147		

*P < .05

From Table 5, we can see that the interaction effects of ball velocity and stimulus-response compatibility on Premotor RT are not statistically significant (F=0.09, P>.05), indicating that the interaction of the ball's velocity (A) and its stimulus-response compatibility (B) does not affect the Premotor RT. However, effect of the ball velocity on premotor RT is statistically significant (F = 698.80, P < .05), which means that there is a significant difference between the influence of fast and slow balls on premotor RT. Likewise, when the effect of stimulus-response compatibility on premotor RT is statistically significant, (F = 13.07, P < .05), so there is a significant difference between the effects of Stimulus-Reactor Compatibility on Premotor RT.

A discussion on the statistical significance of the effects of ball velocities on premotor RT: according to Table 2, the premotor RT under quick-moving balls (251.58 ms) is faster than the premotor RT under slow-moving balls (405.33 ms). This is because participants wait for slow-moving balls, which delay the starting time of muscle movement. Also, with quick-moving balls, participants advance the starting time of muscle movement. These movements are determined by the direction,

speed, height, and distance of the stimulus. In addition, they result after the brain makes a decision and transmit the signals to the muscles, and the muscles contract to perform that movement. This is consistent with Schmidt's (1988) perspective of the three stages that humans use to process information: stimulus identification, response selection, and response programming. Primary school athletes advance the starting time of muscle movement in response to quick-moving balls, while delaying the starting time in response to slow-moving balls. This is because premotor RT influences reaction time due to the athlete's received visual stimulus, individual decisions, the pathways in the nervous system, and the starting point of muscle movement.

A discussion on the statistical significance of the effects of stimulus-response compatibility on premotor RT: as Table 3 shows, premotor RT under the lack of stimulus-response compatibility (317.94 ms) is faster than that under stimulus-response compatibility (338.97 ms). This is because under lack of stimulus-response compatibility (backhand volley), the athlete is more afraid of not being able to rebound the ball, advancing the starting time of muscle movement. On the other hand, under stimulus-response compatibility (forehand volley), the athlete is more confident in their ability to volley the ball, delaying the starting time of muscle movement, thus explaining the difference in premotor RT.

Table 6. Analysis of Variance of Motor RT

Source	SS	df	MS	F
Sample population (S)	157.39	36	4.37	
Ball velocity (A)	20.08	1	20.08	10.4*
S*A	180.42	36	5.01	
Stimulus-response compatibility (B)	5.11	1	5.11	2.65
S*B	48.28	36	1.34	
Interaction (A*B)	3.76	1	3.76	1.95
S*A*B	69.54	36	1.93	
Total	484.6	147		

*P < .05

According to Table 6, the interaction effects of ball velocities and stimulus-response compatibilities on motor RT are not statistically significant (F=1.95, P>0.05). This means that there is no relationship between the interaction of ball velocity and stimulus-response compatibility and motor RT. However, the effect of ball velocity on motor RT is statistically significant (F=10.40, p<0.05), which means that the differences in ball velocity produce differences in motor RT. Yet there is no statistical significance between stimulus-response compatibility and motor RT (F=2.65, P>0.05), which means that the existence of stimulus-response compatibility does not produce a difference in motor RT.

A discussion on the statistical significance of the efforts of ball velocity on motor RT: Table 2 shows that motor RT is faster with quick-moving balls (128.08 ms) than

slow-moving balls (151.38 ms). This is because primary school athletes will immediately start volleying as soon as they receive the stimulus and contract their muscles. The quicker the ball velocity, the earlier the muscle contraction, which results in earlier preparation to volley. Therefore, motor RT is faster with quick-moving balls than slow-moving balls.

III. The effects of ball velocity and stimulus-response compatibility on movement time.

Table7. Analysis of Variance of Movement Time

Source	SS	df	MS	F
Sample population (S)	188.92	36	5.25	
Ball velocity (A)	1.7	1	1.7	3.04
S*A	217.54	36	6.04	
Stimulus-response compatibility (B)	1.49	1	1.49	2.67
S*B	24.86	36	0.69	
Interaction (A*B)	1.04	1	1.04	1.87
S*A*B	20.02	36	0.56	

* $p <$ .05

According to Table 7, the interaction effects of ball velocity and stimulus-response compatibility on movement time are not statistically significant (=1.87, P>0.05), which means that there is no statistical evidence for interaction effects between ball velocity and stimulus-response compatibility on movement time. The effects of ball velocity on movement time is also not statistically significant (F=3.04, P>0.05), as with the effects of stimulus-response compatibility on movement time (F=2.67, P>0.05). This means that there are no significant differences in movement times under different ball velocities, as well as under whether or not there is stimulus-response compatibility. Because athletes receive training for volleying, they are able to consistently react to the ball, so the ball velocity and stimulus-response compatibility have no influence on the movement time.

5. CONCLUSIONS AND SUGGESTIONS

I. Conclusion

a. Differences in ball velocity and the existence of stimulus-response compatibility has no direct influence on reaction time, Premotor RT, Motor RT and movement time.

b. There is statistical significance on the effects of ball velocity on RT, Premotor RT, Motor RT, but not on movement time. Under different ball velocities, there is statistical significance (p<0.05) that reaction time is faster under the effects of quick-moving balls than slow-moving ones. This is because primary school soft tennis athletes will volley quicker when the ball velocity is faster, advancing the start of muscle movement. Also, there is statistical significance (p<0.05) that premotor RT is

faster under the effects of quick-moving balls than slow-moving ones, because primary school soft tennis athletes wait to volley when the ball velocity is slower, delaying the start of muscle movement.

c. Under different ball velocities, there is statistical significance (p<0.05) that the motor RT caused by quick-moving balls is faster than that caused by slow-moving balls. This is because primary school soft tennis athletes will immediately start volleying as soon as they receive the stimulus and contract their muscles. The quicker the ball velocity, the earlier the muscles contraction, which results in earlier preparation to volley. Thus we see that ball velocity affects the volleying capabilities of primary school soft tennis athletes mainly through their reaction times, premotor RT, motor RT.

d. There is statistical significance on the effects of stimulus-response compatibility on premotor RT, but not on reaction time, motor RT, and movement time. There is statistical significance that premotor RT is faster with backhand volleys (lack of stimulus-response compatibility) than with forehand ones (stimulus-response compatibility). This is because with backhand volleys (lack of stimulus-response compatibility), the athlete is more afraid of not being able to rebound the ball, and will advance the starting time of muscle movement. On the other hand, under stimulus-response compatibility (forehand volley), the athlete is more confident in their ability to volley the ball, thus delaying the starting time of muscle movement.

II. Suggestions

a. This section concludes the research and provides suggestions for further studies in regards to future experiments and the training process of athletes.

b. Athletes' personal factors (Visual judgment, neural network conduction, muscle activity) affect their premotor RT. These can be improved through training. This research shows that premotor RT and motor RT affect the reaction speed. Since athletes need to respond to balls attacking from different directions, soft-tennis active defenses heavily rely on the athletes' respond speed and motion time. If the coach knows each individual athlete's ability to respond and adjusts their positions (defensive, offensive) accordingly, it benefits the team and increases the probabilities of scoring the game.

c. Although this research focuses on primary school soft-tennis athletes, we did not factor in the athletes' grade levels. Thus, the research data does not reflect the differences caused by the length of athletes' training. A future studies should also factor in age and grade level.

There are only limited research and experiments related to the primary school athletes. Yet talented athletes are often discovered from this group. In order to enhance the standard of the athletes in this nation, we wish to have more studies done regarding the primary school athletes in the future, to further provide coaches with references for training.

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Relationship between USA Table Tennis Ratings and Technical Features Among Intermediate Players

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Abstract: The skill levels of table tennis players in the United States (US) are represented by standardized USA Table Tennis (USATT) ratings. A player may increase or decrease their rating after winning or losing matches respectively at sanctioned tournaments. However, a lack of research on USATT ratings in relation to technical features makes it difficult to prioritize specific training across levels. The primary purpose of this study was to examine the relationship between skill levels and technical features, categorized into types of serve, receive, third-ball attack, and rally. Their techniques during the first 30 points (15 serves and 15 receives) of a match were observed and analysed. A one-way ANOVA and post-hoc comparisons were conducted to investigate any significant difference ($p < .05$) among the six rating levels. The results showed that for serve and receive, there were significant differences in the frequency of short serve, receive with push, receive with loop overall, and receive with forehand loop. For third-ball attack, there were significant differences in the frequency of forehand loop, backhand loop, loop overall, forehand overall, backhand overall, and the total number of attacks. For rally, there were significant differences in the frequency of forehand drive, forehand block, backhand push, and push overall. Particularly, higher level players used these attacking techniques more frequently. The results suggest lower-level players focus on receive and third-ball attack with loop in individualized training plans that match with their level.

Keywords: USATT rating, skill analysis, match analysis, coaching

1. INTRODUCTION

Player rating has an important role in the table tennis world. It is not only one of the most important tools for measuring skill levels, but it also allows players to assess their training effectiveness as objectively as possible. The USA Table Tennis (USATT) rating system was designed to handle the rating features of table tennis tournaments in the United States (Marcus, 2001). All registered players have a rating, and further gain or lose points by winning or losing matches, respectively, in USATT-sanctioned tournaments. This rating system allows objective comparisons within and between players. For instance, a 2000-rated player is more skilful than a 1500-rated

player. According to the current data from USATT (2014), there are 7604 active registered players in the U.S., and the majority falls into the rating range of 881 to 1898 points (*M* = 1435). Tournament events are typically organized according to rating ranges. For example, an "Under 1800" event is only open to players whose rating is below 1800, and does not accept registration from ratings above 1800. Advanced players with ratings above 2200 usually have much better skill sets than intermediate players.

In China, a premier table tennis country, a table tennis belt system was used until 2012 (Xi et al., 2013). This system had 9-level "belts" similar to taekwondo belt systems where each level is not measured by performance in competition but by coaches' evaluations of the players' skill. This was not objective enough to measure the difference in skill levels. Since 2012, China has employed a new table tennis rating system by following the USATT rating system (The Chinese Table Tennis Belt System, 2012). Around 30,000 Chinese table tennis members currently have a rating in the system. Based on the USATT and Chinese rating systems, it is important to understand the differences in technical features across rating ranges in order to help intermediate players improve to the next level.

From motor learning literature, we understand that novices usually rely on attention from coaches to guide their learning in a step-by-step fashion. According to Fitts and Posner (1967), there are three stages in learning motor skills: the cognitive stage, the associative stage, and the autonomous stage. Beginners focus on what to do and how to do it during the cognitive stage. Performance during this stage is inconsistent, and beginners may not know what they need to do to improve it. The cognitive activity is different at the associative stage, where the players try to understand and apply specific environmental cues to execute skills successfully. Moreover, fewer errors are made. At the final autonomous stage, skill execution is automatic and consistent, and the player can be considered to be at an advanced level. Although the performance across stages is clear, limited research is available on how playing styles change through different stages.

According to Coach Hodges (2010), a "level" in table tennis ranges from about 300 points at the lower levels (under 1000 or so), to about 100 points at the higher levels (over 2500 or so). For most USATT members, a level would be about 200 rating points. However, no studies have examined the differences in technical features among players of different rating ranges. Although a rating suggests an overall skill level, it does not specify the differences in technical features are. Therefore, this study aimed to examine the relationship between players' levels and their technique usage. In this study, we separate the player levels into 200 rating-point increments.

2. METHODS

2.1 Participants

Participants were 84 USATT members with a rating between 1000 and 2200, divided into six rating levels of 200 points apart (e.g. 1400-1600). Most participants have an aggressive playing style.

2.2 Procedure

Matches are selected from 75 YouTube videos and four videos taken by participating players. All matches were played in the format of best of five. According to the experience and expertise of the four authors as high-level table tennis athletes and/or professional coaches, we agreed to observe players for the first 30 points (15 points serving and 15 receiving serve) of each participant in a match in order to evaluate the technical features. The first 30 points started with the first point of the match and ended around the middle or the end of the second game. Each stroke was then categorized into the following techniques, including serve (long serve, short serve, mid-length serve and fault), first receive stroke (loop, push, drive, flip, and receive miss), third-ball attack (loop and smash) and rally (push, flip, drive, loop, block, and smash). These techniques were grouped both dependend and independent of forehand and backhand technique (e.g., receive with backhand push, third-ball attack with forehand loop) so that different patterns can be analysed.

McAfee (2009) states in his "Using the Five-Ball Training System" that 80 percent of all points in table tennis end by the fifth stroke. Even if the point continues past the fifth stroke, one player usually is in a winning position at the fifth stroke. These five balls are first ball: serve, second ball: receive, third-ball: first attack for server, fourth ball: first defensive stroke or counterattack for receiver, fifth ball: second attack for server. Inspired by McAfee, we picked four elements for our technical measurement, including serve, first receive stroke, third-ball attack, and rally.

2.3 The observation standard of each technique

Serve

As an important technique in table tennis, serve is the only technique that players can fully control (Li, 2006). In this study, the serve segment will only be divided into long serve, short serve, mid-length serve, and fault. Long serve (P1) bounce once past the middle of the opponent's side and then goes well off the table. Mid-length (P2) serve are similar but they bounce once before the middle of the opponent's side and then barely go off the table. Short serve (P3) bounce at least twice on the opponent's side of the table. Fault mean the serve failed and the point was lost before the opponent hit the ball.

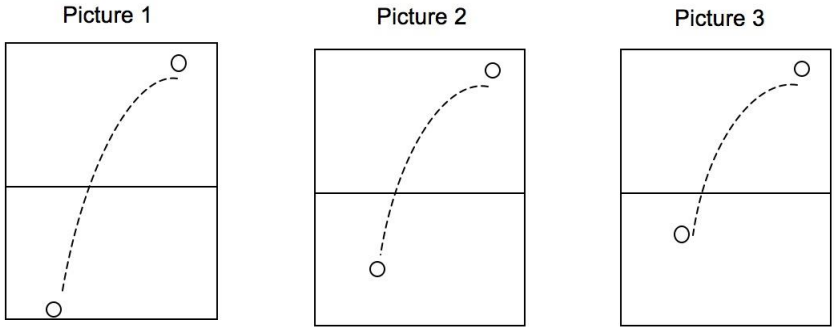

Fig. 1. Long serve (P1) vs. mid serve (P2) vs. short serve (P3)

Receive

There are 16 different receive techniques in table tennis (Yoger, 2012). Due to the limited sample size, only five common receive techniques were chosen for observation, including loop, push, drive, flip, and receive misses. A loop means the player returns a serve with heavy topspin attack; a push means the player returns a serve by generating underspin on the ball; a drive means the player returns the serve with a flat hit or a smash on the ball; receive misses mean the player fails to return the serve completely.

Third-ball attack

The third-ball attack is one of the most important and frequently-used strategies in table tennis. In order to describe players' skill sets, this study separates third-ball attack into third-ball loop and third-ball smash. A third-ball loop means the player executes the attack by creating a heavy top-spin loop, and third-ball smash means the player executes the attack by making a flat hit or a smash.

Rally

According to Tepper (2007), basic table tennis techniques include drive, push, push-short, flip, block, topspin against backspin defense, topspin-counterspin, and smash. In order to make it simpler for recording, we make a small modification. Push and push-short were treated as pushes; topspin against backspin defense and topspin-counterspin are counted as loops. A rally was counted as the stroke(s) right after a third-ball attack. However, if the server did not play a third-ball attack, then the stroke right after the serve was counted as a rally. In a rally, each stroke was observed and counted.

3. RESULTS

A one-way analysis of variance (ANOVA) was used to examine the relationships among skill levels and playing styles, represented by the frequency of technique usage (i.e., service return, third-ball attack and rally). Results indicated significant

differences across skill levels for the usage of different techniques in service return and third-ball attack, but not in rally.

Table 1 indicates the *F* statistics for all of these significant ANOVA results. The significant differences in serve were accounted for by short serves. In the first receive stroke, the significant differences were accounted for by receive with forehand loop, total loop, backhand push, and total push ($p < .05$). For third-ball attack, the significant differences were accounted for by forehand loop, total forehand, total loop, and total attacks ($p < .05$). Specifically, the higher the skill level of the players, the more frequently used are the aforementioned techniques in general. Cohen's *d* ranged from 1.28 to 2.07.

Table 1. One-way ANOVA for significant mean differences in technique usage across skill level (USATT Rating)

Skill Category	Specific Techniques	USATT Rating							
		a. U1200 (n = 9)	b. 1201-1400 (n = 22)	c. 1401-1600 (n = 19)	d. 1601-1800 (n = 10)	e. 1801-2000 (n = 16)	f. 2001-2200 (n = 8)	F (5, 78)	η^2
Serve	Short Serve	$.89_{f}$ (.56)	1.73_{f} (.37)	2.37 (.51)	1.30_{f} (.58)	3.06 (.56)	5.25_{abd} (.96)	5.36***	.26
Receive	Total Loop	3.22 (1.28)	1.41_{f} (.43)	2.00 (.48)	3.00 (.92)	3.94 (.62)	5.13_{b} (.74)	7.41**	.20
	Forehand Loop	.78 (.47)	$.73_{f}$ (.23)	$.74_{f}$ (.25)	1.00 (.39)	1.44 (.33)	2.63_{bc} (.63)	3.41**	.18
	Total Push	9.00 (1.56)	9.41 (.90)	8.42 (.87)	8.00 (.87)	5.38 (.70)	4.38 (.71)	4.05**	.21
	Backhand Push	7.11 (1.37)	7.09 (.99)	5.74 (.81)	4.80 (.84)	3.44 (.76)	2.88 (.81)	3.08*	.16
Third-Ball Attacks	Total	3.56 (.77)	2.50_{cef} (.43)	7.16_{b} (.56)	4.40 (1.04)	7.00_{b} (.79)	7.00_{b} (1.02)	9.90***	.39
	Forehand Total	2.67 (.65)	1.50_{ce} (.35)	4.68_{b} (.53)	2.50 (.72)	4.63_{b} (.59)	3.88 (.67)	6.84***	.30
	Forehand Loop	1.56 (.24)	$.91_{ce}$ (.25)	3.89_{b} (.46)	2.00 (.70)	3.56_{b} (.47)	3.13 (.61)	8.64***	.36

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. Standard deviations appear in parentheses. Means with differing subscripts $_{a, b, c, d, e, f}$ within rows are significantly different at $p < .01$ based on Scheffe post hoc paired comparisons between each two groups.

4. DISCUSSION

For serve, 2001-2200 executed more short serves than 1601-1800, 1201-1400, and U1200. The results of this study suggest that the playing style of higher-level players focuses more on the short game at the beginning of a point. More than one-third of their serves were short. It is consistent with Yang (2010), showing the world class male players mainly used short serves in combination with some mid-serves during matches. The goal of short serves is to avoid the opponent from attacking their serve and provide themselves an attacking opportunity. A previous study (Mulloy et al., 2014) found that the majority of serves bounced in the short middle zone (77.1% and 67.7% for cadet and junior, respectively) during the 2013 Asian Cadet and Junior final matches. Therefore, intermediate players should start practicing short serves if they would like to attain a higher level in the future.

For receive, 2001-2200 executed more total loop and forehand loop than 1201-1400 as well as more forehand loop than 1400-1600. More than one-third of receives among 2001-2200 players were loop, which represents an aggressive style at the beginning of a point. However, receives with loop are also dependent on whether the serve is short or long. Players receive with more loops or attacks in general if the serves are long. Since our study focused on matches of similar levels, results might be different if participants played against advanced players who have stronger ability to attack a serve. Looping is one of the best techniques for attack because looping is the main technique used by many world class players.

For third-ball attack, 2001-2200 executed more total attacks than 1201-1400. In addition, 1801-2000 and 1401-1600 executed more total attacks, total loops and forehand loops than 1201-1400. Based on these results, there is a clear distinction in the ability for third-ball attacks above 1401-1600. Thus, if lower-level players want to move up their rating beyond 1400, they should focus on the skills of and style of using third-ball attacks, especially forehand loop. The higher the level of the player was, the more forehand loops in third-ball attack were used. Forehand loop is the main weapon to win points for world-class male players, because forehand loop is higher in both frequency and effectiveness than backhand loop (Yang, 2010).

Although U1200 was supposed to be the group with the lowest attacking ability, there were not many significant differences found. One reason could be that these players may have just started learning basic techniques. They may not be able to understand the relationship between skill level and accuracy since table tennis is an externally-paced, repetitive task instead of a self-paced task. Koedijker et al. (2010) did an experiment in table tennis on both novices and experts to examine the impacts of instruction and the speed of balls on their accuracy. When preparation time was longer, the accuracy of novices improved, whereas that of experts reduced. Beginners may not have enough time to think about what specific techniques to use and just attack aimlessly in fast-paced matches. From our observation, some novice players would have a mindset of attacking every ball even if they are not consistent.

In motor learning research, differences in cognitive processes among skill levels have been shown consistently. Bernstein (1996) proposed that attaining

automaticity is only one of the first steps in achieving expertise, followed by the parallel processes of standardization and stabilization. Standardization of automatic movement involves the acquisition of extraordinarily accurate repetitive movement execution, and is prominent in skill improvement. Stabilization of automatic movement is the process of acquiring resistance of performance to disruptive influences, such as increased temporal demands. Further practice can help lower-level players accomplish these steps effectively, especially through implicit learning techniques (Masters, Poolton, Maxwell, & Raab, 2008).

Based on this study, we have some suggestions for coaches who have players of different ratings. Coaches of lower-rated intermediate players may incorporate Play Practice (PP; Launder, 2001) instruction on table tennis lessons. Play Practice was shown more effective in teaching serve and forehand attack since target challenges were used to encourage placement of the ball (Zhang, Ward, Li, Sutherland, & Goodway, 2012). When working with lower-level players, the instruction should emphasize learning the skills and then have them refine and perform more efficiently. Wu (2005) suggested five characteristics of training ideologies. One of them was to emphasize uncertainty in training. Otherwise, players may only have good performance in training but not in tournament. In addition, video replays are effective feedback for lower-level players to understand their errors and learn information about how to correct errors and change their playing styles.

5. CONCLUSION

This study suggests that there are relationships between a player's rating and the technical features he/she employs during play in some but not all cases. There were no relationships between the two variables across some groups due to similar stages of motor learning. Ratings above 2000 appears to be the dividing line of players' technical features by having more significant differences with other groups. The players rated less than 2000 did not appear too much different in their technical features except for third-ball attack, which is one of the most important skills to gain at the intermediate level. Although this study did not find out why rating mattered for the technical features, it made a significant contribution as the first study in the U.S. investigating the rating concept. Since this was only an exploratory study, future studies are needed to find out more in-depth relationships and mechanisms among USATT ratings and techniques with a larger sample size. Different demographic factors, such as age, race/ethnicity, and gender, can be compared to enhance learning and coaching strategies for individual players.

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A Qualitative Research of the Career Development of Elite Female Table Tennis Players in Taiwan

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Abstract: The aim of this research was to probe into the career development of elite female table tennis players in Taiwan by examining how seven athletes from different generations and occupations developed, planned, and changed their careers, so as to understand career development variances for respective table tennis athletes as time progressed and social context altered, consequently using the thought process and conclusions of this study to come up with recommendations for athletes and related parties. The seven participants of this study were from different generations with different jobs. They have all represented the Chinese Taipei Table Tennis Team for a number of times. This qualitative study conducted in-depth interviews to collect data with which and to present the following conclusions: Taking into consideration the participants' initiation to table tennis, support from significant others and their sporting experiences, it was the uniqueness of the sport and the athlete's personal experiences that inspired and shaped the career developments of the participants. Regarding career planning, it was corporate financial support, university options and other personal issues that affected the participants' choices and decisions. One thing to note was that most of the participants of the research did not have thorough career plans made when they were professional athletes. As for the timing of career transition, the reasons included weariness towards competitions, graduation, financial issues, and age limitations. The lifestyles after career transitions and how participants adjusted to changes also greatly differed. Recommendations were made following the conclusion of the study for related parties, institutions and towards further developments.

Keywords: career development, career planning, career transition

1. INTRODUCTION

Background

Many elite athletes spend immense amounts of time on training and fail to invest time and effort on their studies and on developing other skills, resulting in the lacking of sufficient prospective career research and preparations in the course of their school years. All of this directly affected their capacity for making a living in a diverse environment after retirement (Chen, 1997; Yeh, 2002). On the other hand,

many elite athletes also accumulated successful experiences during their athletic career and such experiences were transformed to strengths that could be used in overcoming other issues that they face in life later on (Chen, 2009; Cheng, 2009; Hsieh, 2001). Career development is a lifelong journey (Lin, 1987). Related issues included career planning, career transition, career guidance, career management, career barriers, etc. Li (2007) and Lee (2006) conducted separate studies on junior/senior high schools and university first division table tennis players. They found that female players came across more barriers in their athletic career and were more passive when it came to prospective career research as compared to male players. The aforementioned studies were carried out using the quantitative method on one age group and thus could not generalize to those from different generations nor could the reasons that led to the differences be discussed in depth, therefore this study used the qualitative method to probe into elite female athletes from different generations with hopes of addressing previously unanswered questions.

The course of career development mentioned herein referred to elite female players' experiences and frame of mind on various levels starting from the beginning of the their table tennis career to their professional lives.

Purpose of the study

1. To understand the course of career development for elite female table tennis players.
2. To understand elite female table tennis players' career planning.
3. To understand elite female table tennis players' career transitions.

2. METHOD

Participants

This research adopted purposive sampling to select seven national female table tennis players from different generations and different vocations as research participants. The participants' age, education and current profession are shown in Table 1.

Table 1. The background of participants

#	Age	Education	Current Profession
A	76	Junior High	Table Tennis Club Owner
B	45	Open University	Private corporation
C	45	Open University	Public company to private
D	43	Vocational High	Public bank to private
E	41	Grad School (PhD)	University teacher
F	33	Grad School (MA)	Junior high teacher
G	26	Grad School (MA)	Coach

Data Collection

1. Newspaper

Information obtained from old newspapers helped the author to better understand the participants' professional achievements and appraise from the time and environment in which the events took place. Such information was used as supporting evidence during the interviews with the participants. "Table tennis" and "Participants' names" were the key words used in the National Library's "Instant Search on Newspaper Title Index and Scanned Articles Database" and in "UDN Data" for United Daily News, Min Sheng Bao and China Times.

2. Interview

In-depth interviews were conducted following expert reviews according to the interview outline indicated in the study purpose. Interview questions covered: 1. Background information – Family upbringing, initiation and motive of playing table tennis, family support, etc. 2. Career development – Various stages of sporting experiences, ups and downs of playing table tennis, etc. 3.Career planning – Timing, aims, planning factors, etc. 4. Career transition – Timing and reason, course of transition, life after transition, etc.

Data Analysis

This study adopted thematic analysis, conducted in the following order: (1) Transcription of the verbatim. (2) Reading through the whole transcription. (3) Discovering the incident and contextual framing. (4) Rereading the article. (5) Analysis of the structure of implications and experience reconstruction. (6) Confirming common themes and reflections. (7) Verification and explanation by the theme.

Credibility

Triangulation – including examination of different sources of information such as interviews and newspapers – was conducted via member checks and peer examination by the researcher and team members to increase the level of credibility of this research. All members of the team had received qualitative research training and have had related research experience beforehand.

RESULTS AND DISCUSSION

The term "career development" mentioned in this study refers to the participants' experience and reflections during the process of initiating, training, competitions, retirement from table tennis and transition to other career. The results are shown as Figure 1.

