The Proceedings of the Ninth International Table Tennis Federation Sports Science Congress

Edited by
X.P.Zhang , D.D.Xiao and Y.Dong

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Preface

The International Table Tennis Federation (ITTF) is pleased to present the proceedings of the Ninth National Table Tennis Federation Sports Science Congress 2005. The meetings of this year's congress were held at Shanghai Jiaotong University, Shanghai China from April 27th – 30th 2005.

In order to maintain a high level of scholarship required of this congress, a peer review process was utilized in the selection of papers that appear in the proceedings. All papers have been subjected to the rigorous review process normally used for the review of international journal articles. The result of this process was that 13.8% of the papers submitted were rejected and the remainders of the papers were edited for inclusion in this volume.

The volume contains 57 papers, which are organized into six scientific parts, each part representing a theme of the congress and in most cases introduced by one of the keynote lectures. The choice of location of papers in section was at the discretion of the editors and it is acknowledged that some papers in a section could fit happily into more than one section. A choice had to be made and it should be remembered that this choice was an attempt to aid the reader rather than to category work, which in many cases represents the best of interdisciplinary research.

The editors wish to thank the authors for their attempts to comply with the standards required for publication. Nevertheless, the decision to include this number of papers resulted in a great efforts to assist non – English speaks to improve the final draft of their papers. All efforts were made to preserve the originality of the papers appearing in this volume of the proceedings. However, in an attempt to ensure conformity, the meaning of the paper may have been unintentionally changed.

It is our sincere intention that the papers contained in this volume faithfully represent the proceedings of the Ninth National Table Tennis Federation Sports Science Congress held in Shanghai. On behalf of ITTF we hope that the proceedings will improve and enhance the knowledge of table tennis by bridging the gap between the researcher and the practitioner.

Zhang Xiaopeng

Acknowledgements

The organization and administration of the congress would have not been possible without the dedication and hard work of many people. While it may not be possible to mention them personally in this acknowledgement we would like to highlight the efforts made by the Editorial Board in assuring the high standards of the scientific and applied program. Every member of Editorial Board made an enormous contribution by providing rigorous reviews of the papers and valuable comments for the authors. This was accomplished without complaint and within the time constrains imposed by the organizing committee. For this we thank you!

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PART ONE
BIOMECHANICS OF TABLE TENNIS

1 Evaluation of the isometric maximal force of the superior extremeities in high level table tennis players

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1 Introduction

Table tennis is an asymmetric sport, classified as a sport of opposition, in which a motive (the ball) should be hit by means of an implement (the racket) with a certain technical gesture (offensive or defensive), with the principle tactical concrete of directing the motive toward a free space, far from the opponent, the most elementary rule of game (Pradas, 2002).

For the practice of table tennis we are forced to adapt the racket in a concrete way. This form of grabbing the implement, we denominate racket grip, being in table tennis two types of grips: the Asian (Chinese and Japanese) and the European or classic (Pradas, 2004).

The different positions that we can adopt with the union arm – racket allow us to develop the technical gestual of this sport, characterized by a series of speedy and potent strokes (Faccini, 1989), on a ball of little weight, with a physiological demand alternating anaerobic – aerobic, with short and intermittent efforts, incomplete recoveries and where participates, in exclusivity, the skilled arm of the superior extremity (unilateral sports).

In the last years, a series of modifications and changes have taken place and have affected the general dynamics of the game, the dimensions and weight of the ball, and in consequence, the characteristics of the racket.

This study is a preliminary investigation about the force developed in the superior extremities in elite players and its possible repercussions on the yield in the styles of offensive and defensive game.

2 Material and methods

2.1 Participants

The study has been carried out in players of table tennis of a high level (n = 31) , of both sexes, participating in a voluntary way in the same one. The study group was composed of 18 males (age 23. 5 ± 5. 4) and 13 females (age 21. 3 ± 3. 3) .

2.2 Methods

The used material was a digital dynamometer of model Takei 5101 , a portable computer Acer TravelMate 212TX and some registration leaves designed for such an end.