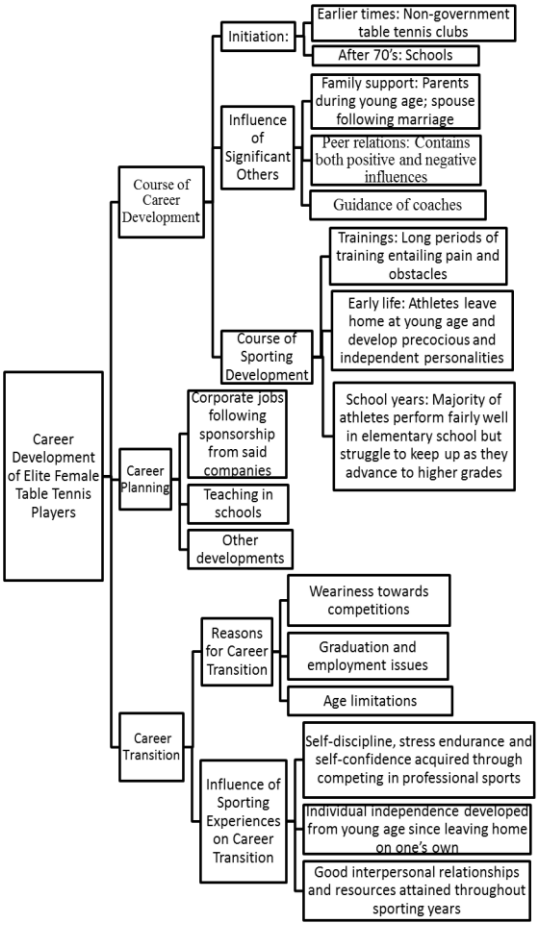

Fig. 1. Career development of elite female table tennis players.

Course of Career Development

1. Initiation

Participant A started from the local Table Tennis Committee, which is similar to a non-government table tennis club. After the 1970s, table tennis players were all initiated at school during the second or third grade. Lee (2006) pointed out that it was common for athletes from the 1950s to 1960s to be initiated at table tennis clubs, examples including Chen Pao Pei and Liu Ciou Zih whose families owned table tennis clubs. Under the political and economic background at the time, only those from wealthier families had the opportunity to play table tennis.

2. Influence of Significant Others

For the participants of this research, family support prior to marriage was the most important moral support for them on the course of their sporting career. Participant G came from a single-parent family and was cheered on by her mother and two brothers along the way to playing professionally. They were also the biggest strength that spurred her to pull through times of hardship and not give in to defeat. Those who could still participate in the sport after marriage considered the spouse's support to be of highest importance. Participant D had two children but continued to join national try-outs because her husband encouraged her to hold on to her passion for the sport. Taiwan United Daily News (1994) reported that she (participant D) "was a national athlete for many years and her husband backed her up during all of her matches. He cheered for her victories and was there to provide solid support and comfort at times of defeat." On the other hand, poor relationships with peers was a major element for early retirement, and it was because of this that participant B backed out from the sport early in her sporting career. Hsieh (2001) believed that many different reasons contributed to athletes' decisions, with parents being the most crucial factor. Interpersonal relationships and the guidance of coaches were also key elements towards the development of female players.

3. Course of Sporting Development

Athletes were subjected to long hours of training, pain endurance and many frustrations, yet they carried on due to their strong desire to compete and to win. They left home at a young age and develop precocious and independent personalities. Most of them performed fairly well in elementary school but as they progress into junior high, the amount of school work, training, and competitions all intensify, resulting in the increasing difficulty of keeping pace with school. Chen (1997) and Cheng (2009) discovered that during the athletes' school years, they spent too much time on training and could not cope with school work at the same time. Some of the athletes experienced much inexpressible pain in the course of their school years such as loneliness, regret, verbal aggression from others, suppressed feelings, carrying on trainings and competitions when they were hurt or in pain, disruption of life routines due to suspension from competitions, etc. Memories of such events greatly affected the athletes' perspective on life.

Career Planning

Career planning for the athletes was mostly affected by career stability: (1) Corporate financial support – Higher education was uncommon in the past, especially for women. Although after 1985, many athletes had opportunities of free entrance to universities, with higher job security offered by companies after sponsorships, they would choose to give up on the opportunity to enter university for a corporate position instead. The content of the corporate jobs differed; some worked in offices, some practiced table tennis, and some turned to coaching after retirement. (2) Teaching positions – Higher education became more commonplace after 1985. Entering National Taiwan Normal University (hereinafter referred to as NTNU) to become a teacher turned into an alternative when deciding what kind of

university to attend. If an athlete chose to attend a teachers' college to train for teaching, this decision would greatly influence the athlete's process of career planning afterwards. Athletes who chose to go to university were mainly affected by social trends, concerns of university's effects on their table tennis skills, and advice from others. (3) Personal issues – Personal issues also affected the athletes' career developments. Participant A came from a wealthy family and did not have any other plans asides from playing table tennis. She was once suspended from competitions for one year due to referee confrontation at a match. During this period she spent a majority of her time on playing mah-jong and cards and even lost her savings to the games. After the end of the suspension a year later, she continued to play table tennis, became a coach, and ran a table tennis club up to now, all of these activities having to do with table tennis. Participant B decided against attending NTNU because of her coach's advice, concerns that she had to take "swimming" courses, and her "introverted personality". She had no desire to coach after retirement because of unpleasant experiences of dislike and isolation from peers due to her athletic performances outshining others. She also disliked discussing table tennis for the same reason. Stambulova (1999) found that many athletes experienced bitterness and jealousy from peers due to premature recognition by the society and how they easily stood out due to their quick rise to fame.

Career Transition

1. The Timing of Career Transition

The participants of this research retired between the age of 23~25, which is slightly earlier than male athletes. The reasons for retirement from sports varied, with the majority being: (1) Weariness towards competitions – Participant B stated that after participating in many international competitions and ultimately the Olympics, there was no higher goal to challenge herself with anymore. Participant D put a lot of effort into qualifying for the Olympics but was ultimately removed from the list because Table Tennis did not meet the country's competition entry standards at that time. This was a great blow and regret for her. (2) Graduation, employment and financial issues – Participant E and F both graduated from NTNU and continued onto teaching following teachers' training, thus ending their athletic careers after finishing school. Participant C had to juggle between work and training and after five consecutive years of poor teaching performance ratings she decided to end her sporting career. Participant G finished graduate school, changed to a new team after the old one disbanded, but was unsatisfied with the difference in values with her team, adding to that financial struggles which prompted her to change career paths. (3) Age limitations – Participant A and D had great passion for table tennis and were two of the few female national players over the age of 30. Nonetheless, due to their declining health with growing age and having to take care of both career and family life, they eventually encountered age limitations in competitive sports. Lu (1990) also pointed out that age limitations, individual motives, graduation and jobs – these mental, physical, and socio reasons – contributed to elite athletes' retirement from sports.

2. Life After Career Transition and Adjustment Issues

Upon the transition to a new role and lifestyle, the female athletes started to experience challenges of a different life and adjustment issues with the changing of career and of personal values: (1) Adjusting to "office worker" lifestyle – Three of the participants of this research stayed to work in company sport teams after retirement from competitive sports. At the beginning the work mode consisted of office work in the morning and training in the afternoon. There was no great adjustment problem for this case. (2) Adjusting to "teaching" life – Two of the participants went on to become physical education teachers after graduating from NTNU. Due to having studied in NTNU and having gone through teachers' training, plus staying in the sporting environment that they were familiar with, there was no adjustment problem for them either, not to mention that they could continue to set goals for themselves profession-wise and to plan their life. (3) Adjusting to "coaching" life – Participant D was both an office worker and a coach and although she faced some pressure from coaching, she said that "One does not grow weary if one has the heart for it." – This being precisely her case. She also had her two children play table tennis so she spent a lot of her time on the sport, hence what changed the most in her life was basically the addition of the role within a family. Participant G had only changed from playing professionally to coaching table tennis for a few months and was still trying to adjust at the time of the interview, but she noted that life was simpler and much easier as a coach than an athlete. (4) Adjusting to new roles – Participant B was a housewife for over ten years before starting afresh in the service industry. She made it through 13 hours of hard training every day and exceled at her current job. Participant E started from teaching in junior high, working though English courses, to obtaining both a master's and a doctoral degree abroad and returning to Taiwan to teach in university. Along the way she played the roles of teacher, coach, administrative staff, researcher, etc. and overcame each challenge one step at a time. It can be observed that the qualities of an athlete to overcome obstacles and their experiences from their sporting years helped all of the research participants to better adjust to major changes in their lives.

3. The Influence of Sporting Experiences on Career Transition

To conclude how the participants' sporting experiences affected the transition of roles for them: (1) Positive effects of an athlete's experiences on work attitude and work performance – When an athlete is trained to be self-disciplined, to endure pressure from unsuccessful events and frustrations and display an air of confidence, all of these turn out to be great assets for the athlete in professional fields. (2) Leaving home and learning to be independent – Many participants in this research left home during junior high and developed a more mature and independent character at an early stage of life. This positively affected their capability to plan their lives later on even if marriage problems arose. (3) Good interpersonal relationships and resources due to one's athletic experiences – When a good athlete learns to follow the coach's direction and to have team spirit, good judgment and observation skills, adding to all of this the athlete's stature, these are valuable assets

that contribute to better career opportunities as well as good interpersonal relationships.

CONCLUSIONS

Conclusions from this study regarding elite female table tennis players' career developments are as follows:

1. Course of Career Development: Athletes' initiation to table tennis varied with different generations. Significant others that influenced athletes' career development included parents, coaches, peers, and the athlete's spouse. Peer competition, on the other hand, could also be negative influence for the athlete.
2. Career Planning: Most athletes began with no concrete plan and received corporate sponsorship because of excellent sporting performance, later on going to the companies that sponsored them directly after graduating from senior high. Career stability was the main consideration for the participants when it came to planning their careers.
3. Career Transition: Major factors that affected the time of career transition included weariness towards competitions, graduation, financial problems and age limitations. Most of the participants adjusted well to the changes. It can be said that the athletes' sporting experiences had positive effects on dealing with career transitions.

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Physical Performance Assessment of University of the Philippines' Table Tennis Varsity Athletes for 2014: Basis for a Comprehensive Physical Training Program

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Abstract: The difference between success and failure in sports comes from a clear understanding and application of Sport Science. Physical fitness and motor ability tests are designed to measure the physiological attributes of an athlete. It consists of a battery of tests that closely represents the various physiological demands the athlete needs for performance enhancement in their respective sports. This is an integral part in the total development of the athlete. This study determined the "baseline data", which can serve as a basis for talent identification and improved intervention program which will eventually result to optimum performance. Twenty-two table tennis athletes (Male-12; Female-10) from the University of the Philippines were tested using a one-shot pre-experimental design. The following components and instruments were used:1) Height and Weight 2) Body fat percentage using Bio-Impedance Analysis technique 3) Joint mobility and stability Functional Movement Screen 4) Lower body strength using the Standing Long Jump 5) Agility using the Agility Run Test 6) Balance using Stork Test 7) Hand and eye coordination using Wall Bounce 8) Upper arm strength using Kneeling Ball Throw, Push up and Sit Up Test 9) Speed using the 100-Meter Dash and 10) Cardiovascular endurance using the 2.2 Km Run and 11) Hand Strength using Grip Test. Descriptive Statistics and Ranking were used to analyze the data. The results were used as a basis to determine the athlete's initial baseline as a basis for designing a comprehensive training program in order to develop their weak points. A pre and post-test, pre-experimental design is recommended to determine if there will be significant changes and improvement in their pre-test results.

Keywords: Sports Readiness Test, Physical Fitness, Motor Ability

INTRODUCTION

The difference between success and failure in sports comes from a clear understanding and application of Sport Science. Physical fitness and motor ability tests are designed to measure the physiological attributes of an athlete. It consists of a battery of tests that closely represents the various physiological demands the athlete needs for performance enhancement in their respective sports (Burton and Miller, 1998). They act as a benchmark upon which a suitable training program can be developed. In fact without an initial integrated assessment any subsequent training may only address already strong areas while neglecting the athlete's weak points. Designing a battery of tests is simply a group of fitness tests that closely

represents the various physiological demands of your sport or event. A well-designed comprehensive fitness assessment provides a variety of subjective and objective information (Clark, Lucett and Sutton, 2012)

First step is to breakdown the sport or simply an assessment of athletes into its different fitness and motor components. Each test must replicate the energy demands and the movement patterns within the sport. Walking 1 mile as quickly as possible (Rockport test) is less sport-specific than running in 20m bursts backwards and forwards (Multistage shuttle run) (Heyward, 1998).

Once the precise energy and movement demands of the sport are understood, the most appropriate physical fitness tests can be chosen. In fact the athlete or coach can even make their own test up so long as it meets the following criteria (Thomas, Nelson and Silverman, 2005):

a. Validity - Referred to as the degree to which a test actually measures what it really purports to measure; also refers more to the agreement between what the test measures and the performance, skill or behavior the test is designed to measure.
b. Reliability - refers to the consistency, of a test; the degree of consistency, and precision or accuracy that a measuring instrument demonstrates
c. Objectivity - A test has high objectivity when two or more persons can administer the same test to the same group and obtain approximately the same result
d. Administrative Feasibility - If two tests are fairly equal in validity, reliability and objectivity, the following administrative factors may determine which test you should choose:
    - Cost
    - Time
    - Ease of administration
    - Scoring
    - Norms

Table Tennis, a sport that is one of the most popular racket sport in the world today demands a great deal of physical and motor ability attributes. In the Philippines especially in inter-scholastic scene, there is no initial baseline data that can serve as a benchmark in assessing fitness and motor components that will improve the skills of a table tennis athlete through an effectively designed intervention program. This has yet to be realized in order to be at par with the other countries in terms of the level of table tennis competitions we have today.

The purpose of the study determined an initial baseline data for the University of the Philippines' Varsity Table Tennis athletes, which served as a basis for talent identification and designing a comprehensive physical training program in table tennis for optimum performance. This is in preparation for the team's participation in the most prestigious inter-scholastics table tennis competitions which is the University Athletic Association of the Philippines (UAAP) event.

The following components were measured:

1. Height and Weight
2. Body fat percentage using Bio-Impedance Analysis Technique
3. Joint mobility and stability Functional Movement Screen
4. Lower body strength using the Standing Long Jump
5. Agility using the Agility Run Test
6. Balance using Stork Test
7. Hand and eye coordination using Wall Bounce
8. Upper arm strength using Kneeling Ball Throw
9. Push-up Test
10. Sit-up Test
11. Speed using the 100-Meter Dash
12. Cardiovascular endurance using the 2.2 Km Run
13. Hand Strength using Grip Test

MATERIALS AND METHODS

A pre-experimental, one-shot case study design was used in the study. Table 1 shows the demographic profile of subjects

Table 1. Demographic Profile of Subject

	Female (N=12)		Male (N-10)	
	Mean	STDEV	Mean	STDEV
Age (years)	18.5	1.204	19.58	1.87
Height (cm)	154.85	4.72	166.08	4.05
Weight (kg.)	52.13	7.56	59.85	8.93

Participants

Twenty-two table tennis athletes (Male-10; Female-12) from the University of the Philippines were tested and the following components and instruments were used:1) Height and Weight 2) Body fat percentage using Bio-Impedance Analysis technique 3) Joint mobility and stability Functional Movement Screen 4) Lower body strength using the Standing Long Jump 5) Agility using the Agility Run Test 6) Balance using Stork Test 7) Hand and eye coordination using Wall Bounce 8) Upper arm strength using Kneeling Ball Throw 9) Push up Test 10) Sit Up Test 11) Speed using the 50-yard Sprint Test and 12) Cardiovascular endurance using the 2.2 Km Run and 13) Hand Strength using Grip Test

Measures

The components were measured using the following instrument:1) Height and Weight 2) Body fat percentage using Bio-Impedance Analysis technique 3) Joint mobility and stability Functional Movement Screen 4) Lower body strength using the Standing Long Jump 5) Agility using the Agility Run Test 6) Balance using Stork Test 7) Hand and eye coordination using Wall Bounce 8) Upper arm strength using Kneeling Ball Throw 9) Push up Test 10) Sit Up Test 11) Speed using the 50-yard Sprint Test

and 12) Cardiovascular endurance using the 2.2 Km Run and 13) Hand Strength using Grip Test

Procedures

The procedures for the testing protocols were as follows (Miller, 2005; Jackson, Morrow, and Dishman, 2005):

1. Height (cm) and Weight (kg)
2. Bio-electric impedance Analysis
3. Rest: 1 minute
4. Warm-up;
    a. 5 minute jog
    b. Lunge and reach 1x5 reps/leg
    c. Reverse lunge and twist 1x5 reps/leg
    d. Knee hug, quadstretch 1x5 reps/leg
5. Rest: 3 minutes (Explain/practice Functional Movement Screen)
6. Functional Movement Screen
7. Rest: 2 minutes
8. Kneeling Ball Throw: 2 trials, 30 sec. rest in between trials
9. Rest: 1 minute
10. Standing Long Jump: 2 trials, 30 sec. rest in between trials
11. Rest: 1 minute
12. Illinois Agility Run: 2 trials, 2 min rest in between trials
13. Rest: 2 minutes
14. Grip Test: Flying Start: 2 Trials: 30 sec rest in between trials
15. Rest: 2 minutes
16. Wall Bounce Test: 2 trials, 30 sec rest in between trials
17. Rest 1 min
18. Stork Test: 2 trials, 30 sec rest in between trials
19. Rest: 1 minute
20. Push Up Test: 2 Trials: 2 minute rest in between trials
21. Rest 2 minutes
22. Sit Up Test: 2 minute rest in between trials
23. 50-yard Sprint Test: 3 minute rest in between trials
24. Rest: 3 minutes
25. 2.2 Km. Run: 1 trial

Statistical Analysis

Descriptive statistics were used in analyzing the data (mean and standard deviation).

RESULTS

Table 2. Descriptive Statistics of the Different Test conducted for both Men and Women

Component-Test	Female		Male	
	Mean	STDEV	Mean	STDEV
Body Composition: (%)	24.9%	3.21	12.16	4.09
Upper Body Power: (Kneeling Ball Throw-cm)	256.2	32.16	465.92	65.52
Lower Leg Power (Standing Long Jump cm)	152.96	19.27	211.002	16.91
Agility:(Illinois Agility Run-sec)	21.784	1.59	19.48	1.52
Grip Test: (PSI)	R-28	R-5.35	R-55.21	R-15.57
	L-24.7	L-5.35	L-48.08	L-13.87
Strength and Endurance (Push-up – Reps)	12.8	6.63	35.08	12.87
Strength and Endurance (Push-up – Reps)	35.1	11.8	48.17	18.59
Speed (Sprint Test – sec)	11.27	3.47	9.03	0.932
Cardiovascular Endurance (2.2 Km run)	14.45	2.42	11.30	1.18
Coordination (Wall Bounce)	15.3	5.93	20.25	4.52
Balance (Stork Test)	R-36	R-20.86	R-26.6	R-19.92
	L-33.24	L-23.64	L-19.92	L-18.15
Joint Stability and Mobility (FMS)	14.1	2.25	16.08	1.98

DISCUSSION

The results shown from the tables were used as a basis to determine the athlete's initial baseline data for designing a comprehensive physical training program in order to develop their weak points. It also provided a thorough overview of assessments of both health and performance-related fitness components (Kluwer, 2014) or motor ability. Since the results can be compared to the standard norm for each test, the objective of the study is purely to come up with an initial profile for the University of the Philippines' varsity table tennis athletes and use as a guide to further improve their physiological attributes.

This is also in conjunction with the technical and psychological skills training that the table tennis players underwent in preparation for the country's premier inter-scholastics league, which is the UAAP. Though both men and women finished 1st runner-up in the recently concluded premier inter-scholastic league in 2014, more have yet to be improved based from the results of the tests. A pre and post-test, pre-experimental or pre and post-test control group true-experimental design are recommended to determine significant changes between the pre-test and post test results for each group and between post-test results.

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The Application of Game Teaching Method in Badminton Teaching in Middle School

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Abstract: According to the comprehensive and systematic investigation of the application of game teaching method in badminton teaching in middle school, and the objectively and deeply analyzing and researching on the teaching methods of badminton elective in middle school physical education, feasibility advantages in the development of game teaching method in badminton teaching in middle school are supposed to be found out. The research indicates that the game teaching method in middle school badminton class teaching can arouse students' learning enthusiasm, help students to master the basic skills and strategies, develop the students' competitive consciousness and ability to bear, improve the effect of badminton teaching. Game teaching method could adapt to the development of modern education to achieve the aims of happy learning, teaching students in accordance with their aptitude, completing the teaching goal, which provide the basis for creative teaching.

Keywords: Game teaching method; middle school; Badminton teaching; application

1. INTRODUCTION

With the popularization of badminton, it has entered PE class in middle school and becomes one of the preferred sports in physical education among middle school students. Badminton sport requires strong and exquisite technique, high speed in moving, varied skills and fierce game competition. To achieve a better grasp of badminton basic skills and improving the sport level, systematic learning and training are required.

Therefore, it is necessary to investigate the teaching method of badminton option course in PE class in middle school. In this paper, 64 eighth graders in advanced class with certain badminton sport foundation are selected as research subjects to conduct contrast experimental study. These 64 students have studied badminton for one year and have grasped the basic skills of the forehand serve, lob, and pick the ball; the mastery of technical movements of smashing and lobbing, near-net ball and the net backhand are not so skilled. Teaching programs are made based on students' current situation of the mastery of badminton technique and syllabus of badminton elective classed. On the bases of the mastery of the badminton skills and the further mastery of smash and lob technique these skills and actions can be consolidated and

enhanced Competitive teaching method can arouse students' interest to make them participate in badminton sports actively, to master the basic skills and put it into daily practice and competition to improve teaching effect.

2 SUBJECTS AND METHODS

2.1 Research subjects

The research objects are 64 students of grade 2 from badminton elective classes in Ji Mei middle school, among whom 32 students are from experimental class and the other 32 students are from comparative classes. The teaching progress, teaching hours, space equipment and other conditions of the two groups are same.

2.2 Research Methods

2.2.1 Literature

The theoretical foundations of this paper are mainly from Sports theory about competitive teaching method and from the related views of literature and materials about the application of competitive teaching method in sports.

2.2.2 Comparison teaching experiment

In teaching, the students from comparative class are taught with traditional teaching method according to conventional teaching syllabus and plan (propose teaching tasks and requirements - demonstrations - student group exercises - patrol correct - after-school summary). The students from the experimental class are taught with competitive teaching method. The whole teaching process needs 16 weeks, 32 hours, and each class is divided into 2 parts: teaching and competition, teaching for 10 minutes (propose teaching tasks and requirements - demonstrations); competition for 25 minutes (in the form of the game using packet technology practice - tour guide, if problems are found during the game, they are supposed to be corrected adjusted promptly; if students make rational use of the technique and fully grasp it during the game, they are supposed to be encouraged and praised); 5 minutes are left for teacher-student interaction after the end of the game, and teachers make targeted comments and analyses for student, and then arrange homework tasks.

2.2.3 Questionnaire

To investigate the learning results of research objects through questionnaire.128 questionnaires are distributed (64 questionnaires are before the experiment; 64 questionnaires are after the experiment), 128 valid questionnaires are collected, and the efficiency is 100%.

2.2.4 Mathematical statistics

Routine statistical processing and analysis about the relevant data obtained from questionnaires are conducted.

3 RESULTS AND ANALYSIS

3.1 Experimental results and analysis

3.1.1 Analysis of the survey results about the influence of match pedagogy on teaching influence

At the end of the experiment, questionnaires survey about the influence of match pedagogy on teaching effect race among students in the experimental group and the control group are conducted. Anonymous questionnaires are used in order to ensure maximum reliability. Statistical results can be seen from (Table 1, Table 2)

As reflected in Table1, 63% students of experimental group, have a good master of the basic techniques; 87% students are interested in badminton sports; 77% can put technical skills into good use in competition and achieve well above the assessment requirements; In the survey, we also learned that 98% students are satisfied or basically satisfied with our teaching arrangements; except for the practice inside the classroom,; 79% students keep on the weekly training. This result shows that the majority of students in the experimental group master the basic badminton technical movements and the ability to use technique and tactic, and have a certain amount of exercise capacity, and develops exercise habits. Therefore, the teaching effect is obvious.

Table1. The experimental group badminton teaching effectiveness survey statistics (n =32)

No.	The survey	Findings
1	basic concept and technical movements	A good (63%) B pass (33%) C Fail (4%)
2	degree of interest in badminton courses	An interest (87%) B generally 11%) C not (2%)
3	In addition to the extra exercise every week	A yes (79%) B no (21%)
4	teaching arrangements satisfaction	A satisfied (97%) B dissatisfied (3%)
5	during the game using the technical and tactical abilities	A good (77%) B passes (21%) C Fail (2%)

Table 2 reflects that the number of students of the control group whose mastery of the basic techniques achieve a good above level accounts for only 51%, nearly 10% students' mastery of badminton is not as good as the that in the experimental group; the number of students who have interest in badminton accounts for 68%, which is 20% less interested than the experimental group; the number of students whose ability to use the technique and tactic during the game that achieve good above assessment requirements accounts for 54%, compared with the experimental group, 23% students fail to reach good; 89% students are satisfied or basically satisfied with our teaching arrangements, which is less satisfied than the experimental group; except the class practice, only 33% students keep weekly training ,which has the maximum gap with the experimental group .

Table 2. The control group badminton teaching effectiveness survey statistics (n = 32)

No.	The survey	Findings
1	basic concept and technical movements	A good (42%) B pass (46%) C Fail (12%)
2	degree of interest in badminton courses	An interest (58%) B generally (40%) C not (2%)
3	In addition to the extra exercise every week	A yes (43%) B no (56%)
4	teaching arrangements satisfaction	A satisfied (78%) B dissatisfied (22%)
5	during the game using the technical and tactical abilities	A good (54%) B passes (38%) C Fail (8%)

Using race pedagogy teaching is in line with not only the direction of development of quality education, but also in line with the direction of education from a focus on imparting knowledge to the emphases on capacity-building, which has a positive meaning for cultivating middle school students' interest in PE and improving the quality of teaching and teaching goals[1]. According to the comparison between Table 1 and Table 2, the game pedagogy improves students' interest in learning badminton sports, and helps students to understand and to master badminton technique; it also helps to improve autonomy to participate in badminton sports and helps to develop and improve self-study ability.

3.1.2 Comparative analysis of traditional teaching and pedagogy game

"Competition approach" means: in the teaching process, in order to achieve a certain teaching purpose, to complete the task of teaching, under the teacher's control, the teacher adopt "race" game to teach.

"Traditional approach" means: in the teaching process, teachers adopt conventional teaching methods, demonstrate essential actions and then students practice or explain and practice [2]. Traditional teaching is a teacher-centered approach, with the direct aim of learning sports technique.

In badminton sports, the use of game teaching means that teachers arrange some teaching tasks, and students complete and master the technical movements in the form of "competition", while teachers instruct and correct in the process of student's race to develop communication between teachers and students to help students fully master and adopt the skills and tactics of badminton sports in the process of "competition". For example, in the exercises of strengthening the lofty ball movement, students in the experimental group are in the form of "competition": 32 people are divided into 4 groups, each group has 8 people and each side has 4 people. In the receiving party, the first person stands in midfield to fight back lofty goals using the back footwork. After hitting, the second person immediately enter the midfield to be prepared, thus everyone take turns to do it; In the same way, the first person in opponent's court serve the ball, waiting for the other one to return the ball and using the back-step to complete the lofty goals strike action. After hitting, the person return to the end of team, everyone take turns to do so. Four groups "compete" for the number of lofty goals fought back, each turn lasts for 5

minutes, and there are 3 turns in total. Teachers make comments on the results of the student game after the first competition and encourage the winner team and then comment and correct the problems appear in the game. After the review and summary, the second game starts. The teachers make summary in the end in the same way. This method can not only improve students 'skills and enhance the results of returning ball, but also enhance collaboration between the groups and improve team spirit, as well as improve students' interest in learning badminton technology in the process of competition.

In the teaching process, "game approach" can fully develop the subjectivity of students; fully mobilize students' interest and enthusiasm in badminton; and allow students to explore boldly, which embody the guiding role of teachers. "Traditional approach" emphasizes on teachers leading role in the teaching process; which means teacher teaches in a single form; and is strict with technical stratification, resulting in the limited time spent on boring, repetitive techniques practice session and a divorce between teaching and the needs of student, thus making it difficult to achieve the overall goal of the teaching curriculum.

3.1.3 Comparative analysis of students' interest

In order to understand the differences of interest in learning between the experimental and control classes before and after the experimental, we conduct a survey before and after teaching respectively (Table 3, Table 4).

The survey finds that, after nearly four months learning of badminton elective classes, students have some understanding of the badminton. The percentage of students from experimental class who choose “very much like” and “like” badminton the two items after the experiment is significantly more than that of the control class. The change of learning interest in experimental class is particularly evident, and students show great interest in the teaching form of applying game pedagogy, such as web access lofty goals and "compete" the number of lofty goals fought back. Experimental class students adopt the form of "game", and this new teaching methods meets students' curiosity, and students have some interest and freshness for web access lofty goals; at the same time students want to hit more balls back ceaselessly and win the game. This will not only improve the quality of comeback of lofty goals, but also greatly enhance the sense of competition and teamwork, which improves learning effect.

Table 3. Student interest survey (before the experiment)

Interest in badminton	very	like	generally	uninteresting	total
Experimental class	15	12	3	2	32
Percentage %	47%	38%	9%	6%	100%
Control class	12	13	3	2	32
Percentage %	38%	30%	16%	6%	100%

Table 4. Student interest survey (after the experiment)

Interest in badminton	very	like	generally	uninteresting	total
Experimental class	23	6	3	0	32
Percentage %	72%	19%	9%	0%	100%
Control class	14	14	3	1	32
Percentage %	44%	44%	9%	3%	100%

Therefore, the application of game teaching in high school badminton sports can not only change the past teaching situation in which students learn passively, but also develop the enthusiasm of most students for badminton and stimulate students' interest in school, as well as help to cultivate students' sports awareness and improve students' badminton tactics to stimulate students' interest in learning and make badminton sports popular.

3.1.4 Comparative analysis of student learning effect

The teaching time of the experimental group and the control group are the same, and the time of learning and consolidating a technical movement are also the same, both of which are three hours. In the Lofty goals exercise, the experimental group adopts the game teaching method: "compete" for the number of consecutive comeback, requiring students to rotate to receive the ball continuously; the control group adopts traditional teaching methods: after the teacher's demonstration, students practice in pairs, and teacher corrects and instructs during the process of exercise. In the combined exercise of smash, drop shot, and smash and toe lift reinforcement, the experimental group uses two-one offensive and defensive practice: the single party attack, while the two-people party stand left and right to defense. The offensive side mainly practices technology of killing and lobbing ball; the defensive two mainly exercise defensive skills of receiving, smash and toe lift. The control group uses traditional teaching methods, students practice in pairs, one person attacks while another defenses, the content of practice is same, teacher instruct and promptly corrected the errors during the practice.

The badminton elective course in high school aims to cultivate the practice ability of students, focuses on discovery, research, problem solving to help students to learn more active and to acquire knowledge and skills faster and more firmly, which can increase the level of practice [3]. Obvious difference can be seen in the teaching results in experimental group and the control group which two different teaching methods are adopted. In the same amount of time, their ability to learn and master the same degree of technical movements and the use of techniques and tactics are significantly different. Meanwhile, the experimental class's learning environment and students' enthusiasm to learn badminton is significantly higher than those of the control class. The teaching effect of game teaching methods is obviously better than that of traditional teaching in badminton elective course. Assessment of serving, lofting, smashing and lobbing of the two groups students are made at the end of the teaching. Assessment criteria: Serve, requiring students adopt a positive stand on the tee hand to make lofty goals, each makes 10

ball, the ball falls onto the area between rear service line and back court end line of counterpart's right field area score; Loft, requiring the use of two forehand grip to hit lofty goals, calculate the number of consecutive hit lofty ball smash, one person using forehand smash action, requiring the smash is over the net at the other below the waist of the other side; Lob, one serving, one hand hanging on the corner with positive action, requiring the hanging ball landed right field area from the other side of the net to extend the line to end line within 2.5 meters of the area. Assessment results show that: examination results of students from the experimental group are significantly higher than those of students in the control class (Table 5).

Table 5. Student assessment result contrast

Project	Class Type	Outstanding	Good	Pass	Unqualified
Serve 10	Experimental class	52%	34%	14%	0
	Comparative class	34%	40%	24%	2%
High ball 40	Experimental class	82%	15%	3%	0
	Comparative class	64%	28%	5%	3%
Ball 10	Experimental class	52%	35%	10%	3%
	Comparative class	33%	37%	20%	9%
Lob 10	Experimental class	32%	31%	32%	5%
	Comparative class	22%	35%	32%	11%

3.2 Analysis and discussion

3.2.1 Competition teaching stimulates students' enthusiasm

Competition teaching is a teaching method that is accomplished according to certain rules and proper amount in race conditions. It has a distinct competitive feature which matches the feisty psychological of young people. Thus it is popular with them. Every student can participate in the race, experience the pleasure of the game, enjoy the joy of sports and become the master of the class. What's more, it is a good way to adjust class atmosphere and to push the atmosphere to a climax [4], which can be reflected in the two survey: the interest in learning and assessment score questionnaire: After the experiment the percentage of students from experimental class who choose "much like" and "like" the two items is much more than that of the control class; the number of students from experimental group achieving outstanding assessment results is far more than that of control group. However, it is easy to fall into a misunderstanding by using game teaching method. Regarding the game only as a surface form is not conducive to the completion of teaching goals. Therefore, teachers should arrange the time and content of teaching game rationally, making it serve for teaching objectives.

3.2.2 Game promotes teaching students to master basic techniques and tactics

The game teaching method is interesting, innovative, changeful and diversified, because of which students' cerebral cortex is always in properly excited state. These features of game teaching also meet students' curiosity. Therefore, it makes for mastering technology, forming dynamic stereotype more quickly and improving the technical level [5]. While using the game teaching method, teachers must give

necessary instructions about basic techniques and tactics to students. They should change the game teaching environment to strengthen and improve these techniques and tactics in time, and finally apply them to the actual game. The changes of difficulty and content of exercises can change the frequency of stimulation of neurons. This can strengthen afferent impulses and ensure the mastery of new technology as well as consolidation of old technology, improving the effect of practice [6].

Ten students were randomly selected from the experimental group and the control group respectively for ten teaching games. The experimental group obtains 7 wins in 10 combats (Table 6). The results show that students in the experimental group have a significant advantage over students in the control group in match ability. Thus the game teaching method helps to improve student's technology proficiency in the game practice.

Table 6. In the experimental group and the control group competition results comparison table

Group	Single match results	Present	Score
Exp-group	10 combat 7 wins	70%	21 21 22 17 21 14 21 21 18 21
Con-group	10 combat 7 wins	70%	15 18 20 21 12 21 13 07 21 17

3.2.3 Competition teaching can cultivate students' sense of competition and psychological endurance

As the saying goes, "Life is movement." Exercise can not only enhance physical fitness and improve individual mental outlook, but also cultivate people's sentiments; relieve the stress in your life to make the body and mind get healthy development[7].The learning pressure of high school students is relatively high. Students are vulnerable to have negative emotions with the intense learning and troubles. But if students are often in depressed mood which cannot be released, they will lose motivation and confidence in learning. Then they not only fall into an endless learning loop but also prevent their future development. Applying game teaching method to badminton can cultivate the students' sense of competition and psychological endurance. Students in the experimental class make use of game teaching method throughout usual practice and game. As a result, they have not only the sense of competition, but also the mental capacity. Their normal level won't be affected by the high psychological pressure. It can be said that the process of badminton teaching and training can foster students with strong, courageous, positive, optimistic quality. Equipped with the fine quality and innovative spirit, they can stand out when stepping into the society and facing with fierce competition [8]. For example: the "game" approach is adopted by students of the experimental class in the exercise of lofty goals, they take turns to comeback lofty goals and "compete" the number of shots. Such method complies with the young students' aggressive minds. It can help improve the quality of ball back and enhance the sense of competition; in the process of taking turns to comeback lofty goals, the mutual encouragement among students can help to enhance the spirit of team work and

raise awareness of unity. The race process also practices psychological endurance, because any one of the students does not want to make mistakes in their own shoot. For the every time shooting back ball, they are under the pressure of fighting for the team's overall score Within a good environment of game teaching, students focus on sports and enjoy the race, compete and cooperate with each other, thus shifting and venting negative emotions. They enhance self-confidence while improving psychological endurance. With the good attitude and quality of self-reliance, self-improvement to deal with difficulties in learning, they will improve their self-personality development.

3.2.4 Game teaching can improve teaching effectiveness

As a teaching tool, game teaching is applicate in badminton elective course, which aims to improve students' enthusiasm in learning and practice, to meet students' curiosity and make them desire to master the basic skills and tactics, thus laying a good foundation of teaching effectiveness improvement. On that basis, teachers instruct students in learning, in order to improve the quality of teaching. In the beginner and improving stage of techniques, teacher targets to arrange a single action contest can strengthen the technical and tactical students learn, and at the same time also check the effectiveness of teaching, which is mutually beneficial [9]. As shown in Table 5, the comparison of the learning outcomes between experimental and control groups fully describes game teaching pedagogy's advantage over the traditional teaching pedagogy. Within the same amount of time to learn and master the same degree of technical movements and the use of techniques and tactics have a significant difference. The reason is that teaching methods of the experimental group is in line with students' psychology. Game teaching method has characteristics like enjoyment, novelty, variability and diversity, while meets students' curiosity so that they can actively participate in the race. Thus helping to master technique, improve the technical level and improve the quality of teaching.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusion

(1) In the process of middle school badminton teaching game, competition teaching can stimulate students' interest in learning, reinforce learning motivation, help them master the basic skills and improve their technical level.

(2) The introduction of competition teaching to middle school badminton class plays a significant promoting role in improving the comprehensive quality of students. On the meanwhile, it can meet the real needs and aspirations of students and mobilize their learning initiative and consciousness of exercise. Also, it is helpful to the cultivation of lifelong sport consciousness and the formation of physical exercise habit, which will lay a good foundation for lifelong sports.

(3)The reasonable use of competition teaching method around the teaching objectives can make students experience the intense atmosphere of competition. In

addition, it is conducive to the cultivation of competition awareness and the improvement of mental endurance.

(4) Application of competition teaching pedagogy in badminton can better stimulate students' interest and develop their awareness of lifelong exercise according to the syllabus. In this way, the students could experience the joy of learning in the process of learning the knowledge about badminton. And the classroom atmosphere will be more harmonious, thus, the classroom teaching effects will be improved.

4.2 Recommendations

(1) In the process of teaching, it is essential to make students understand the importance and necessity of using game teaching method to learn badminton, and fully mobilize the enthusiasm of students.

(2) While applying competition method in teaching the game, it is necessary to make arrangements for a certain amount of basic physical and technical and tactical exercises. Generally, the cross arrangement is adopted. As during a lesson, we, firstly, arrange a certain amount of technical and tactical exercises, which account about 20% of lesson, then teaching the game in 60% of the time, and finally re-arrange physical exercise, accounting for 20% of the class hours. This will not only enable students to master certain tactics, but also repeat practice in the game, which is more conducive to students to acquire knowledge and improve technology.

(3)While applying game teaching method, the arrangements of tactics in each class should be closely linked to the game; Also, the formation of content and rules of the game should be close to teaching skills, which will help students master and understand practical skills, thus developing appropriate teaching methods, and teaching the game should be arranged from simple to complex, from easy to difficult.

(4) To carry out the competition teaching, students should be grouped according to skill level, which not only enhance the intensity and entertainment of teaching game, but also the form a competitive incentive mechanism to catch up with others. And it can stimulate students to make progress, and promote common progress of students.

(5) At the end of the game, teachers must make timely review as well as summary and arrange after-school practice tasks aiming at students' problems arising during the competition teaching. Also, in subsequent badminton teaching practice, the exercises about their weak technique should be strengthened.

(6) Through the experiment, the use of competition teaching pedagogy in middle school badminton teaching is feasible. Therefore, it is recommended to be used in some other middle school sports. "There are methods in teaching, but the methods are different", every teacher should select the appropriate teaching methods based on specific teaching objectives, teaching content and teaching tasks.

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Effects of Paddle competition on biochemical parameters

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Abstract: Few studies have extensively reported the biochemical changes in paddle competition. The aim of this study is analyze detailed changes in twenty biochemistry test parameters before and after paddle matches. Sixteen elite female paddle players (age 29.8 ± 4.5years; height 166.5 ± 4.9cm; body weight 60.3 ± 4.3kg; BMI 20.5 ± 1.0) were studied during competitive matches. Significant changes were observed ($p < 0.05$) between the pre- and post-competition samples in some biochemical variables: glucose, urea, creatinine, uric acid, sodium, potassium, chloride, phosphorus, and magnesium, aspartate aminotransferase, creatine kinase and lactate dehydrogenase. During paddle competition protein catabolism and muscle breakdown are activated, as are reflected in serum urea and creatine kinase levels. Although it seems to not be an important contribution of fatty acids to the source of energy an imbalance in electrolyte levels occurs, due to progressive water and electrolyte loss. This may be reflected in a state of fatigue.

Keywords: Metabolism, serum electrolytes, serum enzymes, paddle.

1. INTRODUCTION

The influence of exercise on body fluid composition depends on the duration and intensity of the physical activity. Exercise may also induce changes in consistent concentration. These effects depend on the time elapsed between exercise and sample collection**.**

Exercise increases blood glucose level that stimulates insulin secretion. The arteriovenous difference in glucose concentration is increased by greater glucose tissue demand. Reduced renal blood flow may cause a slight increase in serum creatinine concentration. Competition between uric acid, lactate and products of increased tissue catabolism for renal excretion may also induce serum urate concentration to increase. Exercise causes an increase of cellular permeability that improves the serum activity of enzymes originating from skeletal muscle, such as aspartate aminotransferase, lactate dehydrogenase and creatine kinase.

Strenuous exercise may double creatine kinase activity, but the activity of enzymes with primarily liver or kidney origins is only slightly modified, although both hepatic and renal blood flow are reduced. Lipid profile is also affected by exercise.

Mild exercise produces a slight decrease in the serum cholesterol and triglyceride concentrations that may persist for several days (Bassini and Cameron, 2014).

This study has the purpose of evaluating the changes in biochemical markers before and after competition in elite female paddle players.

2 MATERIALS AND METHODS

Participants

Sixteen elite female paddle players participated in the study providing a written informed consent for their inclusion. Temperatures during the matches ranged from 14 to 27.5º C, with an average of 22.79 ± 7.52º C. Relative humidity was 42 to 58%, averaging 48.5 ± 5.12%. Players were allowed to hydrate freely during the matches. Anthropometric data are summarized in Table 1.

Table 1. Sample anthropometric data (*n* = 16)

	Range	Mean	SD
Age (yr)	20-40	29.8	±4.53
Height (cm)	155.4-173.8	166.4	±4.94
Body weight (kg)	49.6-65.8	60.2	±4.29
BMI	20.5-23.2	20.5	±1.04

Measures

Blood samples were obtained from the antecubital vein immediately before and after competition. Blood samples were analyzed 2h after the end of the match using an AU5800 auto analyzer (Beckman Coulter Inc, Fullenton, California, USA). Twenty biochemical markers were measured including: glucose (Glu), urea (Ur), creatinine (Crea), total protein (TP), albumin (Alb), sodium (Na), chloride (Cl), potassium (K), calcium (Ca), phosphorus (P), magnesium (Mg), aspartate aminotransferase (AST), alanine aminotransferase (ALT), lipase (Li), creatine kinase (CK), lactate dehydrogenase (LDH), cholesterol (Chol), HDL-cholesterol (HDL-c), triglycerides (Tg) and uric acid (UA).

Statistical analysis

All the tested variables were distributed normally (Shapiro-Wilk test). Biochemical changes among groups, pre-match and immediately post-match energy expenditure and time spent in sedentary activities were assessed by Student's two-tailed t-tests for independent samples. Bonferroni correction was applied to avoid Type I errors. The effect-size (r) was calculated for each comparison. The variables are presented as mean ± SD. The level of significance was set at $p < 0.05$. Statistical analyses were conducted using SPSS software version 20.0 (SPSS Inc., Chicago, IL, USA).

3 RESULTS

Significant changes were found for Glu, Ur and Crea levels when compared to basal serum levels before the match ($p < 0.05$). UA levels also increased ($p < 0.05$), although the improvement from the basal level is smaller.

No differences in TP and Alb levels were found during the match, although there was a slightly increase in both parameters (Table 2).

Table 2. Changes in metabolic parameters before and after the match

	Pre-match	Post-match	%Change
Glucose (mg/dL)*	89.13 ± 10.9	101.81 ± 17.2	14.2
Urea (mg/dL)*	33.50 ± 8.1	37.75 ± 9.3	12.6
Creatinine (mg/dL)*	0.78 ± 0.08	0.88 ± 0.11	13.3
Protein (g/dL)	7.23 ± 0.3	7.31 ± 0.4	1.1
Albumin (g/dL)	4.79 ± 0.3	4.84 ± 0.26	0.9
Uric Acid (mg/dL)*	3.85 ± 0.8	3.99 ± 0.86	3.7

* Statistically differences for a level significance of 0.05

All the electrolytes, except Ca, underwent significant changes in their concentrations before and after paddle competition. There was a loss of Na, K, Cl, and Mg levels, while Ca and P levels were enhanced. Ca did not change significantly (Table 3).

Table 3. Electrolytes levels before and after the competition

	Pre-match	Post-match	%Change
Na (mmol/L)*	138.94 ± 1.57	137 ± 2	-1.30
K (mmol/L)*	4.93 ± 0.23	4.41 ± 0.25	-10.65
Cl (mmol/dL)*	104 ± 1.63	102.63 ± 2.1	-1.32
Ca (mg/dL)	9.58 ± 0.21	9.59 ± 0.23	0.13
P (mg/dL)	3.45 ± 0.53	3.91 ± 0.75	13.41
Mg (mg/dL)*	1.88 ± 0.19	1.68 ± 0.19	-10.33

* Statistically differences for a level significance of 0.05

AST, CK and LDH concentrations improved immediately after the game. These changes were significant. No changes were recorded for ALT and Li after the match (Table 4).

Table 4. Serum enzyme activity before and after the match

	Pre-match	Post-match	%Change
AST (UI/L)*	20.81 ± 4.04	21.81 ± 4.69	4.81
ALT (UI/L)	15.44 ± 4.40	15.94 ± 4.16	3.24
Lipase (UI/L)	27 ± 16.16	27.56 ± 16.81	2.07
CK (UI/L)*	108.19 ± 59.41	136.13 ± 91.49	25.82
LDH (UI/L)*	171.38 ± 24.58	181.88 ± 20.11	6.13

* Statistically differences for a level significance of 0.05

Chol and Tg lowered immediately after the match. HDL-c experienced a slight increase. However, none of them showed significant differences (Table 5).

Table 5. Changes in parameters related to lipid metabolism before and after the match

	Pre-match	Post-match	%Change
Chol (mg/dL)	194.94 ± 34.8	192.56 ± 35.5	-1.22
HDL-c (mg/dL)	69.06 ± 15.14	69.38 ± 16.12	0.46
Tg (mg/dL)	98.25 ± 65.31	91.76 ± 74.70	-6.61

* Statistically differences for a level significance of 0.05

4 DISCUSSION

Few studies have extensively reported the biochemical changes that may occur in paddle competition (Pradas et al., 2015). The results of this study showed the effect of this exercise on biochemical parameters measured in elite paddle players. Moreover, our findings show that paddle significantly influences some of the tested parameters.

The main metabolic markers, such as Glu, Ur, Crea and UA increased significantly after the competition. The increase in Glu during the paddle match may depend on the haemo-concentration or activation of the fat metabolism. The purpose of the warm-up was to adjust the body to the transition from rest to exercise, and during this phase a gradual increase in the supply of energy fuel to the muscle is released, so glycogenolysis and lipolysis are activated from the catecholamines (Noakes et al., 1985). The final concentration of Ur showed a significant rise. This value is generally higher after performing prolonged and exhausting exercise, indicating an increase in the metabolism of proteins, as was the case in this study. The change in Ur level is indicative of the degree of protein breakdown, showing that a prolonged and exhausted effort was made. Blood Crea levels experimented a significant increase after the event. Interconversion of phosphocreatine and Crea is typical of the metabolic processes of muscle contraction. A proportion of the free Crea in muscle spontaneously tends to be converted into Crea. Thus, the amount of Crea produced is related to muscle mass and exercise stimulates its production. The elevation in UA levels is caused by adenonucleotides degradation. Prolonged exercise is known to increase serum uric concentration. Alb is involved in protein synthesis by the liver. Unchanged serum levels reflect that there is no damage to the anabolic functioning of hepatic cells. TP, likewise, remained unchanged (Huey-June et al., 2004).

Prolonged exercise leads to progressive water and electrolyte loss from the body as sweat is secreted to promote heat loss. K, the major intracellular cation, is important for osmosis and normal balance of water and cellular biochemical functions and suffers an important change during paddle practice. Decrease of extracellular K is characterized by muscle weakness, irritability and paralysis. Mg, the second major ion changed in our study, is involved in numerous processes that affect muscle function including oxygen uptake, energy production and electrolyte balance. There is evidence that marginal Mg deficiency impairs exercise performance and

amplifies the negative consequences of strenuous exercise (e.g. oxidative stress) (Nielsen and Lukaski, 2006).

Parameter involved in liver function, such as ALT and lipase, did not experience significant increase after the paddle match. As it is well known, the activities of various enzymes increase following muscle damage, and our players presented a significant gain in serum AST, CK and LDH. The slight improvement found in muscle-derived enzymes in serum in response to high-intensity exercise, has been suggested to reflect the improvement in mitochondrial membrane permeability, rather than muscle damage. Physical exercise results in the transient elevation of liver function. The parameters directly related to the muscular work, such as CK, showed a great improvement. The increase in CK reflects a high level of muscle breakdown as the muscles worked (Clemente et al., 2011).

Lipid parameters recorded no significant changes during competition. However, Tg concentration suffered the most important variation. Serum and muscular Tg were consumed equally during the first stage of exercise, and subsequently the free fatty acid became a source of energy, explaining the reduction in Tg at the end of the match, although it not seem to be the major source of energy (Huey-June et al., 2004).

The biochemical markers indicate that in women paddle players a catabolic state at muscular level may occur.

This sport, characterized by prolonged and intermittent efforts, with short and intense game actions may induce a sharp increase in muscle damage due to the predominance of eccentric muscle movements.

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A Pilot Study on Skill and Tactic in the Top Four From Men's Doubles of Soft Tennis in Asian Games 2012

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Abstract: The purpose of this study was to analyse the use of skill and tactic in the top four from Men's Doubles of Soft Tennis in Asian Games 2012. The top four from Men's Doubles of Soft Tennis in Asian Games 2012 were observed from match live recording videos. Data were analysed by Chi-square goodness-of-fit test and the level of significance was set at α=.05. This study showed that there were significant differences in serve percentage, serve placement, serve and approach, receive placement, receive and approach, skill, and formation. In the top four from Men's Doubles of Soft Tennis in Asian Games 2012, first serve percentage is about 65% in hard court matches. Players do not approach after service. Service placement is near right-hander's body and backhand position. Receive placement is located on diagonal baseline and players approach after receiving ball. Double net parallel formation is mostly used and volley is main skill. In order to attend international men's doubles games, coaches should focus on this tactic and ask players to receive certain trainings of volley and smash and sharpen the skill of passing shots. Strategies of three-stage hits should be designed.

Keywords: volley, first serve, double net parallel formation

1. INTRODUCTION

Soft tennis predecessor was evolved from tennis. In the late 19th century, the Japanese modified rubber ball which become today's soft tennis. Compared with the regular tennis balls, the soft tennis balls are more soft, hollow and light. The competition rules and courts are almost the same with tennis games but there is no provision for the centre strap to lower the net at the centre (Asian Soft Tennis Federation, 2016). During the play, the tennis has evolved from a technical/tactical game, based on well-developed physical abilities, the player are required to perform quick starts and stops, repetitive overhead motions, and the involvement of several muscle groups during the different strokes (Fernandez-Fernandez, Sanz-Rivas, & Mendez-Villanueva, 2009; Fernandez, Mendez-Villanueva, & Pluim, 2006). However, the ball is one of the most important part that mediates confrontation in games (Arias, Argudo, & Alonso, 2012). Parlebas (1999) indicated that the game actions

were developed by other participants, game space, equipment, and the game time. Thus the game actions may be changed and the technical/tactical characteristics may be different between soft tennis and tennis.

In soft tennis doubles games, one player is responsible for volley and smash and the other is responsible for striking the ball at the baseline. The double match it necessary to great silent understanding between the teammates to achieve a perfect match. In order to show the excellent technical performance, the players need to manoeuvre great tactics. At different levels of competition, and when faced with different opponents, there is a unique tactics for the player. To evaluate the technical performance of individual players, quantitative analysis might facilitate to provide objective information feedback (Chen & Liu, 2010; Gillet et al., 2009; Hughes and Barlett, 2007; Abernethy, Wilson, & Logan, 1995; Bompa, 1999; McGarry, Anderson, Wallace, Hughes, & Franks, 2002).

The doubles match is divided into two parties, one for the serving side, and the other for receiving side. In games, the serving side must handle the third shot to score and the receiving side need to find ways proactively and diversified to undermine the tactics of serving side to win. In the doubles match, there were closely related among serve mode, serve placement, receive placement, skill, hits and formation, tactical and strategic (Chang, Lin, Fang, Chan, & Yang, 2013; Cahill, 2002; Unierzyski & Wieczorek, 2004).

It is well known, a game is a combination of several kinds of basic skill into tactical, such as the single skill for research, not fully understand the game, each team's tactical changes and the advantages and disadvantages. In recent years, statistics has become increasingly popular in tennis that can be useful in making decisions on play strategies or other applications (Cross and Pollard, 2009; Filipčič, Filipčič and Berendijaš, 2008; Reid, McMurtrie and Crespo, 2010; Djurovic, Lozovina, & Pavicic, 2009). Therefore, the purpose of this study was to analyse the use of skill and tactic in the top four from Men's Doubles of Soft Tennis in Asian Games 2012 and provide these finding to coaches as a reference in training.

2. METHOD

A total of three matches of the 7th Asian Soft Tennis Championships were analysed in this study, the top 4th games. The technologies and tactics were classified and defined by pervious research (Chang et al., 2013) including serve, serve mode, serve placement, serve and approach, receive placement, receive and approach, score hits, score skill, and score formation. The intra-class correlation coefficient (ICC) was used to examine the test-retest reliability (Siedentop, 1983). The results showed excellent reliability for impact tests, with relatively high ICC values (0.96). The Chi-Square Tests were applied to test the difference. The Significant level was set at $\alpha = .05$.

Table 1. Game results

Games	Athlete	score	hand
Semifinal	Lai li Hung, Ho Meng Hsun/TPE vs. Jeon Jee Heon, Park Kyu Cheol/KOR	5 : 1	right-hand
Semifinal	Lin Shih Chun, Lin Sheng Fa/TPE vs. Lee Jung Sub, Kim Beom Jun/KOR	4 : 5	right-hand
Final	Lai li Hung, Ho Meng Hsun/TPE vs. Lee Jung Sub, Kim Beom Jun/KOR	5 : 3	right-hand

3. RESULT

The statistical results of Chi-Square tests presented in Table 2, Table 3, and Table 4. There were significant differences in serve (χ^2 =86.000), first serve 65%, second serve 30%, and double fault 5%. There was no significant difference in serve mode (χ^2 =.108), under cut serve 51% and overhead serve 49%. There were significant differences in serve placement (χ^2 =56.405), right serve-body 28%, left serve-body26%, right serve- centre20%, left serve- outer corners 20%, right serve- outer corners 4%, and left serve- centre 1%. A significant difference was existed (χ^2 =18.270) between no approach (68%) and approach (32%) tactic after serve.