2.3 Procedure

The objective of the study was to measure the isometric maximal force of prehension of the dominant and not dominant superior extremity, in players of both sexes and with different game styles (offensive and defensive) .

All of the subjects were left for a time of 10 minutes to carry out the standardized general warm – up, with 5 minutes of continuous jogging of low intensity and 5 minutes of stretching. The specific warm – up consisted of the realization of the test, executing two prehensions with both arms in an alternative way, to familiarize them with the development of the test and in this way avoiding any possibility of error in the definitive execution. After a brief period of rest they proceeded to the realization of the test. The correct realization of the test was controlled at all times, annulling the rehearsals executed erroneously. Each player had three executions with both arms making a pause of 1 minute among the rehearsals. The best registration obtained in the isometric maximal force of each arm was written down in Kgf.

For the correct realization of the test, the dynamometer was sustained with the hand, maintaining the arm close to the body and the screen of the dynamometer facing the examiner. The arm that sustained the dynamometer was to be completely extended. So that the results of the test were accurate, the hilt of the dynamometer was adjusted to the sportsman's hand, so that the second phalange of the middle finger was approximately at a right angle. The player made a firm and progressive pressure, to finish pressing the hilt of the dynamometer with all his force.

2.4 Variables

The isometric maximal force was studied in function of the sex and of the game type (offensive and defensive) in the dominant and non – dominant arm.

2.5 Statistics

The used statistical software has been the SPSS v. 12.0 for Windows. It carried out descriptive statistic – obtaining stockings, typical deviations, and minimum – maximum values. Statistical inferencial the non – parametric test U of Mann – Whitney was used in the treatment for independent samples. In the inferencial tests, the used approach of minimum significance was $p < 0.05$.

3 Results and Discussion

The means values obtained in the isometric maximal force (Kgf) were compared, initially, in function of the type of used hilt (European and Asian grip) without finding among them differences to consider. In table 1 the means values are shown obtained in the variables study object by sexes, game styles and manual dominance (dominant and non – dominant arm).

The obtained values are directly related to the motive actions that are developed in this sport, abilities carried out in a serial and coordinated way. This combination of abilities should be necessary in the space – time, with a high automation grade. This precision, defined as the capacity to place the corporal segments voluntarily in a place and in a concrete moment, is affected in the course of the game by fatigue, with decreases in the yield of the different physical capacities, among them, force, for what low indexes of this physical quality could be related with a neuromuscular fatigue and a deterioration of the precision in the technique (Gusi, 1991).

In general, in table tennis, the maximum force of the arm is not the most important requirement in the course of the game, because the force required to conquer the resistance opposed by the ball in the different strokes is very small, the same as in other racket sports like badminton (Reilly et al., 1990; Omosegaard, 1996), but it has relevance in the game. The absolute force is necessary for the situations where the muscles of the arm need to be used (Omosegaard, 1996), like in the right topspin or drive topspin in setback situations where one acts in a desperate way or outside of the suitable position to carry out the hit.

Moreouse this sport, characterized by a reiterated explosivity of technical actions, shows that it will be necessary to maintain high levels of force, avoiding (in this way) a deterioration in the correct execution biomechanics of the different technical expressions to be able to maintain during the competition a high yield (Gusi, 1991). A exhaustive planning of the physical, psychological and technical training, could postpone or diminish the noxious effects of the fatigue on the effectiveness and good yield in table tennis.

In figure 1, the obtained mean results are represented in the dynamometer test, in function of the manual dominance and differed by sexes. There were

some maximum values in the test of isometric force of 45. 1 ± 5. 7 Kgf in the dominant arm and of 39. 7 ± 7 Kgf in the non – dominant arm for the males and of 29. 54 ± 3. 5 Kgf in the dominant arm and of 24. 65 ± 4. 1 Kgf in the females. This higher capacity of developing force in the muscles flexors of the forearm of the men with regard to the women seems to depend on a better neuromuscular activation (Ives et al. ,1993).