Table 2. The results of serve, serve mode, serve placement, serve and approach.

Parameters		%	χ^2
serve	first serve	65	86.000*
	second serve	30	
	double fault	5	
serve mode	under cut serve	51	.108
	overhead serve	49	
serve placement	right serve-body	28	56.405*
	left serve-body	26	
	right serve- centre	20	
	left serve- outer corners	20	
	right serve- outer corners	4	
	left serve- centre	1	
serve and approach	no approach	68	18.270*
	approach	32	

* p <.05

The frequency of receive placements showed remarkable results (χ2 =86.730), crosscourt shot deep ball 42%, crosscourt shot midcourt 18%, centre 16%, forcing shot net player 16%, defensive lab 5%, crosscourt drop shot 3%. A significant difference was existed (χ2 =47.676) between no approach (68%) and approach (32%) tactic after receive.

Table 3. The results of receive placement, receive and approach.

	Parameters	%	χ^2
receive placement	crosscourt shot deep ball	42	86.730 *
	crosscourt shot midcourt	18	
	centre	16	
	forcing shot net player	16	
	defensive lab	5	
	crosscourt drop shot	3	
receive and approach	approach	78	47.676 *
	no approach	22	

* p <.05

There was no significant difference in score hits (χ^2=1.051), 7 hits up 37%, 4~6 hits 36%, and1~3 hits 27%. There were significant differences in score skill (χ^2 =20.254), volley 48%, ground stroke 25%, smash 20%, receive 7%, and serve 0%. There were significant differences in Score formation (χ^2 =28.966), "Double Net Parallel Formation"vs."Counter Opposite Angle Up-Back Formation"22%, "Double Net Parallel Formation" vs. "Opposite Angle Up-Back Formation"17%, "Opposite Angle Up-Back Formation"15%, "Right Straight Up-Back Formation"15%, "Double Net Parallel Formation" vs."Double Net Parallel Formation","Counter Opposite Angle Up-Back Formation"14%, "Left Straight Up-Back Formation"5%, "Double Base-Line Parallel Formation" vs."Opposite Angle Up-Back Formation"5%, "Double Base-Line Parallel Formation" vs."Counter Opposite Angle Up-Back Formation"3%, "Double Base-Line Parallel Formation" vs."Double Net Parallel Formation"2%, "Double Base-Line Parallel Formation" vs."Double Base-Line Parallel Formation"2%.

Table 4. The results of score hits, score skill, and score formation.

	Parameters	%	χ^2
Score hit	7 hits up	37	1.051
	4~6 hits	36	
	1~3 hits	27	
Score Skill	volley	48	20.254*
	ground stroke	25	
	smash	20	
	receive	7	
	serve	0	
Score formation	"Double Net Parallel Formation" vs."Counter Opposite Angle Up-Back Formation"	22	28.966*
	"Double Net Parallel Formation" vs. "Opposite Angle Up-Back Formation"	17	
	"Opposite Angle Up-Back Formation"	15	
	"Right Straight Up-Back Formation"	15	
	"Double Net Parallel Formation" vs. "Double Net Parallel Formation"	14	
	"Counter Opposite Angle Up-Back Formation"	5	
	"Left Straight Up-Back Formation"	5	
	"Double Base-Line Parallel Formation" vs. "Opposite Angle Up-Back Formation"	3	
	"Double Base-Line Parallel Formation" vs. "Counter Opposite Angle Up-Back Formation"	2	
	"Double Base-Line Parallel Formation" vs. "Double Net Parallel Formation"	2	
	"Double Base-Line Parallel Formation" vs. "Double Base-Line Parallel Formation"	0	

4. DISCUSSIONS

In these games, the rate of double fault was only 5% which indicated the stability of these players. The results are similar to other research findings (Pollard, 2008; Barnett et al., 2008). Regarding to the team of KOR, the players used to serve by undercut serve at first serve and overhead serve at second serve. Regarding to the team of Taiwan, the undercut serve mode was used in first and second serve. In the clay court, the overhead serve make the ball faster after striking the field and bounce higher. In the hard court, the ball speed becomes slower after contact the ground due to the friction. Thus, serve by undercut serve might increase friction and sidespin and lower ball bounce which would decrease the success rate of receive. According the results, the serve placement were accumulated at the backhand of the receiver which raised the possibility of fault. Only 32 percent in approach after serve that might be result from the tactics.

In this game, the players usually used the "under cut serve" that caused the lower ball bounce and near the net. Thus, the receiver often strikes back by crosscourt shot deep ball and the counterparts might have an opportunity to score directly. However, if the undercut serve result in higher ball bounce or serve without enough power by using overhead serve which would induce the receiver approach after receive. Sometimes the double approach or double forward tactic might be used to pressure the antagonists (Ling, & Tang, 2001). In addition, the players who used these tactic usually get net point, because of the ephemeral reaction time of the opponent (Woods, Hoctor, & Desmond, 1995).

The score hit of points were 37% in 7 hits up, 36% in4~6 hits, and 27% in 1~3 hits. These results revealed that the soft tennis is characterized by speed endurance and beats tactics which means the players need to move fast and agile to strike back the ball until scoring. The final score of each technique were volley 48%, ground stroke 25%, smash 20%, receive 7%, and serve 0% which infer from the different court.

This finding was consistent with previous results (Djurovic, Lozovina, & Pavicic, 2009) that volley is one of the most important score skills in tennis match. In contrast, this results disagree with the finding obtained by tennis matches that more than 60% of points won on first serve (Brody, 2004; Pollard, 2008; Barnett et al., 2008; Reid et al., 2010). In this championship, the tactic "Double Net Parallel Formation" is widely used in every team which usually combines with volley and smash skills. The significant result was revealed in the present study in score formation performance (22%) that similar with previous studies (Chen, Liu, & Tang, 2005; Djurovic, Lozovina, & Pavicic, 2009; Woods, Hoctor, & Desmond, 1995).

Regarding to this tactic, the players need quickness, power, and agility of physical capability and proficient hitting skills. The "Opposite Angle Up-Back Formation", "Counter Opposite Angle Up-Back Formation", "Right Straight Up-Back Formation", and "Left Straight Up-Back Formation" were in the reverse formation with "Double Net Parallel Formation". Those formations were attackable as well as defensible. In the double match, coordination is one of the most important parts to the players. In order to perform a high quality doubles match, the athletes must be practiced every

skills and cooperate with teammate.

5. CONCLUSION

In the top 4th doubles, the success rate of the first serve was 65% without approach. The service placements were close to the backhand of the righty receiver. The skill of crosscourt shot deep ball was regularly used after receive and the receiver approached, adopting the Double Net Parallel Formation. In addition, the volley is the mainly score skill. According to the results, the Double Net Parallel Formation was recommended to be adopting in the men's double matching. The skills of smash and pair surfs the net are need to be refined and improve the success rate of passing shot.

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Psychophysiological response to men doubles competition in elite badminton players

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Abstract: The biosocial model is the most important hypotheses to interpret the relationship between testosterone and social competition and social status seeking. According with this model, victor men increase T levels and defeated men drop after losing and high postgame cortisol levels. Badminton could be an excellent sport to study the psychophysiological response to competition. We present a study in 18 elite men double players randomly chosen from the XXIII Spanish International Badminton Tournament: age 21.51 ± 3.22 years; BMI 22.80 ± 1.49 kg/m^2. Saliva sampling (to estimate hormonal concentrations), CSAI-2, blood lactate and rating of perceived exertion was taken. Pregame and postgame hormonal response showed that testosterone levels increase after winning (z = -2.366, p = .018) and drop after losing (z = -2.934, p = 0.003). Postgame cortisol levels decrease after winning (-23.90 %, z = -2.366, p = 0.018) and were significantly higher in defeated men (128.28%, z = -2.934, p = 0.003). Psychological measures and postgame lactate concentrations showed no differences between groups, nevertheless rating of perceived exertion was higher in losers (z = -3.303, p = 0.001). Hormonal response patterns to men doubles badminton competition was congruent with the biosocial model: victor men double players showed testosterone rises and cortisol drops after win a match, while defeated men showed important rises in cortisol.

Keywords: Biosocial Model, Testosterone, Cortisol, Anxiety, Blood Lactate and Sport Competition.

1. INTRODUCTION

The effects of human competition on testosterone (T) and cortisol (C) levels have been studied for several researchers. While T is associated with motivation to maintain or social status-seeking (Mazur and Booth, 1998; Wingfield et al., 1990; Archer, 2006; Mehta et al., 2008), C lead physiological and behavioural response to a challenge mobilizing glucose reserves into skeletal muscle (Suay and Salvador, 2012). The biosocial model (Mazur, 1985) is one of the most important hypotheses to interpret the relationship between T and social competition. According to this model, face to face competitions elicit important outcome dependent hormonal changes

(Salvador and Costa, 2009). Victor men increase T levels and consequently enhance their trend to facing new social status threats. In contrast, defeated men drop significantly after losing and inhibit their status-seeking beside negative moods and high postgame C levels related with frustration (Jiménez et al., 2012). Likewise, exceptional higher C concentrations could be related with poor performance (Erikson et al., 2003). C not only prepares the body for action, it is also a reliable indicator of stress (Filaire et al., 2009; Lautenbach et al., 2014). However, in racket sports many few papers had been published analysing the hormonal response patterns to competition. Foreground three studies in men single and doubles tennis and men singles badminton players that results fit to biosocial hypotheses of status (Mazuz and Booth, 1998; Filaire et al., 2009; Jiménez et al., 2012). The aim of the present investigation was study the psychophysiological response and to men doubles badminton match during an official international tournament (EBU).

2. METHODS

2.1 Participants

The sample was composed of 18 international badminton doubles players with following characteristics (mean ± standard error): age 21.51 ± 3.22 years; BMI 22.80 ± 1.49 kg/m^2 and 9.83 ± 2.79 years in official competitions. Participants were not taking any drugs, medication, no endocrine disorders before or during the process and they were familiarized with sampling in previous days. Informed consent was obtained, according to Declaration of Helsinki. The study was conducted at the XXIII Spanish International Badminton Tournament from 23 to 25 May 2010, qualifying for the World and European ranking, with prizes for the winners of € 15,000. At the meeting with delegates from each country, procedure was presented, asking the Referees for the necessary permissions to access to the playing area, receiving the consent of all participating countries. Finally, 6 players from the Spanish Olympic team, 6 players from other European countries, 3 from Oceania and 3 from Asia participated in the present study.

2.2. Procedure

Saliva samples (2-4 ml) were taken in plastic tubes 45 minutes before a player was called to the court and 45 minutes after the match. Warming started 10 minutes after taking the first saliva sample. Its influence on steroid hormone levels was ruled out. The matches were played between 10:00 am and 13:00 pm. Players were instructed to complete sampling before eating, drinking or brush their teeth. Samples were frozen at -20 ºC in first 20 min after being collected and stored in the laboratory´s refrigerator at -30 ºC until assayed using enzyme immunoassay equipment (Grifols Triturus) from the Haematology Laboratory. Samples were assayed twice using a Diametra salivary T and C kits (Diametra, Segrate, Mi, Italy). The coefficients of variation intra-assay and inter-assay were (respectively) 5.5 and 9.3 T and 8.0 percent and 14.1 percent for C. The lower limits of detection of the T and C kits were 3.5 pg/ml and 0.05 ng/ml. CSAI-2 (Martens et al., 1990) was also

used to estimate pregame cognitive and somatic anxiety and self-confidence 20-30 min. before the match. Lactate blood concentrations in the first 60 s. postgame (Dr. Lange LP20 Miniphotometer, Berlin, Germany) and rating of perceived exertion (Borg, 1982) was also taken to estimate the experienced effort to win or lose the match. Total match time (TMT) and final outcome was registered from the official referee documents. To find the optimal psychophysiological response to competition, players had to be highly motivated to win. The official competition with monetary prizes, not only motivated to get social status and international reputation also win money was, presumably, an important incentive to beat their opponents.

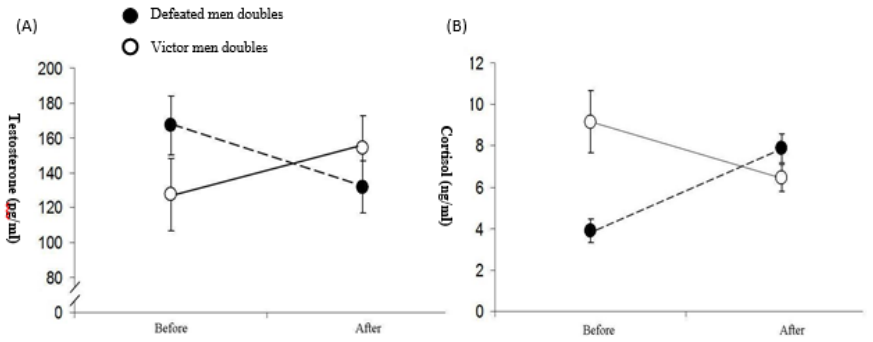
2.3. Statistical analysis

The homogeneity of the variables was assessed by means of the Shapiro-Wilk Normality Test showing that T and C concentrations before and / or after competition, and psychological assessments were not normally distributed. Hormonal variables were square-root transformed (data in Figure 1 were no transformed to facilitate comparison with other prior studies). T and C levels were assessed by two-way ANOVAs (between-subjects factor: outcome) for winners and losers separately. The effect sizes η^2_p were also calculated. The percent change in winners/losers hormone levels [(post-competition minus pre-competition)/(pre-competition) x 100] were assessed using Mann-Whitney U Test for independent samples (winners/losers). Increase (or decrease) in T and C levels ware also assessed using the Wilcoxon´s Signed Rank test for winners and loser separately. Relationships between psychological assessments and precompetitive hormonal levels were assessed by Spearman´s correlation coefficient (rho). SPSS statistical package were applied to all analyses (SPSS Windows, 15.0. SPSS inc, USA).

3. RESULTS

Pregame and postgame T and C levels are shown in Figure 1. Two way ANOVAs sowed that T and C changed linked to victory and defeat, as indicated by a significant time x outcome interactions $F(1,16) = 60{,}96$, $p < 0.0001$, η^2_p 0.792 and $F(1,16) = 37.023$, $p < 0.0001$, η^2_p 0.698, respectively. According to biosocial model, results showed that testosterone levels increase after winning ($z = -2.366$, $p = 0.018$) and drop after losing ($z = -2.934$, $p = 0.003$) in doubles men badminton players (Figure 1A). The mean C salivary concentrations before and after the contents are shown in Figure 1B. C levels decrease after win a match ($z = -2.366$, $p = 0.018$) and were significantly higher in defeated men ($z = -2.934$, $p = 0.003$). Pregame psychological measures (CSAI-2 factors), TMT and postgame lactate concentrations showed no differences between groups, nevertheless RPE was higher in losers ($z = -3.303$, $p = 0.001$). In the same way, changes in T (ΔT) and C (ΔC) are shown that when participants won a match their hormonal responses was rises in T (+27.09 %, $z = 3.487$, $p < 0.0001$*)* and drops in C (-23.90 %, $z = 3.487$, $p < 0.0001$) compared with losers. Is important to note, that ΔC were significantly higher in defeated men (more

than 128 %, z = 3.487, p < 0.0001) while ΔT were decrease notably (-21.42 %, z = 3.487, p < 0.0001). Spearman´s correlation coefficient confirmed the relationships between hormones and psychological assessments. Pre-competitive T correlated positively with pre-competitive C (r = 0.42, p < 0.05) and negatively with cognitive anxiety (r = -0.46, p < 0.01). C just correlated positively with somatic anxiety (r = 0.48, p < 0.01), and self-confidence was related negatively with cognitive anxiety (r = 0.45, p < 0.05).



A) Mean ± SEM for salivary testosterone before and after competition in victory and defeat elite men doubles players and B) salivary cortisol levels in the same groups.

Figure 1. Testosterone and cortisol level for winners and losers in badminton men doubles official matches

4. DISCUSSION

The aim of this study was analyse the psychophysiological response to real badminton men doubles matches. To our knowledge, this is the first study examining the hormonal changes and anxiety components during men doubles official badminton competition. This investigation could collaborate to get an important theoretic framework to understanding what happens in high competition when athletes get (or not) their personal goals. As expected, results fit to biosocial model of status: badminton players showed rises in T after winning a match, in contrast drops in T was observed in losers. In accordance with this model, T not only shows anabolic effects (i.e. increase skeletal muscle or reduce the body fat), also influences in status-seeking or sports performance. Postgame C levels were also related with outcome, likely in response to defeat frustration in a real competition when players are highly motivated to win. Precompetitive somatic and cognitive anxiety and self-confidence showed no differences when victor and defeated men were compared.

Our finding showed a high influence in final outcome over the psychophysiological response in men doubles badminton competition. Winners increased their T concentrations more than twenty-five percent, and dropped in C

levels close to same percentage. However, losers dropped in T and increased drastically their C (more than 120 %). This finding fit exactly with Mazur´s biosocial model (Mazur, 1985), to explain how hormones change over the course of competition and their influence on the future competitions. When athletes lose a competition, two different situations may occur: increasing interest to compete again with their opponents after coping on the mistakes made during the game, or maybe observe how their opponents became aversive for them increasing their vulnerability in future competitions (Mehta and Josephs, 2006). Prior studies linked testosterone to dominance and the status-seeking (Mehta et al., 2008; Stanton and Schultheiss, 2009). In sports, dominance could be the power and influence over others to achieve economic and social incentives of high competition, and T drives to engage in sport competitions (Mazur & Booth, 1998; Jiménez et al., 2012; Aguilar et al., 2013). T play and important role in the reward system, in reduction fear and to increase the power motivation to win (Bos et al., 2010). Consequently, high T circulating levels linked to individual differences in competitive or aggressive behaviours, specially, when status is threatened (Mazur, 1985; Archer, 2006). Hence, this psychophysiological response to competition in men doubles badminton players related to outcome, could be important information to their performance and training plans. T fluctuations to competition were important information about the right neuroendocrine function. Defeated men could be two different fluctuations after losing a match: T rises or remains stable, encouraging the player to increase its interest in competing again and fight to beat the opponent; T drops sharply, possibly resulting in loss of social status and decrease in competitive behaviours (Mehta and Josephs, 2006; Mehta and Josephs, 2010).

Moreover, positive correlations between precompetitive somatic anxiety and C was funding in other studies (Filaire et al., 2001; Filaire et al., 2009). In the same way with this findings, men doubles players showed a significantly relation between same variables. This suggests the close relationship between physiological response and subjective psychological measures in racket sports (Lautenbach et al., 2014). High C concentrations lead with poor performance affecting many cognitive processes, overall when performance could be modulated by the opponent skills (Erikson et al., 2003*)*, our results showed that there was a significant outcome effect on C levels when social status could change (Filaire et al., 2009; Aguilar et al., 2013). Of course, change in C may result from physical effort and in our study RPE suggest a relationship between loser and high effort perceived, however blood lactate concentrations showed no differences between victor and defeated men. A possible explanation could be that it was a real competition, and therefore C could be related to defeat frustration (as argued Jiménez et al., 2012). Competition-related momentary increase in C is a combination of two factors, because the hypothalamic adrenal axis may responding in the same way to physical and/or psychological factors in sport competition (Edwards and Castro, 2013). Besides, the outcome expectancies and available responses to coping the emergent threats could be distorted by psychological mechanisms (Eriksen et al., 2003). Important to note that

not differences was observed in precompetitive anxiety measures between winners and losers, so outcome was not influenced by the previous psychological situation, it was likely consequence of an emotional response to defeat. Finally, RPE could have an important outcome dependence related to psychological factors (as argued Hall et al., 2005).

5. CONCLUSION

Hormonal response patterns to men doubles badminton competition were congruent with the psychophysiological impact of outcome on T circulating concentrations (according to the biosocial hypotheses of social status and dominance). In the same way, postgame C levels were related with outcome, although the literature suggest a relationship between physical effort and C rises, present study showed no differences between victor and defeated men in postgame lactate concentrations, so C rises was not just related with physical effort. The affective responses experienced by the players on competition were also related with hormonal changes. RPE (highly modulated by psychological factors, as argued in prior studies) showed greater score after losing, but was not related to total playing time or blood lactate concentrations.

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PART 2
Short report

High potential in table tennis from the perspectives of elite players and their youth trainers: an explorative qualitative study

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Short report / Abstract

Introduction: Many table tennis associations use talent development programmes to identify young high potential players and to support children intending to become elite players. Selection criteria to participate in such programmes are often based on performance results, coach's judgments, physical appearance, perceptuo-motor tests for speed, agility and coordination, motivation, self-efficacy and parental support. However, identifying young children with the potential of becoming elite players is a challenge as the key factors for future success remain ambiguous (Elferink-Gemser, Jordet, Coelho E Silva, & Visscher, 2011; Faber, Bustin, Oosterveld, Elferink-Gemser, & Nijhuis-Van Der Sanden, 2016). An extensive determination of the nature of high potential for table tennis is suggested to provide a better understanding of these success factors. The experiences, perceptions and 'hidden' knowledge of players who succeeded and became world-class elite players and of their youth trainers can be helpful to unravel this mystery. Consequently, the aim of this explorative qualitative study was to get grip on what is meant by 'high potential' for elite table tennis from the perspectives of elite players and their trainers.

Methods: Semi-structured in-depth interviews were conducted in elite table tennis players (n=3; mean age 40 (SD 6); ITTF's World Ranking top 20 between 2000-2015) and the trainers of their formative years (n=3; mean age 68 (SD 6); licensed trainers with > 30 years' experience as table tennis trainer) to uncover the multi-dimensional concept of 'high potential' for table tennis. After transcribing the interviews, open and axial coding were carried out using an inductive approach. Consecutively, all authors were involved in the peer debriefing process. A member check was conducted on a summary of the results. As this study was explorative in nature, data saturation was not intended.

Results: The results presented seven interrelated categories: early exposure, deliberate play, fit to table tennis, learn fast, taking the next step, constant competition and reaching the top of the world. Each category demonstrated that 'high potential' for elite table tennis can only be described with reference to the three elements: the player, the task table tennis and the environment.

Discussion: The results of this study are consistent with the ecological-dynamic approach (Newell, 1986; Shumway-Cook & Woollacott, 2007). In addition, it is proposed that 'development' should be inserted as a fourth element since the other elements continuously change over time (Elferink-Gemser & Visscher, 2012). All interviews showed that the elite players presented a successful combination of physical, perceptuo-motor, technical, tactical, mental, emotional, self-regulative and learning abilities in a stimulating and adequate context fitted to the needs at that moment in time. Yet, it is important to realise that the pathways to success are individual (Phillips, Davids, Renshaw, & Portus, 2010). Moreover, it needs to be acknowledged that this study was conducted in successful male European elite players and their trainers which influences the findings. The current study asked elite players and their trainers to recall their personal experiences. It might be possible that characteristics provided by the current study be limited in the power of forecasting elite performance or distinguishing elite players from ordinary players. Longitudinal studies are necessary to study predictors or prerequisites of future elite performance. Nevertheless, as the intention was to present the 'richness' of findings regarding the perspectives of the elite players and their trainers, the results of this study might give direction to further studies focusing on the concept of 'high potential' for elite table tennis and to ways of assessing or monitoring this in young table tennis players.

Keywords: table tennis, racquet sports, aptitude, gifted children

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PART 3
Professional papers

Improved and Enhanced, Modular and Low Cost Electronic Scoring System useful for Table Tennis and Squash

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Abstract: This paper shows a low cost electronic scoring system, for use in table tennis and/or squash, but also it can be used in others sports. The system includes several options for controlling input data, also as for displaying the score; it's modular in such way that can be used from a minimum quantity of parts (e.g.: 1 keyboard and one display) to several parts; multiplatform and simultaneous matches (multiple LED displays; projectors; webpages; tablets and computers). All the scores can be projected to a large screen, or can be seen from a local network or from internet. Any people with a smartphone, tablet, or laptop can follow all the scores. This modular scoring system is similar to the professional system used in big tournaments, but its low cost allows use it in local tournaments, clubs, or any similar competition. Currently this system is being used in a small local club: Table Tennis and Squash "Lomas del Valle" in Morelia, Michoacán, México. The sports in this club are precisely Table Tennis and Squash.

Keywords: electronic scoring system, modular design, internet, multiplatform

1. INTRODUCTION

In all the sports, the score is a very important element for athletes, also as for coaches and general public. Each sport has its own form and equipment to carry out the score and to show it to spectators.

There are specialist companies that do all the necessary to display on giant screens the scores from many matches, as well as to broadcast these scores to the whole world through internet. These companies work professionally in major championships, and they require a large budget.

When a small championship or tournament (as is the case of many local, regional or even national tournaments) requires such services, generally they are out of budget.

In this paper is shown a low cost scoring system that brings many of the previously described benefits, without the requirement of a high budget. The work shown here is based on an electronic scoreboard designed previously (Méndez P. A., 2007), which has been improved and enhanced.

2. BACKGROUND

The starting point of this work is the electronic scoreboard previously designed as shown in (Méndez P. A., 2007), which is based in a low power microcontroller that makes the following activities:

- Control of a 7-segment, 6-digits display with 4 additional indicators.
- Scanning the keyboard to accept orders of adding points to each player.
- Sending the current score through a CAN network to other scoreboards (called "mirroring") and to the PC working as master control.
- Follow the table tennis rules (ITTF Handbook 2014-2015).

This initial design includes also a software for PC (Personal Computer) to receive the scores of several scoreboards of the same kind.

There are several points to remark of this previous design, as:

- An industrial network is used for the scoreboards, in order to avoid any security issue, the chosen industrial network (CAN) has algorithms for detecting and correcting errors in data reception and it retry to send data when there is any data corrupted.
- Several displays can be easily configured to show the same score (called "mirroring").
- All points of each match are recorded to a file, so that the software can calculate match statistics.

Some of the areas for improvement of this scoreboard are:

- The keyboard is wired; could be wireless therefore reduce installation time and facilitate the maintenance.
- The keyboard only has 4 buttons; a graphical interface could be friendlier to the judge scoring, and can display the names of the players and the flags of their countries.
- The PC software displays the scores in the local facilities, would be better show the scores to any people in the world via the internet, if it is available.

In this new work we implement these improvements and some additional functions, keeping the original advantages of low cost and modularity, to allow grow from one to many simultaneous scoreboards. The original display of 7-segments 6-digits can be used yet or can be substituted by smart-TV connected to a network.

In the following paragraphs we will describe each one of the improvements

3. DESCRIPTIONS OF IMPROVEMENTS

3.1 Input Device (Keyboard)

The original design had a keyboard with 4 keys, wired to the electronic scoreboard. This keyboard is very easy to use and intuitive.

The continuous improvements in the electronics circuits, manufacturing and display technology, have allowed to have more powerful smartphones and tablets, with very good display resolution in a low cost; with touch screen technology, with multiple options for communication included, as WiFi, Bluetooth, USB.

A 7" tablet can cost 25 USD or less. We choose to use this kind of tablet as wireless keyboard instead of the 4-key wired keyboard. A typical resolution of the screen of these tablets is 800x600 pixel, allowing to show the score (points and games); the current server; the name of players; the timeouts of each player, etc. in a graphical way. All messages required can be shown in full text.

A cluster of matches can be preloaded in the device, allowing to the judge select the match to play. This is useful for a previously known, group of matches, such as in preliminary group rounds or the matches between teams.

A register file is stored also in the controlling device. This file has a full register of all the points of all games in every match. Each register includes the time (hour: minute: second) and the player server of each point.

In order to do all these things, we design the software for this wireless keyboard, working under Android operating system.

We wrote this software in java language (Deitel P.J., & Deitel H.M., 2013), using the touchscreen capabilities of the tablet. The visual interface of this software was designed similar to a typical table tennis scoreboard, and so to be familiar to the judge.

The Fig. 1 shows the initial screen of this visual interface. A general messages box is on the center of the top part of this screen. The general messages inform to judge: the need to select the server; the number of game being playing; the end of game; the time of rest between games; that a timeout is taken; that a timeout is over and the game must restart; that the match is over and shows the name of the winner, etc.

At the bottom part of the screen is shown the points of each game played.

Fig. 1. Software Initial screen on the Tablet.

This software makes the following activities:

At the beginning of a match:

- Read a cluster of matches to play from a file stored in the tablet memory, this file has a list containing number of match and names of players of each match.
- Allow to scoring judge selecting a match from the list of matches. This is

done by touching the word “match” (“Partido” in Spanish) on the screen.

- Allow to scoring judge selecting the number of games to play (5 or 7 games), by touching “3/5 Sets?” box will change to “5/7 Sets?”, pressing again will return to “3/5 Sets?”.
- Allow to scoring judge selecting the player who is at his right side and who at his left side, this is done touching one of the two names of player.
- Allow to scoring judge selecting the player who will do the first service, by touching one of the two table tennis balls. This action mark the start of match

During of match, the activities of the software are:

- Allow to scoring judge add or subtract a point to each player, this is done by touching the points (bigger boxes) of the player to add a point, or touching the “JI-” or “JD-” boxes to subtract a point.
- Indicate with a table tennis ball which player is the current server, helping in this way to the judge in the order of services.
- Allow scoring judge to give each player one timeout. When a timeout is given by touching the “TF” box, a countdown timer is shown in the same box and a message “Timeout of player …” is shown on the general messages box.
- Shows the current points (on the bigger boxes) and games of each player, also as the score of all games (on below of the screen).
- Shows constantly the match time.
- At the end of a game, shows a countdown timer between games.
- At the last game (game 5 of 5 or game 7 of 7) advice to the scoring judge the change of side required when the first player arrive to 5 points.
- After each point scored, 3 files are updated. One is the register file (writing the time in hour, minutes and second for each point, indicating which player was the server) in text format; other file with the current score in html code, in order to be seen from any web browser. And a third files with the current score in text format.

The Fig. 2 shows a screenshot of the tablet while the match is being played. In this case neither player has used his timeout. When a player has used his timeout, no longer appear his “TF” box.

Fig. 2. Screen on the Tablet during a match.

As can be seen in Fig. 2, the table tennis rules (ITTF Handbook 2014-2015) are embedded in the software application designed for the tablet. This can be advantageous in small clubs, where commonly the judge is a player and he hasn't much experience as a judge. This characteristic also helps when you want to teach to new players the table tennis rules.

Each tablet must have web server installed in order to broadcast the current score to any people connected to the same network, using a web browser.

The Fig. 3 shows a sample screen of the web page on each tablet.

Fig. 3. Sample Webpage of the score on the Tablet during a match.

In this way, a single tablet with only one match can be used as a full scoring system, broadcasting the score in the network, and anyone with an electronic mobile device can see the real live score.

The table 1 shows a fragment of the register file that is written in the tablet. The asterisk indicates which player was the server. In this file also is stored the names of players; the time duration of each game and the time of the whole match. This information is not shown in Table 1.

Table 1. Small section of the log file in the Tablet.

Hour	Points	Games	Time of point
13:23:56	*00-00	0/0	00:00
13:23:59	*01-00	0/0	00:03
13:24:08	02-00*	0/0	00:09
13:24:15	02-01*	0/0	00:07
13:24:20	*03-01	0/0	00:05
13:24:30	*03-02	0/0	00:10

With this information we can calculate several statistics as:

- Average time of points,
- Points won with own service for each player,
- Points won while receiving for each player,
- Average time of games,
- Average time of several matches.

These statistics will be useful for player's feedback; for coaches to evaluate the player performance; for the organizing committee to do a better distribution and

time assignation of tables and matches.

The file with the matches to play is received from the master PC though WiFi, Bluetooth or USB. The current score of each tablet is read from the tablet by the master PC, also by wireless as above.

3.2 Main Controller PC or Master PC

As a main score system controller we also use a personal computer PC. This PC must have:

- Wireless Ethernet card,
- CAN interface, as designed in (Méndez P. A., 2007),
- The custom software installed, as designed in this work,
- Web server activated.
- Internet access (optional),
- Wired Ethernet card (optional),

For this computer we wrote several programs in different computer languages. We use C++ language (Horton I. 2005) compiled under Microsoft Visual Studio (Microsoft 2008) for sending information through CAN to 7-segments, 6-Digits displays. We use html code (Grupo EIDOS, 2000) for broadcast to whole world the scores.

The functions of this PC are:

- To send the file with the matches to play to each tablet.
- Been continuously reading the current score of each tablet.
- Sending continuously the score to each 7-segment, 6-digit displays through CAN network (optional).
- Updating continuously the html file with all received scores.
- Broadcast through internet the scores of all matches.

The Fig. 4 shows a sample screenshot of the web page. This figure shows only two of the scores, but can be shown any number of scores.

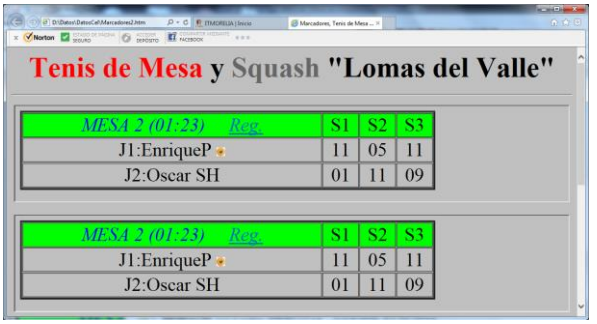

Fig. 4. Sample Webpage of the scores from several matches.

This figure is only a sample, because the design and distribution of information can be modified, according of any specification or requirements. Pictures and

publicity of sponsors can be added to this screen, as any web page, giving added value to any tournament.

4. CONCLUSIONS AND FUTURE IMPROVEMENTS

This work shows a very low cost scoring system, with similar characteristics as professional system, but with a fraction of the cost, useful for tournaments with a limited budget. The added value given to a tournament by a system like this, make it more attractive to players, the general public and sponsors.

The modular design allows to be used with personalized number of simultaneous matches, in concordance with the customs requirements.

This system can be used in many configurations; the following list shows only some of them:

- Only one match, without any PC, with only one tablet working as keyboard; score system and broadcasting device. Anyone with a smartphone, tablet, laptop, or computer can see the score.
- Several match with several tablets each one broadcasting its own score.
- Several match with a PC receiving all the scores and broadcasting all the scores in only one web page.
- Several match with a PC and one or more 7-segment, 6-digits displays for each match.
- Several match with a PC and one or more smart TV for each match.
- Several match with one or more smart TV for each match.

In all the previous cases, a tablet is required for each match.

The modularity of this design gives many options of configurations as is required for much kind of tournaments and budgets (as was described above).

When this system is used in other sport as squash, the only thing to change is the software wrote in java for the tablet. All the other software applications (html and C) are the same. This is the same case if this system is needed for other different sport.

We will continue to improve the visual interface of this system, working in team with graphical designers in order to have a more professional system.

In future work we will try to introduce the use of a generic template of a datasheet or maybe custom software, specifically designed for the control of a tournament in all its phases (preliminary group phase also as in the main or final draw). This software or datasheet will be in synchrony with the scoring system, sending the matches to be played in each tablet and receiving the final score of each match. In this way the administration and control of a whole tournament will be easy, it needing only a general supervision.

As any design, many improvements can be done; we are open to receive observations and suggestions to improve this work. Any criticism and/or advice are welcome.

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Are the spaces for the practice of physical exercise in the free time profitable or not?

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Abstract: The attitudes, opinions and behaviour towards spending the free time could be a research study for different companies that offer services which allow the citizens relax and spend their free time; on the other hand, even the town hall could be interested in finding out how the population spends the free time, the place and the time allotted to it, the complaints and the general opinion concerning the places that are available for this purpose.
However, in order to approach the topics concerning the attitudes and the opinions concerning the free time, we should find out the availability and the opportunities of practicing free time activities, since at present there is no such practical guide or any centralized information of this sort, at least not in the city of Bacau.

Keywords: efficiency, physical exercise, sports centers

1. INTRODUCTION

The sociologist Joffre M. Dumazadier defines recreation as a set of activities to which the individual dedicates himself freely, willingly and heartily either in order to have some rest, or in order to have fun and to satisfy his/her aesthetic needs, or to improve his/her knowledge and to develop his/her formation in a detached manner, to enlarge and develop his/her voluntary social participation or his/her creative ability, after he/she gets free from the professional, social and familial demands (Ioncica, 2003).

At present, the free time is not appreciated just as a residual time when compared to the working time, but it is used in order to enlarge the field of knowledge and in order to get active rest for comforting purposes (Coralia Angelescu and Jula, 1997). Thus, we can notice that the demands and the new requirements concerning the quality of the touristic component bring an improvement in the field of spending the free time, stimulating the creation and development of some specific services, the entertainment ones (Cosmescu, 1998).

The entertainment services ensure active rest by satisfying some physical and mental needs of the individual, creating the atmosphere necessary for spending the free time in a pleasant and instructive way. The entertainment services thus

contribute directly to the quality of life (Ministry of Youth and Sport, Council of Europe, CDS, Newsletter, 1996).

2. PURPOSE

The purpose of this research is to conduct an investigation which should emphasize the availability and the opportunities for practicing sports activities in the city of Bacau and, at the same time, to present information that could lead to new investors and new centers for practicing physical exercise in our city.

3. HYPOTHESIS

We started from the hypothesis that the spaces meant for the practice of physical exercise are a viable alternative for the business community.

4. SUBJECTS AND CONDITION OF THE RESEARCH

- Period of investigation: September 2013 - June 2014
- Method of investigation: Survey based on a question sheet including 13 open questions.
- Subjects: 24 managers of different sports centers in the city of Bacau out of a total number of 46 whom we tried to contact in order to get information concerning the subject investigated

5. DEVELOPMENT OF THE RESEARCH

Initially we considered for our investigation 46 institutions which could offer relevant information for the subject treated here. Out of objective or less objective reasons, some of the 46 sensitive subjects refused or didn't prove to be available to participate to our investigation. Due to this aspect, the information achieved was gathered from the following institutions which have a sports center:

We presented the questionnaire to our subjects individually, also allowing them to make observations on the questions asked as well, while formulating the answers.

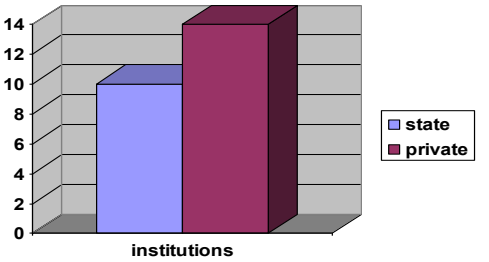
The survey was performed in a controlled manner, time offered to the subjects for offering their answers was not limited. We used printed questionnaires.

6. PRESENTATION AND INTERPRETATION OF THE DATA

Graphic no.1 shows the answers offered by the subjects interviewed to question no.1 "What kind of institution do you represent?" which showed that most of them are private institutions 58.33%; from this point of view we consider that the answers offered are even more interesting, the private area having to find solutions and opportunities for supporting their own activities faster and more efficiently than

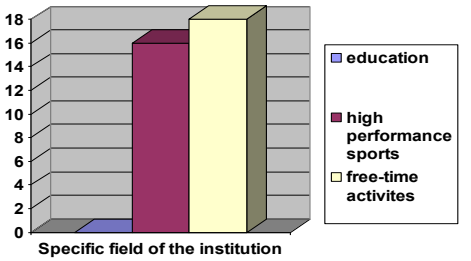
their counterparts which are financed by the state.

The answers for question no.2 "What is the specific field of your institution?" allowed us to make graphic no.2 where we can notice that none of those investigated represent an educational institution,



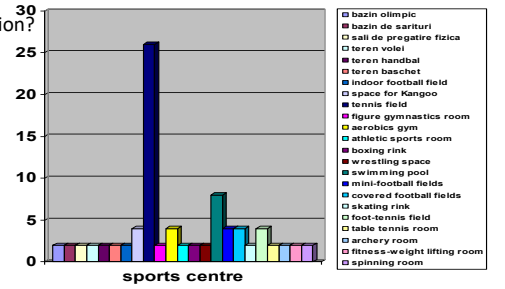
Graphic no.1. What kind of institution do you represent?

66% of those investigated organize high performance activities and 75% of those investigated organize free-time activities. The answers offered indirectly showed that among those investigated there are institutions which organize high performance activities as well as free-time activities.



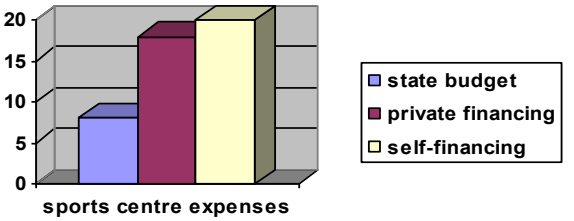
Graphic no.2. What is the specific field of your institution?

The answers offered for question no 3 "What does the sports center of your institution include?" showed a great variety of gyms, rooms and fields used for sports activities. Among them we could notice the great number of tennis fields (26) as well as the number of swimming pools (8).



Graphic no.3. What does the sports centre of your institution include?

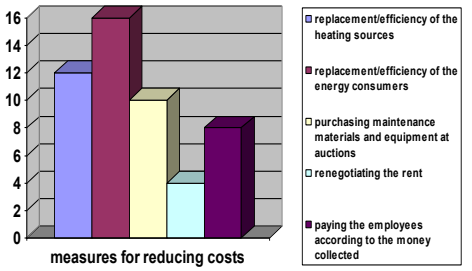
The answers for question no 4 "What kind of funds pay the expenses for your sports center?" showed that 33.33% have funds for the expenses of the sports center coming from the state and 66.67% from private financing sources. At the same time, 83.33% of them have as a supplementary source self-financing, which is a good thing considering the financial crisis we are in and the more and more obvious trend to cut



Graphic no.4. What kind of funds pay the expenses for your sports centre?

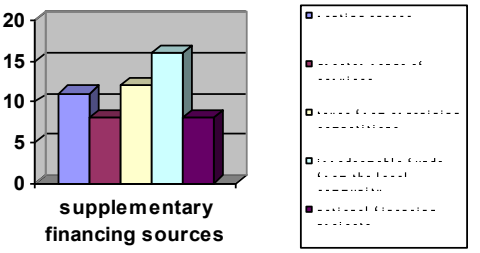
the funds offered from the state budget.

Graphic 5 shows the answers to the question "Which are the main measures taken in order to reduce the maintenance costs?" The answers showed that 66.66% of those interviewed considered as a means for making their maintenance costs more efficient – the replacement/efficiency of the energy consumers, 50% considered as an important measure the replacement/efficiency of the heating sources, 41.66% saw the purchase of maintenance materials and equipment at an auction as an efficient method of reducing the costs, 16.66% considered that renegotiating the rent is a factor that would lead to reducing the costs and 33.33% considered that paying the employees according to the money collected could be a method of reducing the maintenance costs.



Graphic no.5. Which are the main measures you took in order to reduce the maintenance costs?

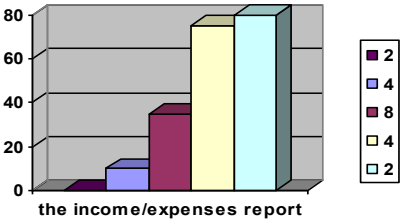
The financing sources the people interviewed underlined are presented in graphic no.6; 91.66% of them considered that renting the space is one of the sources for making their sports center more efficient, 66.66% considered that a greater range of services could be a method for making their institution more efficient, 50% considered that the taxes achieved from organizing competitions could be a supplementary source of financing, 66.66% considered that the irredeemable funds from the local community should not be neglected and, 33.33% believe the national financing projects to be an important source of supplementary financing.



Graphic no.6. Which are the supplementary financing sources for making the sports centre more efficient (managing the sports centre)?

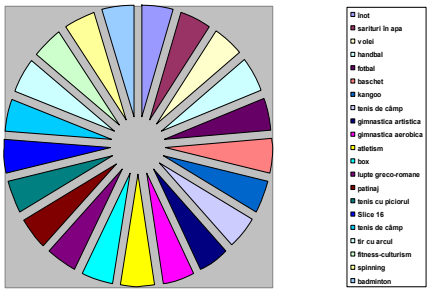
Question 7 "Do you believe the sports center is or could be a source of profit?" got the same answer in unanimity. All those interviewed believe that the sports center is a potential source of profit.

The answers offered to question no.8 are presented in graphic no.7 and showed that 2 subject did not



Graphic no.7. What is the report between the income and the expenses for 2013(percentage)?

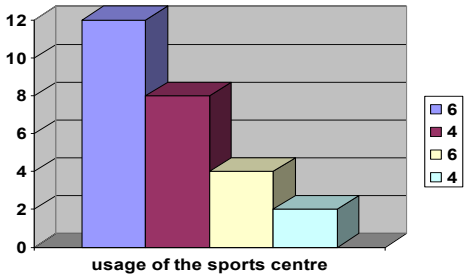
have income from the sports activities, 4 subjects from those interviewed declared that the income from sports activities represented 10% of their expenses, 8 subjects declared that their income was of 35%, 4 subjects declared incomes of 50%, 4 subjects declared incomes of 75%, 2 subject declared incomes of 80% of the expenses.



Graphic no.8 Name the sports activities performed in your sports centre

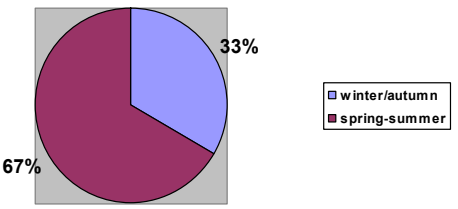
Question number 9 "Name the sports activities performed in your sports centers" showed that in the centers of the people interviewed 20 sports activities are performed as follows: swimming, diving, volleyball, handball, football, basketball, kangoo, field tennis, figure gymnastics, aerobics, athletic events, boxing, wrestling, skating, foot tennis, table tennis, archery, fitness-weight lifting, spinning and badminton.

Question no.10 "Which of the sports activities performed in your sports center are the most efficient?" showed that the most efficient of the sports activities are: swimming, football, kangoo, field tennis, aerobics, skating, table tennis, fitness-weight lifting and spinning,



Graphic no.9 How many hours a day is your sports centre used?

Question no.11 "How many hours a day is your sports center used?" intended to underline the extent to which the sports centers are used and the managers are those interviewed here. The answers presented in graphic no. 9 showed a distribution of the usage time which is not homogenous, 3 subjects saying that their centers are used 12 hours a day, 4 subjects- 8 hours, 3subjects-4 hours, 2subects-2 hours.

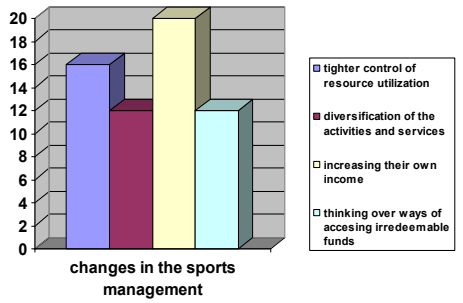


Graphic no.10 .Which period of the year is more productive?

Question no.12 underlined the most efficient periods of time from the financial point of view. Graphic no 10 shows that 33.33% of the people questioned answered that the most productive period of time of the year is the winter/autumn and 66.67% believed that the most productive period of the year is

the autumn/summer.

The answers offered to question no 13 "From your experience so far, what do you think should be changed in the management of the sports center?" revealed (graphic no.11) the following suggestions: 66.66% considered that a more strict control over the use of resources should be improved, 50% of the subjects interviewed believe that the diversity of activities and services should be improved, 83% believed that, when it comes to the increase of their own income, the management should be changed and 50% stated that the way of thinking over the methods necessary for accessing irredeemable funds should be improved.



Graphic no.11. From your experience so far, what do you think should be changed in the management of the sports centre?

7. CONCLUSIONS

- We believe that the purpose of the paper, that of conducting an investigation which should emphasize the availability and the opportunities for practicing sports activities in the city of Bacau and, at the same time, to present information that could lead to new investors and new centers for practicing physical exercise in our city, has been achieved.
- After centralizing the data, we could notice that there are other "opportunities" (swimming, football, kangoo, aerobics, skating, table tennis, fitness-weight lifting, spinning, etc.) in the field of physical exercise that could be exploited as business opportunities in the city of Bacau.
- The hypothesis which was our starting point, that "the spaces meant for the practice of physical exercise are a viable alternative for the business community" has been confirmed. The answers offered by the people interviewed showed without any doubt that a sports center can be a source of profit.
- The pragmatic approach of the problem concerning the financial support for the sports centers by renting spaces, diversifying the services, taxes from organizing competitions, irredeemable funds from the local community and national financing projects can make the sports centers an attraction for possible investors.
- A series of aspects underlined the fact that many of the managers investigated found and are applying in this period of financial crisis different solutions so as

the report costs-profits should incline towards the profits. Among the solutions presented, the main means for diminishing the maintenance costs included the replacement/efficiency of the energy consumers, the replacement/efficiency of the heating sources, purchasing maintenance materials and equipment's in auctions, renegotiating rents and paying the employees according to the money collected.

- A management based on a more strict control over the use of resources, the diversification of the activities and services, increasing the self-incomes and thinking over methods of accessing irredeemable funds is the solutions of a successful business.

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A Case Study on Suzhou's Table Tennis Project Development

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Abstract: Table tennis is our national sport. Since being introduced into China in 1904, the table tennis project has gradually formed unique Chinese table tennis culture with a set of sports system and the humanities culture combined. In terms of the development of table tennis in China, Suzhou is a classic case which not only attaches importance to the cultivation of the backup echelon, but also pays attention to the mining of the mass sports. Therefore, the paper investigated, studied the developing situation of Suzhou table tennis project, and finally put forward relevant suggestions and countermeasures for its future development.

Keywords: table tennis, table tennis culture, mass sport

1. INTRODUCTION

Originated in Britain according to historical records, China's table tennis project was first introduced in 1904. After Rong Guotuan got the title at world championships at the 25th Borussia Dortmund in 1959, the table tennis project was gradually developed in our country. Since 1981, the Chinese table tennis delegations, whichever in the Olympics, the World Championships, or other international competitions, have made great achievements, by virtually sweeping all the items on the medals. Our Olympic plan or the national fitness promotion is all doing well in place, but with the passage of time, can the table tennis project develop to have a bigger breakthrough? How to promote the table tennis as a culture on a global scale is the high priority we need to take in the future.

2. LITERATURE REVIEW

As known to all, the table tennis project has been conducted in China for a long time. From the perspective of the role of the project that has played in many aspects, its influence is mainly on China's economic development, city's driving forward, the implementation of the national fitness, and the cultivation of the professional sports reserve forces. The previous researches are primarily based on the following aspects. Cheng Senjiao et al. mainly explored the development of Chinese table tennis in the Olympic period, and analysed the Chinese national table tennis team's way to success; Zhang Yufei focused on the status quo of table tennis project in public services, by investigating the consumption of citizens in table tennis, and finally put forward the suggestion of promoting table tennis services; Jiang Nan and Wang

Xiaozhou aimed at the developmental premier league table tennis career in our country; Wang Xiaozhou mainly compared Chinese with German table tennis league so as to figure out the right future direction of Chinese table tennis professionalization; Li Jun et al. carried out the study primarily on table tennis in schools, including primary schools, secondary schools and universities, and suggested that the government should lead the table tennis project into the campus, creating a new trend of "Grabbing from Babies"; Li Rongzhi et al. brought us deep insight into the ball history and sport culture of our country, and then put forward in their research a new cross-cultural communication path, thinking we need to build the good image of the country under the trend of globalization. They thought the Chinese also need to dig deeper into the core values of table tennis culture, and construct closer organizational relations and more frequent exchange with the outside world. But the former researches did little in the local table tennis culture development, either provincially or municipally.

Therefore, this paper, with the current situation of the development of table tennis of Suzhou as the research scope, surveyed the current situation of table tennis project development in Suzhou in ways of observation; interview and literature review, and make sensible suggestions concerning new direction of promoting the table tennis project conducive to Suzhou.

3. INVESTIGATION AND ANALYSIS

3.1 Survey of table tennis project development in Suzhou

Jiangsu province ranks top in the sports industry and has relatively leading cities with sports cause development ranking high across the country. In terms of the table tennis project, great importance is attached to by municipal leaders and the masses. Since the 1950s, there have emerged quite a few world champions in Jiangsu province. Under their influence, the table tennis project has been gradually developed into many big cities across Jiangsu Province. Among them, Suzhou is a dynamic city full of passion and vigour for the small ball. Through interview with Chairman of Suzhou Table Tennis Association and by field observation in person at 2013 "Harmony Cup" Table Tennis World Tour Open China in Suzhou, the author learned that Suzhou is a city combining its classical culture and modern science. Small though it looks, the enthusiasm of Suzhou citizens to participate in sport is kept appreciatively high all the year round. The number of people to participate in the various ball-related activities in Suzhou reaches about ten thousand. Each year, more than 10 brand competitions and traditional sports activities are held regularly on a yearly basis. Through long-term exploration, accumulation and inheritance, Suzhou has fused its table tennis project into the city culture, innovated and practiced the project culture propaganda, thus promoting a huge role played in Suzhou development.

3.1.1 Cultural Development Characteristics in School Sports

School sports in Suzhou features combination of training and education. A systematic chain of table tennis training has been set up with university (national

youth sports club), down to the middle schools and elemental schools as training bases (specialist schools, table tennis traditional schools). The local authorities are striving to develop its municipal team to be provincial or even national one. Schools feature not only to have designed school-based table tennis course and after-school interest tutoring in table tennis, but also offer a systematic training, and a competition platform to those who have talent and keen interest. In addition, a kid-friendly "ping-pong dance" is also designed and performed by young students with technical movement combining vigorous sports elements, which is now popular among teachers and students in schools. Each semester table tennis matches are held class vs. class or grade vs. grades, among which those little seed players are selected to receive more intensive and professional training and competition in the municipal table tennis team. This mechanism effectively leads more children to know about, and even to participate with great passion, in table tennis project, which would further spread the patriotic spirit of national sport, and equally cultivate their innovative and collective spirit.

3.1.2 Cultural development characteristics in competitive sports

In competitive sports, Suzhou, since 2009, has undertaken a "Harmony Cup" Table Tennis Open China Suzhou for five consecutive years. By hosting such a significant table tennis sports event, more Suzhou citizens are being attracted to participate in table tennis sport in response to the development of the national fitness activities. In the process of the games, the local government and major organizers conducted multi-themed activities to enrich and hold the Suzhou citizens' great enthusiasm to the national fitness activities. In addition, a series of cultural activities also aimed to deepen people's impression in the tournament and better understand the culture of ping pong. During the event, the organizers even encouraged people to go and enjoy field watching and visit the exhibitions by offering free tickets. The event created favourable conditions for cultural communication with the outside world and further promote the competitiveness of the city to build a harmonious Suzhou. The 2015 World Championships that is to be run as a host in Suzhou Industrial Park will further unveil this ancient cultural city's new look of the reform and development.

3.1.3 Cultural development characteristics in mass sports

In terms of mass sports, Suzhou folk games have been conducted to increase the number of participants and to promote the national fitness activities. Mayor Cup held on every New Year's Day has urged city leaders at all levels to take the lead and set a good example in response to the development of the national fitness activities. Suzhou Finance Cup and Suzhou Club League have not only created a platform for the development of Suzhou economy, but also make it possible to exchange the ping-pong skill among the enterprises and institutions, to recruit talented players and to spread the enterprise culture and features; Happy Ping Pang Tournament also inspire more table tennis enthusiasts from all walks of life to challenge themselves and surpass themselves. This sort of interactive environment helps to enhance

friendship and mutual learning among the participants, resulting in strengthening the competitiveness and image of the city.

3.2 Suzhou table tennis development situation analysis

Through the interviews and field observation of the development of the table tennis project in Suzhou, it can be found that the table tennis project development in our country is much of regional characteristics. Every city's strength and effects are different in carrying out its table tennis cultural undertaking. In promoting the culture, some cities would choose to focus on the development of the professional leagues and the generation of celebrity effect; some other cities, however, would rather hold domestic competitions so as to guide the table tennis culture properly. Comparatively speaking, Suzhou has its own particular features. Unlike its neighbouring city Shanghai, where they set up the Chinese Table Tennis Academy, Cao Yanhua Table Tennis Training School and a series of other gathering points driven by celebrity ping-pong players, Suzhou has its own deep roots that are of paramount importance to table tennis culture promotion and that refers to a solid mass base. So Suzhou can, on the basis of the masses' demand, create its own brand effect brought about by the table tennis culture.

4. COUNTERMEASURE AND SUGGESTION

4.1 Innovatively build and strengthen local professional team

At present, Suzhou amateur training mode is mainly in the form of training chain body with education of the high school, junior middle school, and the elementary school combined. The school is the basic point of the provincial and municipal team. Observations from several well-performed schools as basic points revealed that local parents are surveyed to have roughly three kinds of attitudes towards their children's participation in amateur table tennis training: 52.66% of the subjects in Suzhou support their kids who can both study and play ping pang; 30.86% regard ball playing as a kind of exercise just to keep fit; only 16.48% parents interviewed say they want their kids to qualify for being a place in the professional leagues. It should be said that the phenomenon is common as the amateur training system is widely practiced in our country, which definitely affects the students' progress and growth. This study argues that Suzhou can consider moral education be combined with the professional leagues. Since Jiangsu Province has only one professional team located in capital city Nanjing, to have an innovative path locally, i.e. establishing a municipal professional league would be a wise choice. It would not only provide students with good training opportunities and conditions for the game, but also create a good learning exchange environment for students and with foreign schools. It can even better convince parents that their child would get comprehensive development. In doing so, more local students or even non-local teens are willing to participate in table tennis training and enjoy table tennis culture as their life experience.

4.2 Enrich table tennis cultural extensions by expanding the scope of the services

To enrich table tennis cultural extensions, the characteristics of cultural undertakings should be mainly highlighted by extending product's integration, coordination and popularity. For instance, table tennis commemorative coins, calligraphy exhibition, photography exhibition and the rest should not be on display only during competition. Instead, it is more sensible to have Suzhou culture and the culture of table tennis displayed in sports and tourism festival activities as well. Each updated rolling display can not only deepen the impression of local citizens, but also hold the attention of tourists. What's more, you can invite some domestic famous table tennis coaches, researchers, active or retired athletes to be interactive with local citizens or deliver non-profit public lectures, from which people have more in-depth understanding of the sport and mobilize their enthusiasm to participate in sports.

5. CONCLUSION

To sum up, the table tennis project is in full swing in China, while in a foreign country it is not so warm. By comparison, foreign people tend to be keen on bigger ball and collective sports like basketball, football or tennis. We need to do something if we want more foreign audience to join in table tennis sport. Luckily, the government has already noticed this, and thus implemented the "Wolf Plan", but this study suggests that, to spread the culture, relying on professional top players alone is just not enough. Cultural promotion not only needs star effect, but more power at the grass root level. Only by deepening the foundations of the table tennis culture at the grass roots level can we expand the depth and field of cultural promotion.

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Analysis of China's Combination of Sports and Education based on All China Secondary Schools Table Tennis Championships

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Abstract: By studying the participating number, participating regions, participating provinces and cities, and competition level of the Chinese secondary school table tennis project, this paper aims at revealing the existent misunderstandings between sports and education departments in practicing combined teaching and training. Through literature review, interview, and mathematical statistics, the paper analysed the status quo so as to find a reliable data and information and finally put forward sensible suggestions and valuable reference for both the education and sports departments.

Keywords: table tennis, all China secondary schools table-tennis championships (ACSSTC); all China students games (ACSG), combination of sport and education ('Combination'), national youth table-tennis championships (NYTC)

1. INTRODUCTION

At present there are just two large, formal table tennis events which secondary school students in China can take part in: one is All China Students Games (ACSG), Before 2011, it was still called All China Secondary School Students Games (ACSSSG). The other is National Secondary School Students Table Tennis Championship, organized once a year by the Table Tennis Branch of the China Secondary School Sports Association (CSSSA), and acknowledged by Table-tennis and Badminton Management Center (TBMC) of the State General Administration of Sports (SGAS) and under the leadership of Student Sports Association Secretariat (SSAS) of the ME. The Association's objective is to enrich the school cultural life, promote after-school sports training, and cultivate school athletes to work hard so that athletes may enhance their competitive level and be selected as sports reserve talents.

Through 1999-2014 information retrieval of China's journal full-text database, it was found that there were very few related published papers working on secondary school table tennis project. So it is necessary, through investigation and analysis, to provide valuable reference data and advice for administrative departments of sports and education, scientific research institutions, and schools.

2. RESEARCH AND METHODS

2.1 Related data were analysed of 2010 to 2014 ACSSTC participating provinces and municipalities.
2.2 This paper mainly adopted the literature data method, mathematical statistics method, interview method, and inductive method.

3. RESULT AND ANALYSIS

3.1 2010-2014 ACSSTC

ACSSTC is the most influential domestic national student tournament of high level held by the CSSSA in order to promote the popularization of national table tennis project for secondary school students. Held once a year in summer vacation, the tournament has wide popularity among young students. The participating athletes are junior and senior high school students who are on behalf of their own schools instead of the provinces and cities they belong to. So the number of participating schools and athletes are relatively larger, which basically reflects the current situation of secondary school students' carrying out the table tennis project.

Table 1. Number of participating provinces and cities, and schools at ACSSTC in 2010-2014

participating prov.& cities	2010	2011	2012	2013	2014	entry	number	ranking
1.Shanghai	4	3	3	4	4	18	5	(tied for)
2. Beijing	6	6	7	6	7	32	1	
3.Chongqing	1	1	1	1	1	5	9	(tied for)
4. Tianjing	0	1	1	1	1	4	10	
5. Shandong	4	3	6	6	6	25	2	
6.Guangdong	5	3	4	4	3	19	4	(tied for)
7. Hebei	4	3	3	3	5	18	5	(tied for)
8.Jiangsu	1	2	1	2	4	10	6	
9.Liaonin	4	3	4	3	5	19	4	(tied for)
10.Heilongjiang	5	5	3	1	4	18	5	(tied for)
11.Hunan	4	4	5	4	5	22	3	
12.Henan	1	1	2	1	1	6	8	(tied for)
13.Hubei	1	1	1	1	1	5	9	(tied for)
14.Jilin	5	2	1	0	1	9	7	
15.Shaanxi	1	0	0	0	0	1	12	(tied for)
16.HongKong	0	0	1	0	0	1	12	(tied for)
17.Zhejiang	0	0	1	1	4	6	8	(tied for)
18.Shanxi	0	0	1	0	2	3	11	
Total	46	38	45	38	54	221		

From Table 1 it can be seen that, (1) although the ACSSSA was set up just five years ago, the number of participating teams have increased up to 54 from 2010 to

2014, a fairly fast development on the premise of very heavy learning burden; The number of participating provinces and cities also reached 18, accounting for 52.94% of the total number of 34 provinces. (2) Beijing ranked top the country over in number with 32 participating schools joining during the five years, taking up 5% of the total participating schools across the country, the author referred to the NYC held in November 2014 and found that Shanghai, Beijing, provinces of Shandong, Guangdong, Hebei, Heilongjiang, and Liaoning all ranked top 8 in men's and women's groups. This proves that the larger number of participating provinces and cities has a direct relationship with their better table tennis performance.

Table 2. Number of participating areas, and provinces and cities at ACSSTC in 2010-2014

participating areas	2010	2011	2012	2013	2014	total number of participating provinces &cities total
1. North China	2	3	4	3	4	5
2. East China	3	3	4	4	4	7
3. Northeast	3	3	3	3	3	3
4. Central South	4	4	4	4	6	6
5. Southwest	1	0	0	0	1	5
6. Northwest	1	0	0	0	1	5
7. HK Mc. Tw.	0	0	1	0	0	3
provinces and cities	14	13	16	14	19	34

Note: The latest national administrative division was pronounced on January 25, 2014; the country is divided into seven areas, and 34 provinces and autonomous regions.

Table 2 shows: (1) the participating areas are wide in range, covering all seven administrative zones; North China, East China, Northeast, Central South are the four areas that were best and most involved in. While in other three regions like Southwest, Northwest, Hong Kong, Macao and Taiwan, only 3 of the total 13 provinces and cities entered for the tournament in the five years, taking up 20.07% of the total number thereof. (2) The competition results we referred to of the 9th - 12th ACSSTC held between 2010-2014 revealed that: among the 70-piece medals in the competitions, Shanghai got 27, Beijing11, Hunan 8, Guangdong and Liaoning respectively 5, Shandong 4, accounting for 85.7% of the total medals. (3) Nevertheless, the author found in Competition Order Volumes that 16 of 34 provinces and autonomous regions across the country, not one school has ever participated in the competition in the past five years, accounting for 47.05% of the total, which is rather regrettable and thought-provoking as Ping Pong is such a popular "National Sport" in China.

3.2 Achievement Analysis of NYTC and the Status Quo of Its Development

3.2.1 Level analysis of the national secondary school table tennis sports

Every year the NYTC is organized by TBMC of SGAS, and joined by the professional table tennis players who have registered in their own provincial and

municipal Sports Bureau. As the sports school gradually values the cultivation of adolescent athletes' cultural qualities, sports and education departments have also begun to strengthen the mutual fusion. The education department used to be only responsible for student learning and student status management. Then it slowly tended to be involved in the games. On the other hand, the Table-tennis Branch of the CSSSA has organized a student team after approval of the TBMC since 2010 and entered for the NYTC of the same age bracket in order to improve the sports level of the national secondary school students of table tennis.

Table 3. Chinese secondary school team event result at NYTC in 2010-2014

Scores	2010		2011		2012		2013		2014	
	MG	FG	MF	FG	MG	FG	MG	FG	MG	FG
total	25	21	29	29	30	30	25	25	31	32
gr results	22	0	27	18	0	27	20	16	24	32
sin. results	0	0	0	24	0	0	0	0	23	0

Note: (1) '0' in group results represents missing the game.(2) Only top 32 was awarded for the singles, so '0' stands for being after top 32.

Table 3 clearly indicates that secondary schools table tennis team participated in the (NYTC) in 2010-2014, during which it got the 20th place in men's team event, the 18th place in women's team event, the 23rd place in men's singles, and the 24th in women's singles. Therefore, the results listed above can clearly indicate: the junior school students' overall team level and their individual performances were comparatively lower than that of professional team players, either provincial or municipal. The 10th item of the statistical data -- education, science and technology and culture -- released by the National Bureau of Statistics on February 24, 2014 says that there were 44,401,000 junior school students in 2014. Theoretically speaking, it is a large base in number. Yet, its performance was still far from satisfactory.

3.2.2 Analysis of "Combination" model applied in secondary school table tennis project

It can be seen from the above Tables 1~3 that, at present, the table tennis project in educational field has made great progress in number but still not yet in level of competition. After all, the competition and performance play a leading role in the development and expansion of the project. We had a case study on the two schools that respectively got the first and second place in the 12th ACSSSG. They are Shanghai High School and Suzhou Tian Jianbin High School. With the support from the two departments of education and sports, these two schools, through many years of 'Combination' model, have contributed to a greater degree of resource sharing. "Combination" model has enabled them to achieve win-win. But then, they are still facing some unsolved contradictions and confusions in actually practicing the 'Combination' model.

Differences in teaching objective and training goal: On the one hand, the educational experts think that their edge in cultural education combining with the

advantages in competitive sports can reduce the long-term unsolved problems of talent cost in the development of sports industry. Likewise, high-level athletes' good results in the competition can help enhance the school profile, and promote the construction of campus culture. But sports department officials, motivated by 'Combination' model, are mainly aiming at solving the realistic problems to some extent, like the athletes' basic course learning, and even their academic degree after they get retired from sports career, which would offer larger possibilities for their employment in future.

The contradiction between the 'Combination' model and the competition goal: At present the implementation of the 'Combination' pattern in China is basically confined to the practice that athletes would just be scattered and allocated in normal classes accordingly, while the sports department would provide competitive or promising athletes who can bring competition awards for their school. So people crave the early emergence of a new model that can really reconcile and address the extant yet unsettled contradictions.

The current talent selection system deficiencies in our country that barricade the development of sports: From the perspective of students as a main body of school, students in their basic schooling years are overwhelmingly harnessed by their own parents. Strongly influenced by three-day Higher Entrance Examination in China, parents much value their kid's academic performance at this examination as the cultural course test scores have an overwhelming advantage in talent selection. Parents generally believe that score matters more than anything else. So children's study should be taken a higher priority than any other extracurricular interest class. No matter how well a kid performs in a club and how gifted he is in sports, he has to drop it if it becomes a barrier to academic learning and achievement.

4. CONCLUSION AND RECOMMENDATION

4.1 Conclusion

The participating teams from 2010 to 2014 rose to 54 and the participating provinces reached 18. But in 16 of 34 provinces and autonomous regions across the country, not one school has ever participated in the competition in the past five years, which is rather regrettable and thought-provoking.

There was the largest number of participating teams in 2014 covering all the seven administrative areas, among which North China, East China, Northeast, and Central South gave the best performances, which are shown by the achievements of the 5 participating provinces and cities mentioned above. While in the other three regions like Southwest and Northwest on the mainland, Hong Kong, Macao and Taiwan, only 3 of the total 13 provinces and cities entered for the tournament in the five years.

Secondary schools table tennis team participated in the NYC in 2010-2014, but its competitive level either in boys or girls group events or singles was comparatively lower than that of professional team players, either provincial or municipal. With

such a large schooling population and sophisticated sports facilities, its performance was still regrettably far from satisfactory.

Education and sports both belong to the same-level administrative units. The two departments, in the process of cooperation, are still facing problems like student athletes' learning, training, and competition. How to adjust cultural course learning and sports training time always remains to be the key question involving the interests of both sides.

4.2 Recommendation

As education and sports departments have their own advantages, the comprehensive cooperation between them two can make up mutually in the teaching and training management, sports popularization, sport training for specific purposes, human resources cultivation, and comprehensive utilization of funds and facilities. When scientific distribution meets with the national system reform, sports departments should timely adjust the direction, and speed up the research on joint educational goal, idea, management system and the specific measures for relevant rules. What is more expected is that deeper cooperation should be encouraged between schools and sports teams, and a new way is gradually to be formed to follow the law of competition and training, and the rules of cultural education management as well. Only through the combination of sports and education can athletes' ideology, cultural level, and innovation ability be enhanced, and can athletes also probably make themselves the nation's talents with knowledge and skills.

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2010-2014 NSSTTC Results

2010-2014 NYC Results

Major Functions and Characters of Controlling and Guidance Techniques of Rotating Arc Ball

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Abstract: The character of precession in the banana shape trajectory of the rotating arc ball is caused by the small angle cutting strike between the swing of the paddle and the ball, which leads to the inverted rubber to deform mainly in the tangential direction, and this in turn brings about the rolling friction rebounding carry motion. This is caused by the control and guidance of the cross force of Magnus effect, which deviates the flying trajectory of rotating arc ball. The cross force comes from the non-overlap between spinning angular velocity vector and flying speed vector. This non-overlap is caused by the differences in air flow speed and pressure, which leads to the difference in speed between the two ends.

The precession momentum of the rotating arc ball not only controls and guides the initial banana shape trajectory, but also controls and guides the trajectory after the ball landing on the table; it also controls the precession speed, strength, target of landing, which makes its rotation fast and precession strong, which is the reason why it has high scoring average. This is caused by the successive control and guidance character and function of the precession momentum of rotating arc ball.

Keywords: control and guidance, precession, banana shape trajectory, trajectory change, bounce

The control and guidance technique of rotating arc ball means the ability to control and guide the motion direction, rotating direction, trajectory, strength, speed, landing target of the ball and win the match. The competition lies in matching against each other for their abilities to control and guide. The precession momentum of rotating arc ball keeps in motion. Control and guidance means its direction of precession is the same with the direction of speed.

1. The banana shape trajectory of rotating arc ball is controlled and guided by the precession function

Limited by the height of the net and the boundary of the table, an ideal trajectory for the ball is the banana shape trajectory with the first half straight and the latter half curved. This facilitates the landing onto the table of the ball, guarantees a high hitting rate, and reduces the bounce trajectory out of the table. The fast precession, strong rotating speed, and easy-to-score functions all come from the control and guidance of precession function.

Precession means the rotating of the ball centering around point O on the plane or axis O in space, and the point O or axis O rotates and moves at the same time. Different from precession, there is no shift for rotation, therefore it cannot cover precession; but there is rotation in precession. In this sense, the popular saying in the table tennis field that "the function of rotating arc ball lies in its rotation" is deficient.

Cutting strike (see Lufang Jin & Shusheng Wu et al. On the Principles and Techniques of Rotating Arc Ball, a keynote paper presented to The 13th Science Congress of International Table Tennis Association, held in Pairs during the 52th World Table Tennis Championships, 2013). The elasticity of the inverted rubber produces a deformation mainly in the tangential fashion, and the rotating arc ball thus produced by the rolling friction rebounding carry motion will process in the banana-shape trajectory. This is caused by the control and guidance of the cross force of Magnus effect, which deviates the flying trajectory of rotating arc ball. The cross force comes from the non-overlapping between spinning angular velocity vector and flying speed vector. This non-overlapping is caused by the differences in air flow speed and pressure, which leads to the difference in speed between the two ends.

In a word, the precession of the rotating arc ball is successively controlled and guided by the Magnus effect.

2. The precession momentum of the rotating arc ball is produced by the cutting strike friction rebounding carry technique

The friction between the paddle and the ball can cause resistance. If there is no rebounding carry motion, the ball cannot pass over the net due to lack of rebounding force, therefore friction alone cannot produce rotating arc ball. The cutting strike produces the rotating arc ball, the friction causes the spinning of the ball, and the rebounding carry makes the ball to process forward. The back spinning path of the rebounding carry successively controls and guides the ball, leading to the increase of the positive pressure, friction, spinning strength, tangential force, and precession speed.

In a word, the precession momentum of the rotating arc ball is produced by the cutting strike friction rebounding carry technique.

The high value of rotating arc ball is seen from its high hitting rate and high scoring average. Where do these come from? They come from the effective functions and characters of high spinning strength, fast precession speed, and the banana shape trajectory. They also come from the functions and characters of the cutting strike of the ball with the paddle, precession kinetic energy produced by friction rebounding carrying technique, and the full-scale control and guidance on the precession strength and speed by the rotating arc ball.

3. The rotating arc ball does not fall immediately after spinning out of the table but instead is controlled and guided to move in the banana shape trajectory

After spinning away from the paddle, the rotating arc ball first processes in the banana shape trajectory; then changes into gliding precession after landing on the table and going through the slanting hollow sphere-deformation; then it bounces away from the table and vibrates in centrifugal fashion, processing in irregular trajectory; at last the ball forms back to sphere and processes in banana shape trajectory again. These are the four stages of the whole trajectory. The second and third stage of the precession is often overlooked, that's why there are discussions on the saying of "the rotating arc ball falls immediately after leaving the table".

Mechanism for the landing of the ball on the table is similar to that of the landing of the rotating tire on the plan. The landing of the ball on the table is spinning cutting strike, the pressure and torque force towards the table result both in the Mohr's circle deformation and slanting hollow sphere deformation. The spinning axis of the ball, shape center, and the mass center deviate out of the ball, making the horizontal central position to hollow in and deform and causes gliding precession; then there is sphere-deformation; then the torque force and centrifugal force act together to lower the bouncing angle, making the ball to leave the table, forming a precession trajectory first vibrating centrifugally forward and upward irregularly.

The elasticity changes the ball back to roundness, and the deviated axis center, shape center, and mass center quickly come back to the center of the ball, the air surrounding the ball also recovers, repeating the banana shape trajectory motion caused by the friction between the round ball and the air.

The rotating arc ball does not fall immediately after leaving the table, but spins upward and forward due to the complex control and guidance by the rebounding force and Magnus effect. That being said, the popular saying in the table tennis field that "the rotating arc ball falls immediately after leaving the table" is not supported by the mechanism, law, function and character of the banana shape trajectory controlled and guided by the rotating arc ball.

4. Conclusion

The rotating arc ball processes in the banana shape trajectory after spinning away from the paddle. This is caused by the control and guidance of the cross force of Magnus effect, which deviates the flying trajectory of rotating arc ball. The cross force comes from the non-overlapping between spinning angular velocity vector and flying speed vector. This non-overlapping is caused by the differences in air flow speed and pressure, which leads to the difference in speed between the two ends.

The precession kinetic energy of the rotating arc ball successively controls and guides the banana shape trajectory at the first part, and then the following trajectory after landing on the table. It also controls and guides the precession speed and strength, landing target, and processes. This is the reason for rotating arc ball's high rotating speed and fast precession speed, also the reason for its high score. In a word, it is because of the function and character of the control and guidance of the rotating arc ball.

The popular sayings in the table tennis field that "the rotating arc ball falls immediately after leaving the table", and that "the function of rotating arc ball lies in its rotation" are not supported by the mechanism, law, function and character of the banana shape trajectory controlled and guided by the rotating arc ball.

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Main Measures of Youth Sports Organization and Development on Table Tennis

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Abstract: Research methods such as literature review, expert interviews and logical analysis would be carried out in this essay to discuss the main measures of youth sports organization and development on table tennis projects. The aim of this essay is to provide reference for relevant departments in order to promote a healthy and orderly development of table tennis reserve personnel training. We must keep pace with the times and explore in depth, enhancing youth table tennis organization and construction to be suitable to actual circumstances, fully guarantee a scientific and effective personnel training system. In the meanwhile, we must improve communications between physical and cultural education departments and promote the win-win situation of training talented people of physical and cultural dual-system.

Keywords: table tennis, youth, sports organization, development

Reserve talents are the foundation of a sports project maintaining long-lasting, while youth table tennis organizations at all levels is the important carrier of table tennis development, the basic support of table tennis reserve personnel training and the vital guarantee of forming a system of training table tennis reserve personnel scientifically and effectively. It is necessary to develop and integrity various youth table tennis sports organization in order to achieve the healthy and sustainable development of table tennis in China.

1. To strengthen management of organizations and promote three-in-one harmonious all-round development of "group, competition, learning" of table tennis in china

It is necessary to develop macro management and guidance of policy, developing plan, project layout and investment by table tennis project management center, as well as the regulatory functions of all kinds of table tennis community in order to promote the wide launch among general public, vigorously push on the organization and implementation of table tennis "physical and cultural combination" work in teams at all levels and national teams, also pay attention to the management and

construction of excellent table tennis teams and clubs, and construction and training of national teams.

What's more, we should ensure the stable development of high-level competitive table tennis teams in our country and successful complication of "Olympic" mission, meanwhile keep reserve talented people "production" efficient and smooth, develop and organize the national contests of table tennis projects, vigorously disseminate and popularize table tennis and standardize management of sports. Besides, we can support actively the establishment of private table tennis clubs while organizing the masses and teens to take part in it, reform and perfect the games of all types and levels which are suitable for middle and primary schools and general public to combine "popularization and promotion". Therefore, we will truly increase the total population of table tennis projects in the society and lay a good foundation of the table tennis reserve talented people development.

2. To consolidate foundation, improve youth table tennis sports organization service network, train table tennis reserve personnel in muti-chnnels.

The cultivated mode of diversified table tennis reserve talented people should be adopted currently and also in the future for a long time in China because of the characteristics of its "double track system" and "gradual reform", in order to form a system of "government-led, department-managed, implementing subjects-diversified". According to experts, there are three main channels to cultivate them combined with the national condition of our country (Figure 1): (1) Clubs cultivate themselves. The table tennis association make regulations timely to ask for the cultivation of athletes and will no longer allow clubs to take part in competitions by loaning athletes. (2) Table tennis associations in every regions establish "school table tennis committees", which are led mainly by related leaders in charge of sports in education committee, to let sports and education departments grasp together such as organizing table tennis matches regularly in regional primary and middle schools and colleges and establishing a connected cultivating system of primary schools, secondary schools and universities. (3) The Sports Bureau at all levels must maintain and strengthen the original cultivating modes during the transition currently, the table tennis associations give guarantees from the aspect of policy, organization and fund, and gradually transit from free-training to paid-training.

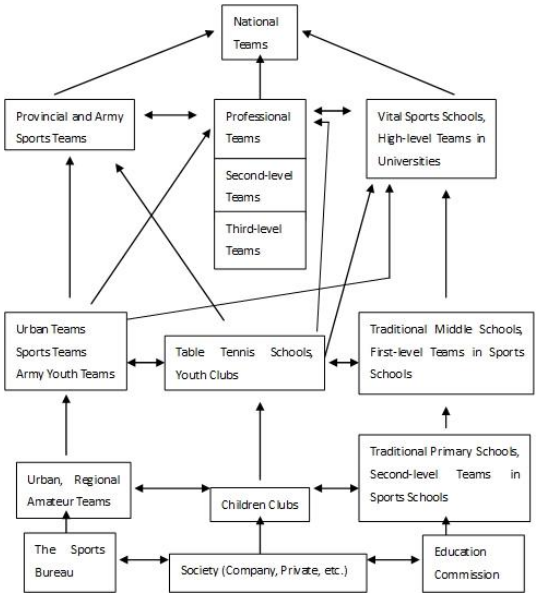

Fig. 1. Table Tennis Reserve Talented People Cultivating Sports Organization System and Path Model in China at the Present Stage

Table Tennis Management Center consult with other government administrative departments to launch preferential policies such as tax cuts, in order to encourage any groups in the society (private, corporate, etc.) to construct table tennis schools, children and youth table tennis clubs and devolve power, improve the independence and autonomy of operators. Meanwhile, they should actively guide all kinds of table tennis sports organizations to increase their own "hematopoietic function", encourage social forces to participate in the reserve personnel training system by developing sports intangible assets, striving for social sponsorship, collaborating with companies and other social institutions, etc. in order to achieving the diversification of teams (clubs, sports schools, etc.) fund.

3. To enhance institutional construction and intensify standardized management.

It is necessary to go a further step to improve our table tennis competition management system and reserve talented people selected regulation system, to give full play to the competing leverage and break the limitation of administrations running matches, cultivate and rely on social forces such as companies and organizations to hold a variety of multifarious events, as well as build an open competing platform with sports and education departments participated together. At the same time, we should improve the reserve personnel selection mechanism, following the selecting principle of openness, impartiality and fairness by adopting the selecting method of combining quantitative index and qualitative index, in order

to select talents openly and preferentially and promote the rational flow of table tennis reserve talented people. The specific methods are as follow:

(1) To take overall consideration, formulate policy of carrying out table tennis by supporting less-developed areas and arouse the enthusiasm of it in remote areas to realize the equalization trend of population distribution that youngsters participate table tennis training. (2) To revise the athletes' technical level standard, play a role of policy readjustment and attract teenagers to take part in table tennis sports to the utmost. To intensify age detection further, establish the rotated measuring system of youth games, and narrow the volatility of age detection gradually. To check on the passing age strictly when national second-level team select and apply athletes and establish joining age detection system. To achieve an obvious real regression of table tennis athletes making age falsehood in three years. (3) To obey the regulation that top two athletes in national youth championships and those gold medallists of right age in national youth championships join in national second-level, arouse the enthusiasm of cultivating excellent young athletes in provinces and cities. (4) To abide by the stipulation that those athletes who make outstanding achievements in national youth matches do not account for the quota of the teams and can take part in national training practice in order to highlight the fundamental role of competition in youth reserve force training. (5) To develop the construction of high-level reserve talented people and evaluate methods to create basic conditions of cultivating excellent reserve talented people. (6) To revise the national table tennis youth training outline to make the training more scientific and reasonable and accord with the needs of cultivating new backup talented people. (7) To promote the intercoordination of sports departments and education departments on the basic of existing policies and regulations, establish together and gradually consummate the incentive policy, supervision and reward mechanism, flowing mechanism and promote management informatiozation. (8) To establish table tennis information network system and input information of competition performance at the county level and above in it every year, establish personal network profiles of second-level athletes as well as above so that it is easy to track athletes and propitious to the fair competition of selecting and recruiting.

4. To deepen reform and transform functions, to reinforce construction of associations, to accelerate process of association substantiation.

(1) To exert the brand advantage of China table tennis Association and develop new industrial growing point to make more companies become our cooperative partners and expand the influence of association from the aspects of economy and society. (2) To mobilize the forces of the society, companies and media to develop table tennis national fitness market in a larger measure and gradually become the main strength that China table tennis association can rely on while developing. (3) To expand the cooperation with other news media, seek new media partners and increase industrial growing point of table tennis development while opening up table tennis market and fully giving play to the resource advantage of China Central

Television (CCTV). (4) To shift method of capital investment of China table tennis association, let it be put by the government to make the transition to full market and the society and sell high quality service of China table tennis association to the government. (5) To transform the choosing and employing mechanism of China table tennis association by practicing a separation of work and society, management and conduct so that there will be more social personage working in association and stimulate vitality of developing table tennis sports by China table tennis association.

5. To strengthen propaganda and create atmosphere.

The table tennis management center should strengthen ties to major media such as China Central Television, China sports, Table Tennis World and China table tennis association's official website, or use different forms to enhance propaganda level of youth competition and training in order to expand influence and create a good atmosphere. In addition, all kinds of table tennis sports organizations at all levels should intensify propaganda, increase funding and use a variety of highly individualized means targeting to the organization itself to strengthen it, in order to more youth table tennis sports organization known by more people and attract more children and adolescents to take an active part in table tennis.

6. To unearth table tennis cultural connotation deeply and increase influence of table tennis sports by using the power of culture.

(1) To continue carrying forward our fine cultural tradition of table tennis sports in our country, blending it in the whole process of sustainable development and running through every aspect of developing table tennis career. (2) To spread table tennis culture, pay attention to compile table tennis sports history and its team history, as well as collect chronicle of events and records of success and failure cases, in order to compile and accumulate materials of "China Table Tennis Sports History". To do a good job in the construction of China Table Tennis Museum, making it mixing together informative, educational and entertaining in one. To conduct vigorous propaganda of China table tennis teams' spirit of patriotism and collectivism, pay attention to the publicity of table tennis public welfare activities and establish a good social image of table tennis projects. To organize elite athletes to participate in influential and healthy school education activities. To coordinate with education departments so that we can provide excellent athletes to help and organize high-level college student’s table tennis leagues, therefore, more games will be held in schools and there will be more influences of table tennis in schools and universities, which are beneficial to build a table tennis campus culture.

7. To improve communication of departments and promote the win-win situation of training talented people of physical and cultural dual-system.

We should stick to the principle of sharing resources together, taking responsibilities, fulfilling obligations, enjoying achievements, besides, in the work of promoting sports and education combination, we should go a step further to strengthen the communication, communion and cooperation of both sides to fully arouse the enthusiasm of physical and educational departments combined in all aspects.

On the one hand, educational and physical authorities should enhance the cooperation between policy-making leaders and organizational management in order to solve "sports and education combination" promoting and source power developing problems. Because some educational and physical departments in a considerable range of cities and counties have been combined into one during the reform of government institutions and the work management at basic level has already been unified, but those two departments still in a state of separation at provincial level ; therefore, strengthening the cooperation between leaders making policies and organizational management institution at this level becomes more urgent and important in order to make a greater achievement at higher level in "sports and education combination".

On the other hand, both sports and education departments should reinforce their utilization and sharing of resources to fully reflect the developing principle of win-win cooperation and advantage complementary. We should focus on sharing spirit in material resources, promote exchanging and flowing equally on faculty and human resources, construct together in cultivating reserve talented people and sharing achievements, create an open and exchanging system in race-constructing to boost communication between athletes. Therefore, on an open and competitive coexisted resource platform, we can realize not only improving table tennis athletes' cultural quality in physical departments and coach's scientific research ability, but also promote the technology breakthrough of table tennis athletes in educational departments and development of teachers' teaching ability, thus we can achieve the unity and consensus of the two-way flow between coaches and teachers, title appraisal mutual recognition and scientific research cooperation and so on in both educational and physical systems.

In addition, when referring to the mechanism of college athlete’s enrolment, physical and educational departments should strengthen cooperation more especially to high-quality rare students such as national athletes and table tennis athletes above that level, and actively absorb domestic and foreign advanced delisting system of sports talented people. We should make public in time those knowledge-seeking information of professional teams and high-level table tennis athletes in clubs every year on the information network platform including sports and education, and avoid partial colleges and universities scrambling and monopolizing resources of recruiting, hence, we can promote the personnel

reasonable complementary and structure optimization of high-level table tennis teams in colleges, and improve the whole level of them.

Moreover, sports and education departments, specific to the table tennis professional sports teams and those in colleges and universities, should all confirm the primary goal of cultivating reserve talented people as well as the reality of developing them. Professional leagues should also positively advocate conveying better comprehensive talents while cultivating excellent athletes in medal competition. Sports teams in colleges and universities should also aspire to cultivating outstanding and high-level table tennis competitive sports talents for our country on the basis of combining popularization and improving.

Currently, we should mainly do the following five specific jobs well:

(1) Firstly, we should closely coordinate with the educational department, drawing up teaching outline, teaching material, examination standard that sports and education combine with students to make coalescent of table tennis and its education. Key schools should be assessed and named to arouse the enthusiasm of launching table tennis sports in schools.

(2) Secondly, we should promote the credit system in culture learning for athletes in national teams, establish national culture education office and organize specialized personnel to conduct research and implement. The athletes' culture test scores should be included as a hard index in being selected to national second team, meanwhile, set up corresponding exiting mechanism.

(3) Thirdly, we should promote the construction and development of Tongzhou China table tennis institute and Shanghai China table tennis academy, giving play to advantages of education, resource, policy, human resource in colleges and academies to provide experience of table tennis for sports and education combination. On principle, athletes in national teams should go the China table tennis academy to study and make great achievements.

(4) We should promote combining sports and education, fight for basically realizing that juvenile table tennis players above 15 years old can complete the nine-year compulsory education until 2020, and 90% national-team coaches' culture level can reach university level and coaches all over the country can reach it.

(5) We should establish the testing system of national youth competing culture, which means those cannot take part in matches if they fail in cultural courses. We should also establish specialized teams to test culture levels and strengthen the cultural research, continue increasing the difficulty ad normalization of testing culture levels in matches and strive to let degree of difficulty of test questions attain the standard of the same grade in ordinary schools in six years.

8. CONCLUSION

Reserve talents are the foundation of a sports project maintaining enduring, while youth table tennis organizations at all levels is the important carrier of table tennis development, the basic support of table tennis reserve personnel training. Therefore, we must keep pace with the times and explore in depth, enhance youth

table tennis organization and construction to be suitable to actual circumstances, fully guarantee a scientific and effective personnel training system. In the meanwhile, we must improve communication between physical and cultural education departments and promote the win-win situation of training talented people of physical and cultural dual-system to achieve a healthy and sustainable development of reserve personnel cultivation, so that we can make the table tennis competitive level of our country lead the world in the long term and the table tennis movement in schools as well as among the masses develop vigorously so that it can bring into full play the social value in the process of constructing a harmonious society.

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A Research on 2014 Assembled Training Elements and Model of National Elite Youth Table Tennis Players

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Abstract: This paper utilizes the methods of documentary study, field investigation and mathematical statistics to carry out a survey and analysis of the main work and key elements of the 2014 national assembled training of elite youth table tennis players. The objective is to give statistical support for accomplishing the tasks of assembled training and building a more reasonable assembled training model, and provide reference for the training of table tennis reserve talents. The following conclusions haven been drawn from this analysis:

1. The overall competitive strength and level of grassroots youth teams have been inspected. Centering on the vision of discovering emerging players, fostering backbone players and highlighting key players, the role of our teams as talent reserve and booster was maintained and developed. Well-structured talent reserves have been built, with key talent reserves of players born between 1995 and 1996 and after 1997 taking shape. Various table tennis techniques were developed, with special attention given to the skills improvement of players favouring the pen-hold-grip, rubber play, and left-hand-grip techniques.

2. During the assembled training, the players' training awareness and training execution were given special attention. The aim was to improve their awareness of whole-table serving, stability of serving and receiving, and the combination of various techniques. Players were required to make their footwork more active and rational, and to improve movement around the whole table, thereby making more concentrated strokes and better-combined techniques near and away from the net. In a stalemate stage, varied play was encouraged in forehand and middle paths, and abilities such as attack-after-defence were improved.

3. During the assembled training, the methods of periodic arrangement and module training were combined. In consideration of the large number of players, of their wide age span, and of the various play styles and tactical development characteristics, exercise loads were reasonably arranged in training cycles and module training was exercised according to players' personality and styles so as to achieve maximum improvement of players' overall competitive ability. Throughout the assembled training, the different periodic arrangements of exercise load and relatively high-stress-level training worked together to achieve the purpose of enhancing overall strength. During multi-ball training and the makeup stage, more attention was given to players' module training. In line with the techniques of different players, deficiencies were compensated and strengths were increased. Multiple skills of handling over-the-table short shots were strengthened, while active

coordination of the first three strokes, attack in passive situation during sustained rallies, the application of one's own tactics and other abilities were also improved. Through targeted module training, players' overall competitive strength was promoted.

4. To consolidate the competition and motivation mechanism and enhance players' actual competitive ability, the assembled training was divided, by different lottery methods, into three stages, which included 24 sections and over 1,500 matches. Based on the principle of competition between the strong, the players were trained in the overall application of skills and tactics, the keeping of psychological balance and the improvement of willpower. They were trained to remain motivated when leading, not to give up when trailing, and to do more thinking and dare to play during key points and key games.

5. Related regulations on bone-age detection were strictly followed during the assembled training. The few over-aged players present saw the number of their matches limited according to the regulations. Even though this move might have had a temporary impact on the overall level of matches during the assembled training, it would facilitate the sound development of the team in the future, the correction of mistakes and the building of a qualified team with a good competitive reputation and huge influence at home and abroad within a short period of time.

Keywords: table tennis, assembled training of elite youth, training elements and model

1. INTRODUCTION

The 2014 national assembled training of elite youth table tennis players was held in Chengdu. Participating in the 36-day training were 70 players from the national men's B team and various provincial teams, as well as six coaches from provincial teams.

During the assembled training, the coaching staff required the trainees to grasp the latest developments in the world of table tennis, actively made use of the latest methods and approaches in tactical training, and gave major attention to the improvement of players' basic competitive abilities. The effective connection between training and competition was emphasized and the improvement of players' overall strength was underscored.

2. OBJECT AND METHOD OF RESEARCH

This paper takes the 2014 national assembled training of elite youth table tennis players as its research object. Through such methods as documentary study, field investigation and mathematical statistics, the training elements of the 2014 national assembled training of elite youth table tennis players are surveyed and analysed so as to establish a model of regional assembled training.

3. RESULTS AND ANALYSIS

3.1 Training cycle and exercise load

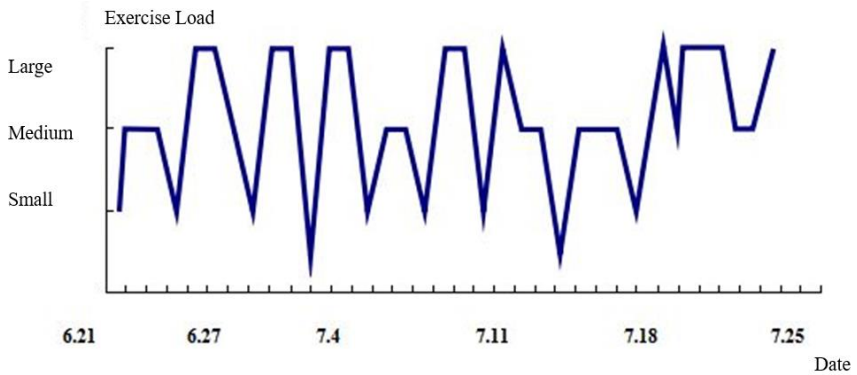

Chart 1. Exercise cycle and load

The assembled training combined periodic training and module training. Each cycle comprised three stages of large exercise load, three stages of medium exercise load and two small-load adjustment stages. The development of players' overall abilities, particularly their technical and tactical abilities and physical abilities, was the focus of each cycle, and larger exercise loads were implemented. Through the periodic arrangement of different exercise loads and the stimulation of stronger stress training, the aim of improving overall strength was achieved.

3.2 Match cycle and match load

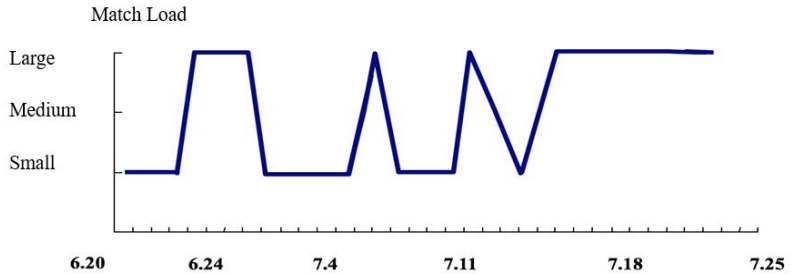

Chart 2. Match cycle and load

The assembled training included 24 match sections, spread over three stages, and displaying the features of periodic training and periodic matches. Matches in the early period of the training, which were aimed at testing players' ability, finding out deficiencies and differences, were heavy-loaded. Matches in the middle period of the training, which were aimed at checking the results of training and making the following training more targeted, were medium-loaded. Matches in the later period

of the training, which was aimed at checking the results of training and reinforcing the competition and motivation mechanism, were heavy-loaded and lasted a longer time.

3.3 Content arrangement of training and analysis

Table 1. Overall content arrangement and share

Content	Technical and tactical training	Physical training	Literacy education	Professional learning	Internal matches
Share	36.07%	5.06%	17.32%	12.73%	28.82%

The assembled training centered on technical and tactical training and internal matches as its main content, with physical training, literacy education and professional learning as its supplementary content. During technical and tactical training, players consolidated their existing skills and made up for their deficiencies. Through the matches, training quality was assessed, problems were found and the gaps between players were identified. Physical training was aimed at enhancing physical strength. Literacy education and professional learning worked to improve players' knowledge structure and promote their quantitative understanding of the laws of the sport.

3.3.1 Technical and tactical training

Technical and tactical training highlighted the cultivation of awareness and played a positive role as a pilot. This training comprised both basic technical and tactical training, and personal plans, at a ratio of 4:1. The main tasks of basic technical and tactical training included strengthening the awareness of whole table serve drop-point, improving reception stability, making footwork more active and accurate, enhancing the overall offence-and-attack ability and sharpening forehand and middle-path breakthroughs. Personal plans aimed at making up for one's deficiencies and reinforcing one’s advantages. Targeted training was implemented according to the specific conditions of each player.

3.3.2 Physical training

Table 2. Share of each quality in physical training

Content	Strength	Speed	Stamina	Agility	Flexibility
Share 1	0.48	0.17	0.13	0.20	0.02
Share 2	0.25	0.30	0.15	0.25	0.05

Note： Share 1 in the chart describes the share of different physical qualities in the assembled training; Share 2 in the chart describes the share of different physical qualities suggested in a research in 2006.

From Table 2, it can be seen that the share of strength training had increased significantly, the share of speed training had decreased, and the share of the other three qualities had dropped slightly. The reason for this change lay in the fact that the players at this assembled training were in poor physical shape. Also, the gap between high-level table tennis players in terms of technical and tactical abilities is

becoming increasingly narrow, which has made strength an important factor influencing sports performance. For those reasons, strength training took a larger share. The diminished share of speed training was caused by the larger share of strength training.

3.3.3 Match organization

Matches accounted for 28.82% of the assembled training, which was second to technical and tactical training only. In the early period of the training, players were divided into four groups according to age and competitive levels, and round-robin matches were held within each group. In the middle period of the training, matches were held between national team players, and between national team and provincial team players. Round-robin matches were also held within groups. In the later period of the training, all the players were divided into three groups for round-robin matches. Finally, matches were held between the six national team players with the lowest scores and the eight provincial team players with the highest scores. With respect to the arrangement of matches, different match modes were adopted for different stages and purposes, which made the matches target-oriented and purposeful.

3.3.4 Literacy education and professional learning

Each week, two sessions of literacy education were scheduled in the morning and evening respectively. Professional learning sessions were irregularly arranged in the evening. Literacy education, which accounted for 17.32% of the assembled training, aimed to help players enhance their knowledge level, master multi-disciplinary knowledge, achieve all-round development and improve overall knowledge structure. Professional learning included specialized theoretical learning and video analysis, and accounted for 12.73% of the assembled training. The aim was to make players understand the fundamentals of the sport and other professional knowledge so as to better grasp the characteristics of table tennis, master the laws of training and provide theoretical and knowledge support for the improvement of training quality and the cultivation of players' self-training and management ability.

4. CONCLUSION

3.1 With technical and tactical training, physical training, professional learning, literacy education and internal matches being the key modules of regional assembled training, the model of assembled training was established for the testing of table tennis talent reserve, the overall improvement of competitive ability and the all-round development of talents. Selection of the different learning and training modules should be based on the actual conditions of players. While stressing overall development, differential treatment should also be exercised. The results of learning and training should be checked regularly so as to identify problems and adjust the methods and approaches of learning and training.

3.2 Periodic arrangement and module training were combined during the assembled training, and the training awareness of players was the focus of the training. With respect to matches, the competition mechanism was consolidated. Different modes of match were used in different stages. Bone-age detection was strictly implemented and over-aged players were dealt with seriously.

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Market role on promoting table tennis from the perspective of economy

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Abstract: In 2014, the State Council issued a document about some ideas on stimulating sports consumption by accelerating sports industry development. The sports industry is facing a favourable time for growth, meanwhile, table tennis, being an important part of China sports item, will set off the boom. By means of document inquisition, experts' interview and theoretical analysis and market economics theories, this paper aims to analyse several questions about the role of market in promoting economic development and discuss the function of table tennis market's expansion in table tennis item.

Keywords: market, table tennis, development

After the reform and opening up, China has spent 30 years to cover the development that the developed countries in 200 years. It has something to do with the superiority of socialist system, in addition, Chinese government's understanding of the role that the market in economic development also has a very important relationship. Although economics and sports science are different in study object, they have research method in common. Many economic theories can provide reference for sports institution reform. In 2014, the State Council issued a document about some ideas on stimulating sports consumption by accelerating sports industry development, making it clear to speed up the development of sports industry. In the development boom of the sports industry, table tennis related industries will show a vigour it never had. Thus, with the aid of successful experience in economic field and recognizing rules and principles in table tennis market to promote the development of table tennis.

1. INTRODUCTION

1.1 The definition of table tennis market

The definition of market by Wikipedia: originated in ancient human trading places for a fixed period of time or place, and the trading venues were formed in order to reduce the searching cost by those who were in need of regular goods exchange. The definition of the American marketing association, 1960 the

committee proposed the following definition for market: market refers to a collection of potential buyers for a kind of goods or services. Philip Kotler defined as: the market refers to a set of actual and potential buyers for a certain product.

According to the definition and characteristics of the contemporary market, table tennis market is defined as: table tennis related transactions of goods and related services. It includes general and special table tennis market. General table tennis market refers to the goods market. Special table tennis market refers to a market aiming to satisfy table tennis development, customer demand and service demand.

1.2 Classification and current situation of table tennis market

1.2.1 Classification of table tennis market

According to China's sports industry development report (2013), the blue book of sports industry, the classification of Chinese table tennis market can be divided into table tennis competition market, fitness market, products market, venue industry market, media market.

1.2.2 Current situation of table tennis market

In general, the development of the Chinese table tennis market is at the exploration stage, facing many challenges and confusion, but the potential of market development is huge. If the table tennis market can be rationally developed, it will play a very important role in promoting and developing table tennis sports.

Chinese table tennis club super league continues to explore and gradually make itself into the market since its foundation, but has not yet to achieve a true professional. In the competition part, the role of the market in the table tennis competition completely didn't show up. With the improvement of national life, sports fitness industry has become a new growth point of national economy. Because of its strong fierce competitive, entertainment and convenience of participate, table tennis is becoming a favourite sports of consumers. Chinese table tennis products market scale is expanded year by year, but it is "big but not strong" on the whole, in addition to its chaos of the products market, the development of table tennis industry is serious restricted. In the part of table tennis venue industry market: venue scale expands gradually, but the venues and facilities are not standard, poor environment is still the problem in the development of the market. With the development of Internet, consumers changed their way from traditional media to merging Internet. Table tennis media market develops in the direction of diversification.

2. METHODS

2.1 Basic role

2.1.1 Table tennis market's expansion is the direct material base of table tennis development.

The development of a sport needs money, social donations, corporate sponsorship, national financial invest and self-capital, they are all important source of table tennis development. So, its capital investment is influenced by personal income, corporate revenue and the government financial aspects, capital source of

table tennis development is not stable. It is the fastest and most direct way that using the wealth achieved in table tennis market to promote the development of table tennis. This is because that it has a direct interest relationship between table tennis development and the development of related industries. Wealth from table tennis market will be used into the development of table tennis, and the sport will promote the development of table tennis relevant industries to the further development.

2.1.2 The growth of the table tennis market adjusts table tennis developments direction.

Table tennis market can automatically adjust the operation process and basic proportion relationship in table tennis. As a carrier and reality show of commodity economy, table tennis market is essentially a form of the realization of the value law. According to the experience of socialist development, people are the main body of the markets, and people's consumption behaviour determine the market development, while the market development direction gives clear goals for table tennis' development. So, table tennis' development should be people-oriented. People can promote table tennis' development in direction of its own needs through the market consumption.

2.2 Guiding role

2.2.1 Guiding role of the government in the development of table tennis

The government's guidance of table tennis development will consider the public interest and often with a certain political colour. Early period of China, government vigorously developed table tennis to show the comprehensive national strength for political activities. Such as: ping pong diplomacy melted ice in China and the United States, making two powers in the world to establish the connection. The government's guidance of table tennis making its development faster, more direct and more targeted, and it can focus more resources, realizing a rapid development of the sport in a short time. However, there is no validated proof for the guidance of the government. Too much intervention by the government may play a negative role to the development of table tennis.

2.2.2 Guiding role of the market in the development of table tennis

Under the socialist market economy system, enterprise's production and business operation activities directly depends on the market regulation and guidance. By using supply, demand and price adjustment mechanism, table tennis market guides the production direction of table tennis related enterprises, and the main development direction of table tennis will be decided according to the needs of the market. So, in order to guarantee the healthy development of table tennis, it must ensure the healthy development of the table tennis market.

2.2.3 Relationship between the government and the market guidance in table tennis

To some extent, government and market are able to decide the development direction of table tennis. It is a complementary relationship. Government intervention in the table tennis development has the characteristics of high efficiency, but the government's intervention will need a lot of market data

feedback. Market intervention in the table tennis development is more directly and it can solve the actually needed problems, but compare to the government, the market's efficiency is low. So, the government and the market are two indispensable means to adjust the table tennis development. If the government can use large amounts of data of the market feedback to guide the sport development, giving full play to the advantages of government and market, making up for deficiencies in between these two means, table tennis will achieve rapid development.

2.3 Promoting role

(1) As a bridge of producers in table tennis related industries, market can promote fair competition, fair and public cooperation between producers, and the development of productivity. Market promotes innovation and improvement of the relevant industries and services of table tennis.

(2) Market is an important connection between products and consumption, and it understands consumer demand for table tennis market more directly.

(3) Table tennis resources configuration relay on the market.

Market can monitor table tennis' problems and needs in the process of developing. According to these problems and needs, market tends to make a reconfiguration of table tennis related resources, improving economic efficiency, and guaranteeing a healthy development of the table tennis and the market.

3. RESULTS

3.1Market has a lag in promoting the development of table tennis

Market is timely and sensitive in adjusting the table tennis' development, but it can't reflect the long-term trend of supply and demand. When consumers compete to pursuit goods and services in table tennis market, as a result, the demand for the goods from the society has reached saturation point. While, the commodity producers are still there to continue mass production, causing a product backlog, in the end, causing huge losses to producers. At the same time, consumers also lost confidence in the development of the market and table tennis. In addition, the lag of market regulation can also leads to resource waste and economic fluctuations. For example, after 2008 Beijing Olympic Games, the number of China's table tennis venue developed rapidly, but due to the high cost, most large gymnasium are completed in the idle state, and some small sports venues and facilities are not perfect, with an inadequate service, etc. Consumer can't afford to play and do not have a good time in this game. Long-time development of this kind of situation will make consumers lose confidence to the table tennis, and it leads to serious impact on the development of table tennis.

3.2 Market has blindness in promoting the development of table tennis

Under the condition of market economy, the participants of table tennis industry economic activity were scattered in their respective fields. For example, table tennis commodity production, media, training and other industries, individual producers and business operators can't grasp the detailed information of the social various

aspects, so they can't control the trend of the economic changes. When making business decisions, therefore, the participants decided their production and management only according to what price is high and what is profitable to figure. So, it has certain blindness. This kind of blindness tends to make social anarchy, will inevitably cause of economic fluctuations and the waste of resources.

3.3 Market has spontaneity in promoting the development of table tennis

The economic activities of commodity producers and operators of the table tennis market conform to the basic law of the normal market, namely under the spontaneous regulation to pursue their own good, in fact, according the price fluctuation to determine their production and business activities. The first function of law of value, therefore, plays a positive role, namely the spontaneous adjustment of production and labour in the distribution of each department, rational configuration of resources. At the same time, it also makes some individuals or enterprises result in improper behaviour due to the excessive pursuit of the interests, such as producing and selling inferior sports products. In addition, due to the particularity of sports market, people not only consumer goods but also services, but now the good and evil people mixed up personnel engaged in table tennis industry makes bad impact on this market. Like, many people are new to table tennis and easy to be deceived due to they do not know this market. We can image it will be ended in a chaos in the market. Consumers want to achieve fitness or simply entertain from table tennis, but the result is, by contrast, they do not. The contradiction between the results will not be conducive to the healthy developments of table tennis.

4. CONCLUSION AND SUGGESTION

(1) Government should simplify the regime, further open the table tennis market step by step, and be aware of the positive role that market plays in promoting the development of table tennis sports. In the early time, it is important to lay a good foundation for the development and promotion of table tennis rather than make it develop too fast.

(2) Making full use of the large amounts of data that market produces in the era of big date, and providing theoretical basis for government to give macro guidance to the development of table tennis item.

(3) Strengthening the cooperation of government and the market. Market demands determine the development direction of table tennis item, at the meantime, government guarantee its development direction.

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Brief Analysis on Reasonable Dietary Nutrition of Table Tennis Players

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Abstract: Dietary nutrition is the foundation of sports training, and it's the fundamental guarantee to accelerate the recovery of a variety of consumed nutrients in sports after exercise. Only on the basis of reasonable dietary nutrition ingestion, scientific training methods can increase players' exercise ability. Based on energy consumption and supplement features of table tennis, this paper discusses how to make reasonable nutrition supplement for table tennis players, and provides reasonable dietary nutrition recommendations for table tennis players, in order to improve players' training level as well as their exercise performance.

Keywords: table tennis player, reasonable diet, nutrition supplement

1. INTRODUCTION

1.1 Movement Characteristics and Energy Supply of Table Tennis

The movement characteristics of table tennis are those like small ball, fast speed, diverse changes, strong antagonism and relatively long sports time. And table tennis is a set of physical strength, power, speed, agility and springing ability. During the process of sports training, three kinds of energy supply system—ATP-CP, glycolysis and aerobic oxidation participate mutually. Studies have shown that: on the one hand table tennis is an explosive activity of short time with the ball, mainly relying on anaerobic energy system; while on the other hand, in the absence of the ball, it is a low intensity activity giving priority to aerobic energy system; these two forms consists of the intermittent and moderate intensity competitive sports process. [1] With the changes of rules of table tennis game, such as small ball becoming bigger, 21points reducing to 11points, these changes weaken the capacity of aerobic metabolism obviously, while anaerobic energy system is strengthened. The energy of table tennis movement is provided by decomposition of sugar, protein and fat, so reasonable dietary nutrition is of great importance to energy substance supply.

1.2 The Meaning of Reasonable Dietary Nutrition

Fundamentally, reasonable dietary nutrition means promoting body growth and development and maintaining good health status, aiming to achieve the dynamic balance of nutrients supply and consumption, so that it is helpful for preventing

diseases. During exercise, reasonable dietary nutrition is not only beneficial to prevent motility diseases and injuries, but also to the recovery of exercise-induced fatigue and improvement of athletic ability.

1.3 The Significance of Reasonable Dietary Nutrition of Table Tennis Player

In the process of sports training, the decline of athletic ability is associated with nutritional factors, such as energy substances depletion, dehydration, increased body temperature, acid metabolites accumulation, electrolyte loss, lack of vitamins and trace elements. Therefore, reasonable dietary nutrition is the material foundation for players to keep in good condition. It has good effects on players' functional status, physical strength adaption process and recovery after exercise, and prevention and treatment of motility diseases. [2]

(1) Reasonable dietary nutrition provides appropriate energy substances for sports, and ensures them in good use. Table tennis is based on heat energy consumption, if there do not have enough available energy substances in players' body, the synthetic rate of ATP cannot satisfy movement needs. Therefore, table tennis players should pay attention to ingest food containing abundant carbohydrate to guarantee that there have plenty of muscle glycogen reserves in their body. Decomposition or reserve of energy substances in the body needs a series of enzyme catalysis, while most of vitamins and trace elements are the components of coenzyme or activator, even slight deficiency of these nutrients may also affect athletic ability.

(2) Reasonable dietary nutrition can provide against sport injury. The level of energy substances in the muscle fibres (glycogen) has a direct relationship to the occurrence of sport injury. When glycogen in fast twitch fibre depleted, the ability of physical control and corrective get damaged and the chance of getting injuries improved. If can improve the level of muscle glycogen before exercise and promote the recovery of muscle glycogen, it will have positive effects to prevent sport injury.

(3) Reasonable dietary nutrition can help recovering after strenuous exercise. The key of recovering athletic ability is to regain physical metabolism, including reserve of muscle and hepatic glycogen, the concentration of key enzyme (vitamin B complexes and trace element), body fluid, elemental balance and cell membrane integrity and so on. Recovering metabolic capability depend on reasonable dietary nutrition.

(4) Reasonable dietary nutrition not only can lighten the degree of exercise-induced fatigue but also postpone the starting. The reason to make athletic ability decline such as dehydration, increased body temperature, acidic metabolites accumulation, metabolic disorders caused by unbalance electrolyte, wastage of energy reserves. Facing so many problems, reasonable dietary nutrition can solve all.

(5) Reasonable dietary nutrition is helpful to solve some special medical problems in training. In the growth development period, teenage players (especially female players) participating in sport training, different medical problems will be existed. On this occasion, they need a specific nutrition supervise to ensure they can

have a normal training and physical. Therefore, the impact of reasonable dietary nutrition cannot to be neglected.

2. ENERGY SUNSTANCES SUPPLY OF TABLE TENNIS PLAYERS

2.1 Carbohydrates--Sugar

Carbohydrate is the most important energy substance for table tennis players. It can be directly oxidized to form ATP with little oxygen consumption and the quickest energy generation, and it has the largest output power in all energy substances during energy supply of oxidation, but in hypoxia state, only carbohydrates can be decomposed for energy supply to generate ATP and lactic acid. Carbohydrates reserved in players' body (glycogen and glucose) can be obtained through the diet, which mainly includes plant-based food, such as the rice, wheat, wheaten food, tuberous food(like potatoes and sweet potatoes), corn and vegetables, etc. While the carbohydrates in above-mentioned food are mostly provided as polysaccharide, but other types of carbohydrates such as monosaccharide and oligosaccharide have less content, and they need to be gotten from other food (fruits, milk, honey and sugar). In terms of supplying time, according to a current research of exercise physiology, the carbohydrate supplement 2-4 hours before exercise can increase the storage of glycogen in muscles at the beginning of exercise to reduce the utilization of motion muscles to blood sugar, and to delay the decline of blood-sugar level, and the emergence of exercise-induced fatigue. Carbohydrate supplement cannot be preceded 1 hour before the game to prevent the insulin effect, in which case the blood sugar will decrease. Nevertheless, carbohydrate supplement over half hour or in two hours after exercise or game, as well as the constant carbohydrate supplement at an interval time of 1-2 hours, can contribute to the glycogen restoration of players, and then the remission of fatigue. [1] [3]

2.2 Proteins

Protein is an important energy substance for the energy supply of table tennis players. When there is a shortage of carbohydrate supplement in their food or after fat has been largely consumed, the body will continue to supply the energy through the amino acid decomposed by tissue proteins. Proteins have little storage in the body as 3 percent of proteins needs to be updated every day, which means that certain proteins must be daily supplied to meet the body requirements, and the supply level must achieve the nitrogen balance of the body. When the proteins in the body are in short supply, on the one hand, the intestinal mucosa and the gland secreting digestive juices will be primarily inconvenienced, which can further result in dyspepsia, diarrhoea, dehydration and salt loss; on the other hand, the liver also can be damaged with fatty infiltration and failed combination of plasma proteins, which will lead to the decrease of plasma proteins content, especially the albumin, and then the edema of plasma proteins; furthermore, the proteome organization that has a faster update also can be affected and the skeletal muscle will fail to maintain its normal structure with muscle atrophy. It is indicated in a research that

the skill merit of players will be influenced if there is a 30- percent shortage of proteins in the body. [1] In recent years, as the rules of table tennis have changed a lot and the proportion of anaerobic energy supply system has increasingly strengthened, players and coaches should attach great importance to the increase of protein intake. Meat, peanut and beans have higher content of proteins relatively, and as far as table tennis players are concerned, vegetable proteins are of high calorie, so the dietary nutrition should focus on animal proteins. It is worth noting that we cannot blindly intake lots of proteins, especially animal proteins. Too much absorption of proteins is bound to be followed by the intake of high fat, results in fat accumulation or metabolic disorders, and weight gains and affect the movements in exercise; normally, the body cannot store proteins, so an excess of proteins must be deaminized and decomposed, and with the urine excreted from the body, the liver and kidney will be overburdened and are easy to be fatigued; as the water-electrolyte metabolism is influenced, the lithiasis and constipation in urinary system can be caused. In addition, superabundant animal proteins can lead to excessive intake of sulfur-containing amino acid, which will accelerate the loss of calcium in bones, result in osteoporosis and then the decline of sport performance. The reasonable supplying time is within 90 minutes after training, during which the requirements of proteins reach a peak, and then the best effect of protein supply can be achieved. However, it is important to note that players need not to supply extra amino acid when they are on a balanced diet.

2.3 Fat

Fat is also an important source of energy supply for table tennis players. It has large storage and can be obtained mainly from food, and when carbohydrates and proteins in the body have reached a specified level, they also can be converted into fat and then be preserved, which accounts for 30%-35% of total energy supply. In our country, table tennis players generally ingest overmuch fat in their diets. Too much fat intake can trigger hyperlipidaemia, result in obesity, lower endurance quality, influence movement utilization and the absorption of other nutrition. However, the ability of body to store fat is nearly unlimited, so we should try to keep the balance between intake and consumption of the body as far as possible. If you want to keep lower body fat, you'd better not to intake the food fat more than 20%-30% of total thermal energy, and it is important to control the proportion of saturated fatty acid SFA, monounsaturated fatty acid MUFA and polyunsaturated fatty acid PUFA as 1:1:1.

2.4 Others

It is well-known that table tennis is conducive to improving eyesight, but we should notice that the eyesight of players is under pressure throughout the training, so the supply of Vitamin A for players should reach 1.8mg every day. [4] And Vitamin A can be got through food, mostly including animal food, such as animal liver, cod

liver oil and whole milk, etc. Besides, Vitamin C and B are also very important to table tennis players. During the training, a lot of free radicals will be produced, and Vitamin C can help fight against them and remove fatigue. Vegetables and fruits contain abundant Vitamin C. while Vitamin B is in the body in the form of coenzyme or the precursor of enzymes, which can facilitate the conversion of nutrients into energy. When carbohydrates are in insufficiency of intake, the deficiency of Vitamin B will further aggravate the short supply of energy in the exercise.

The supply of minerals such as potassium, sodium, iron and calcium also makes perfect sense to table tennis players. Potassium and sodium can help maintain the inner environment of the body; iron can accelerate the conveying efficiency of oxygen; calcium can not only strengthen bones, but also play an important part in muscle contraction and nervous excitation, etc. During burning-hot training or in a sweltering environment, great attention should be paid to the supplement of minerals for players.

3. THE BASIC REQUIREMENTS AND RECOMMENDATIONS OF REASONABLE DIETARY NUTRITION [2]

(1) The quantity of table tennis player's food should satisfy the consumption of sports training and competition; in terms of quality, it should ensure comprehensive nutrition needs and appropriate proportion.

(2) Dietary food of table tennis players should have balanced nutrition and diversified varieties. Adhere to the principle "four more three less": eating more staple food, vegetables, fruits, dairy or soy products; eating less fat, meat, fried foods. [5]

(3) The food heat distribution of table tennis players' three meals a day should be arranged according to actual situation of training or competition. Training in the morning, breakfast should contain higher calorific power and abundant vitamins and proteins, etc. The quantity of heat of dinner should not be excessively high in order to avoid affecting sleep. During large amount of training, due to the increased consumption of heat energy, having extra meals can be taken into consideration: because of the long training time and limited mealtime, snacks and fast food can be used, but should pay attention to its comprehensive nutrition and nutrition density.

(4) Table tennis players eating time should consider players' digestive function and habits. The meal before large amount of training or game should be finished at least 2.5 hours in advance, for the purpose that upper gastrointestinal tract is almost empty during strenuous exercise. Meanwhile, overeating is not good before strenuous exercise, and meals or food supply should be arranged 30 minutes later, making sure not to be crapulent after exercise.

(5) In the cooking and conserving process of table tennis players food, it should avoid the loss of nutrients and have a good colour, aroma, taste and delicate shape so that enhance players appetite.

(6) Table tennis players under the condition of having a balanced diet with good quality, it's unnecessary to have additional supplements. While in preventing the

effects of deficient nutrition on sports capacity, it should also pay attention to the bad effects of over nutrition.

(7) To strengthen the education of table tennis players' eating habits, and to develop a good habit of reasonable diet. It is necessary to popularize the knowledge and education of nutrition and hygiene to coaches, leaders of sports centre and team, administrators, and kitchen staffs, enhancing their dietary nutrition consciousness so that they can understand the significance of reasonable dietary nutrition to players' health and improvements of athletic ability.

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Exploration of the International Popularization of the Table Tennis Grading System

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Abstract: Grading system is an important criterion to evaluate the sports skill level. With the research method of literature, expert interviews, comparative analysis and so on, this paper proposes the international promotion paths and strategies of the table tennis grading system by analysing the current situation of the development of the grading system and the significance of the worldwide promotion and acquiring the experience of the international promotion of the Chinese martial arts, taekwondo and other projects. The research indicates that the international promotion of the table tennis grading system needs the support from the national policy and a scientific formulation of the macroscopic strategies and specific development goals. On the basis of establishing the international promotion agencies, optimizing the evaluation systems, developing the promotion personnel, compiling the teaching materials regarding the international promotion, we need to attach importance to the application of the "geo-advantage" and the "celebrity effect" to ensure the successful implementation of the international promotion of the grading system.

Keywords: table tennis, grading system, international promotion

Grading system is a grade mark of measuring the level of sports skill. Grading means stage and location. Currently, many sports use grading system to measure the practitioners' sports skills level (grade), such as Chinese martial arts, the game of go, chess, taekwondo, karate, Europe fighting technique and so on. Through strict assessment content, rigorous stage and scientific system, practitioners can find practice standards and goals that motivate them to pursue higher level on both skill and ideology, which promote the popularity of national sport in the world. [1] Based on the needs of further promoting the development of the table tennis and establishing a standardized project evaluation system in order to assess the level of a practitioner's sport skill scientifically and comprehensively [2], a significant practice and exploration has been made on the setting of the table tennis grading system.

1. Table Tennis Grading System

Table tennis grading system is applicable to both professional athletes and amateur practitioners, 10 grades in sum, divided into four levels, namely elementary, intermediate, advanced and honoured. Each level from elementary to advanced is divided into three grades. Elementary level is Grade 1-3; intermediate is Grade 4-6; advanced level is Grade 7-9. Grade 10 is the honoured level, awarding those celebrities who made outstanding contributions to the development of table tennis and athletes in "Hall of Fame".

Table 1. Evaluation System of Table Tennis Grading System

Level	Grade	Qualified People
Elementary	1-3	Professional athletes, amateur
Intermediate	4-6	Professional athletes, amateur
Advanced	7-9	Professional athletes (provincial and national team)
Honoured	10	Celebrities making outstanding contributions

The setting of the table tennis grading system adopts a method that is a combination of quality and quantity. Training contents, qualified standards and grade characteristics of every level have strict rules. Skill system, with structural features of gradually proceeding in order, can guide practitioners to exercise from easy level to hard level, and continuously improve their table tennis skills and knowledge level. At the same time, low-to-high grading evaluation system can excite practitioners' ambition and sense of honour and attract them to pay unremitting efforts to achieve the desired grade.

Table 2. Elementary Level of the Table Tennis Grading System

Grade	Training Contents	Qualified Standard	Skill Characteristics
1	Grip, ball sense, stance and posture	pop and tip 60 times, correct stance	Able to hit a ball
2	Forehand attack, backhand block, serve, chop	Continuous 40 times hits, grasp 4 kinds of serve	Hit ball with quality
3	Backhand block with forehand attack, sudden, forehand loop	30 turns per minute, continuous 15 hits	Basic skill gradually solid

Intermediate level certification takes competition results as reference. The table tennis grading system holds level-up competitions according to regions and administration divisions. Competitions are divided into national grade passing competition, provincial (municipal) grade passing competition and municipal grade passing competition. Participators cannot apply to the grade that is two or more grades higher than theirs. Among them, the municipal competition winners may be granted for Grade 4; provincial (municipal) competition winners may be granted for Grade 5; the national competition winners may be granted for Grade 6.

Table 3. Advanced Level of Table Tennis Grading System

Level	Grade	Qualified People
Advanced	7	Outstanding national youth team player, top provincial and municipal professional team player
	8	Outstanding National team player, top national youth team player
	9	World champion, Olympic champion and top National team player

Advanced level is certified according to the players' competition records. The competition records are based on the national championship contests held by the Chinese Table Tennis Association, national athletic meetings and other international and domestic competition results. The competition scope for the records certification of the national youth team and provincial professional team can be extended to the qualification trials, the provincial championship contests and so on. Among these, the world champion, Olympic champion and top national team players are identified as Grade 9; outstanding national team players and top national Youth players are identified as Grade 8; outstanding national youth team players and top provincial professional team players are identified as Grade 7.

After corresponding level is approved, a certificate and a badge will be given to player, to encourage the prize-winner. In terms of the social policy, table tennis grading system, adopting "point to area" strategy, formulates a promotion pattern of "level-by-level promotion with good interaction" from province to city and then to county.

It is known from the analysis of the setting of the grading system, evaluation methods, promotion model etc. that the evaluation system of the table tennis grading system has a strong practicability and the evaluation method is easy and feasible without being unaffected by the geographical and cultural barriers, which is favourable for the international promotion.

2. Significance of the International Promotion of the Table Tennis Grading System

2.1 Become an Important Medium to Demonstrate the Nation's Soft Power

Serving as an important medium to show the nation's "soft power", the international promotion of the sport is valued by more and more countries: taekwondo in South Korea, Yoga in India, Basketball League (abbreviated NBA) in the United States and so on, under strong support of the national policy, are promoted externally by the international organization propelling or overseas performances and other methods. China possesses a significantly distinctive table tennis culture. Adding the promotion of the grading system into the international promotion strategy system corresponds to the requirements of raising Chinese soft cultural power after becoming an economic giant.

2.2 Play an Important Role in the International Publicity of the Fitness Value of the Table Tennis

Compared with the thorough evaluation system of the professional athletes, the evaluation of the amateur table tennis player's sports skill is more difficult. A

dilemma quite often happens that a person plays table tennis for a lifetime, but he or she cannot answer the question that on what sport level he or she is. The setting of the table tennis grading system more emphasizes the entertainment and important fitness value of the table tennis. By setting the skill levels, we could stimulate and satisfy people's sense of achievement, and thus progressively spread the table tennis. The table tennis grading system also makes the “reference target” change from the competitors to the enhancement of the players’ own technical capabilities. It also increases the flexibility and challenging of the sport by means of enhancing the grade of the players who pay continuous efforts. With small entry difficulty, table tennis grading system will play an important role in the global publicity of the fitness value of the table tennis in the international promotion.

2.3 Become an Important Supplement of the "Rival-Fostering Project" Promoting the World Table Tennis Development

In recent years, worldwide table tennis has shown the trend of "non-balanced development" and the worldwide promotion and publicity have been greatly affected. The International Table Tennis Federation appealed to China to take the responsibility as the giant table tennis country to contribute to the promotion, development and improvement of the table tennis in the world. Since 2009, Chinese Table Tennis Association has proposed to strengthen the cooperation with the ITTF, helped the other Table Tennis associations in the international scope by increasing the intensity of the training of the reserve personnel, and even offered to share with the world many achievements of the Chinese table tennis, which is the famous “rival-fostering project”. However, the implementation of the “rival-fostering project” brought a lot of problems. Only relying on the Chinese Table Tennis Association's assistance, other associations’ self-motivation has not been effectively mobilized, so that no improvement was made on the overall pattern of the world table tennis. Chinese coach Liu Yanjun who taught in Austria said, “Table tennis in Europe lost the foundation among young people, which is the main internal reason for the declination of the European table.”[4] The international promotion of the table tennis grading system and the "rival-fostering project", in two dimensions of competition sports and popular sports, can jointly enhance the "table tennis population", increase the motivation of the table tennis associations from different countries and guide all nations to intensify the training efforts of the reserve talents, finally resulting in the worldwide prosperity and development of the table tennis.

3. Experience of International Promotion of Sporting Events

Making clear the historical evolution and the current situation of the international promotion of sporting events, and understanding the development, adjustment, and positioning process of promotion strategy of different countries in different historical status or era will bring huge enlightenment to the international promotion of the table tennis grading system.

Table 4. The Elements for Promotion of Taekwondo and Martial Arts

Taekwondo	Martial Arts
1. International Organization World Taekwondo Federation	International Wushu Federation
2. Domestic Institution Kukkiwon	National Wushu Institution
3. Talents Promotion coach sent overseas	Coach group sent overseas
4. Strategy Promotion Perfection of technique theory and rules	Reform of upgrading evaluation
5. Features Promotion Becoming an Olympic event	Emphasizing the role of media in promotion
6. Textbooks Compilation	A Guide to International Martial Arts

The major factors accounting for the success of the international promotion of taekwondo include the assistance of the international organization, the support of the domestic institution and the demo performance overseas. The first international promotion of Korean taekwondo dates back to the Korean War period, during which the American army and the soldiers from the United Nations stationing in Korea brought this sport they learned back home. And this became the first time that taekwondo spread abroad [6]. In 1996, the associations from nine countries including Korea, Vietnam and Malaysia set up the first international organization in the history of Korea-International Taekwondo Federation (ITF). Since then taekwondo has been officially integrated into the international society. Since Korea set up Kukkiwon, the technique theory of taekwondo, competition rules, coach and operation management have been constantly reformed, developed and improved. The World Taekwondo Federation was set up in 1973 and admitted by the International Olympic Committee in 1980. Taekwondo became the demonstration project in the Seoul Olympic Games in 1988 and then became an official competing event in the Olympic Games in 2000, which helps the world to better know about Korea and Korean culture. During the process of promotion, the Korean government also takes the measure of sending coaches overseas to train and develop lots of taekwondo talents for free.

The success of international promotion for Chinese martial arts is due to the following three aspects: the first comes from the planned and purposed world promotion from the Wushu administrative department of the Chinese government; the second comes from the unconscious world spread by means of media including TV programs and movies; the third comes from the individual communications of the folk Wushu artists and traditional Wushu organizations.

Before the set-up of New China, the internationalization development of the martial arts mainly focused on Asia. Only in the 1990s did the martial arts achieve the international development on the whole in the real sense. The Chinese government also sent the coach group and large number of Wushu performance groups overseas for a visit in order to let all the people from foreign countries have a direct cognition about the martial arts so as to promote the spread of the martial arts. The International Wushu Federation has a special role that cannot be replaced

by any other organization in the world promotion, promotion and development of the martial arts. The federation plays an important role in spreading the Wushu performance overseas, promoting the competing Wushu, holding the international training workshops, setting up the international or state Wushu organizations and holding the international competitions [7].

As a conclusion, the following aspects should be paid attention to in the process of the international promotion of the sporting events: first, it needs the strong support from the state policies; second, the international sporting associations should come into play and a well-structured international promotion organizations should be formulated; third, we should pay attention to the cultivation of the talents skilled at international promotion; fifth, we should reasonably make use of the geography advantage, forming the "from point to area" promotion pattern; finally, we should attach importance to the propaganda function of the communications media.

4. Conception of the International Promotion of the Table Tennis Grading System

The international promotion of the table tennis grading system requires a scientific formulation of the macro strategy and specific development goal, and based on that a set of thorough and concrete guarantee measures and promotion plans in order to ensure the smooth implementation of the international promotion of the grading system.

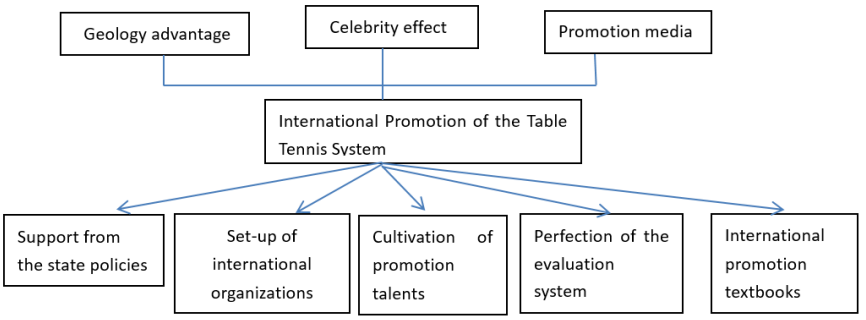

Fig. 1. International Promotion of the Table Tennis Grading System

4.1 Set up the International Promotion Organizations

Currently, the major organizations concerning table tennis include the International Table Tennis Federation (ITTA), the various state table tennis federation and associations, and the table tennis associations from different countries and regions. Among these, the International Table Tennis Federation, as the supreme table tennis management organization, carries out the macro adjustment and control and coordinates the table tennis development task of various states. We should make full use of the cooperation between the Chinese table tennis associations and the ITTA to influence and improve the ITTA's

understanding and cognition towards the implementation significance of the table tennis grading system. On the basis of that, we should try to build the organizations geared at the popularizing the table tennis around the globe and establish the platform for the international promotion. At the same time, we should selectively establish the cooperation relationship with the eligible member organizations of the ITTA step by step, and establish the test centers and training centers of the table tennis grading system overseas.

4.2 Give Full Play to the "Geo-Advantage"

The geo-advantage has a certain positive relationship with geography and history. From the current table tennis development domain around the world we could know that the sport of table tennis develops well in Asia and Europe, which has an important geo-advantage in the promotion of the sport. We should pay attention to the influence of the geo-advantage and give it to a full play. It could promote the gradual development of the table tennis from a nation to a region and to a state. The promotion of the Economic Belt of the Silk Road and the Confucius College around the globe provides a very good reference meaning.

4.3 Cultivate Promotion Talents Actively

International promotion talent is the bridge of the promotion of the sporting events. The success of the international promotion of the Korean Taekwondo manifests that the cultivation of the high-qualified promotion talents plays an important role in the international promotion. The talents for the international promotion of the table tennis grading system are required to have a higher specialized knowledge, ability and quality structure. They need to not only have the high technique level, understand the culture about the table tennis, but also grasp the related international laws and regulations and the economic knowledge. We should strengthen the training of the instructors and the evaluation staff of the table tennis grading system at home and abroad, enlarge the backbone team constantly, and improve the professional skills of the backbone team by continuing education.

4.4 Attach importance to the Compilation of the International Promotion Textbooks

The compilation of the international promotion textbooks is an important guarantee of keeping the table tennis grading system unified around the globe, and provides basis for the organization of events and the implementation of the grades. In the process of compiling the international promotion textbooks, we should pay attention to the description of the operation processes and propose the relevant requirements to some important operation procedures.

4.5 Establish the Standardized Evaluation Systems

The standardized evaluation systems for the table tennis grading system should be established. It should be standardized in all of the aspects including the procedures, rules, evaluation criteria, the organizations, the site settings and the advancement standards. We should give full play to the stimulating mechanism of

the grading tests and the lever function of the sporting competitions to promote the constant development of the table tennis grading systems. Compared with the domestic promotion, the international promotion entails attention to the influence of factors like language, characters and culture on the appraisal of the grading system. Therefore, in the process of forming the standardized evaluation systems, the difference between regions should be considered in order to make the evaluation systems flexible.

4.6 Give Full Play to the "Celebrity Effect" and the Communications Media

In China, during the time when table tennis evaluation systems were promoted in places like Shanghai and Jiangsu, the honorary president of the ITTF YinshengXu, the Olympic Champion Qi Chen and some other celebrities demonstrate in person, which gives full play to the "celebrity effect" and achieves a very good result, having a very good reference meaning for the international promotion. We should also pay attention to the important role of the media and the promotion and packaging of the international promotion of the table tennis grading system. The promotion organizations should conduct the widespread report by means of public communications channel like TV and radio, and at the same time pay attention to the important role of the new media in the promotion.

5. Conclusion

The ITTF has made a series of reforms in order to develop the sport of table tennis in recent years, but achieved little effect. The Chinese Table Tennis Association has made a lot of exploration for the development of table tennis by carrying out the "rival-fostering project". The international promotion of the table tennis grading system will increase the number of people playing table tennis among the domain of public fitness and thus play import role in the publicity of the table tennis. Coordinating the strategy of improving the nation's soft power and spreading the national culture abroad, the domestic grading system promotion organizations should strengthen the communication and cooperation with the ITTF and other institutions, and actively popularize the table tennis grading system by means of high platform in order to make the worldwide publicity of the table tennis achieve great leaps in progress and also make a balanced and sustainable development of the table tennis.

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