Table 1. Extract of results in Kgf

	♂	♀	OFF ♂	DEF ♂	OFF ♀	DEF ♀
Dominant	45. 11 5. 7	29. 54 3. 5	46. 06 5. 3	37. 5 1. 4	29. 95 3. 6	28. 17 3. 5
Non – dominant	39. 7 7	24. 65 4. 1	40. 76 6. 6	31. 25 3. 8	25. 3 4. 3	22. 5 3. 4

The values of the non – dominant hand are inferior to those of the dominant hand in both sexes. The values of the males are superior to those of the females in both members, dominant and non – dominant, respectively, being significant differences for $p < 0.001$. Considerable differences of isometric maximal force were appreciated in the feminine gender with relation to the masculine one in 34. 5% in the dominant arm and in 37. 9% in the non – dominant arm. The levels of isometric force are half at least for term 30% inferior in the women regarding the men (Bosco,2000).

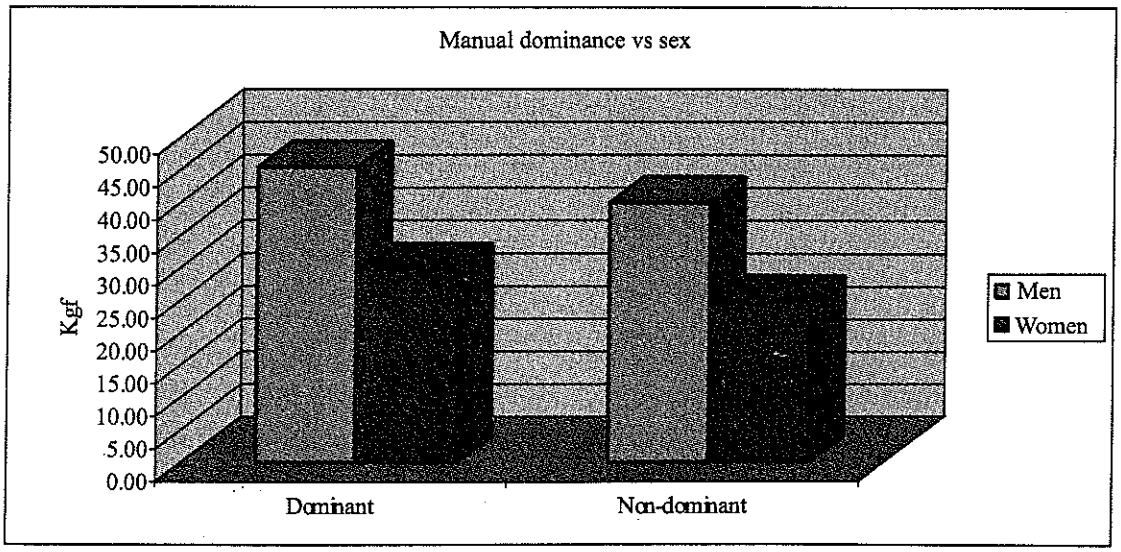

Figure 1. Comparison of the manual dominance between sexes

Some published studies have ended up identifying differences of force of manual prehension among dominant and non – dominant members, in favor of the first one. In our case these registered differences in favor of the dominant member are in males, 88. 01% and in females, 83. 45% , what means that knowing the maximum force of one hand, the other can be estimated with an explanation in the variation of the 87% (Hanten, 1999), very similar results

to those obtained in the present study. These obtained values are an evident fact that the absolute force of the women is smaller than that of the men (Marcos,1994), it is a fact that could be explained by the higher testosterone concentration in males (Bosco,2000).

In figure 2, one can observe the comparison according to sexes and manual laterality in front of the dominance. The obtained data indicate bigger values of force for the skillful men 45. 53 ± 5. 1 Kgf in their dominant hand in front of 43. 65 ± 8. 2 Kgf in their non – dominant hand, registering the lowest values for both members in the skillful women, with 28. 7 ± 3. 2 Kgf in their dominant hand and 23. 6 ± 3. 7 Kgf in their non – dominant hand.

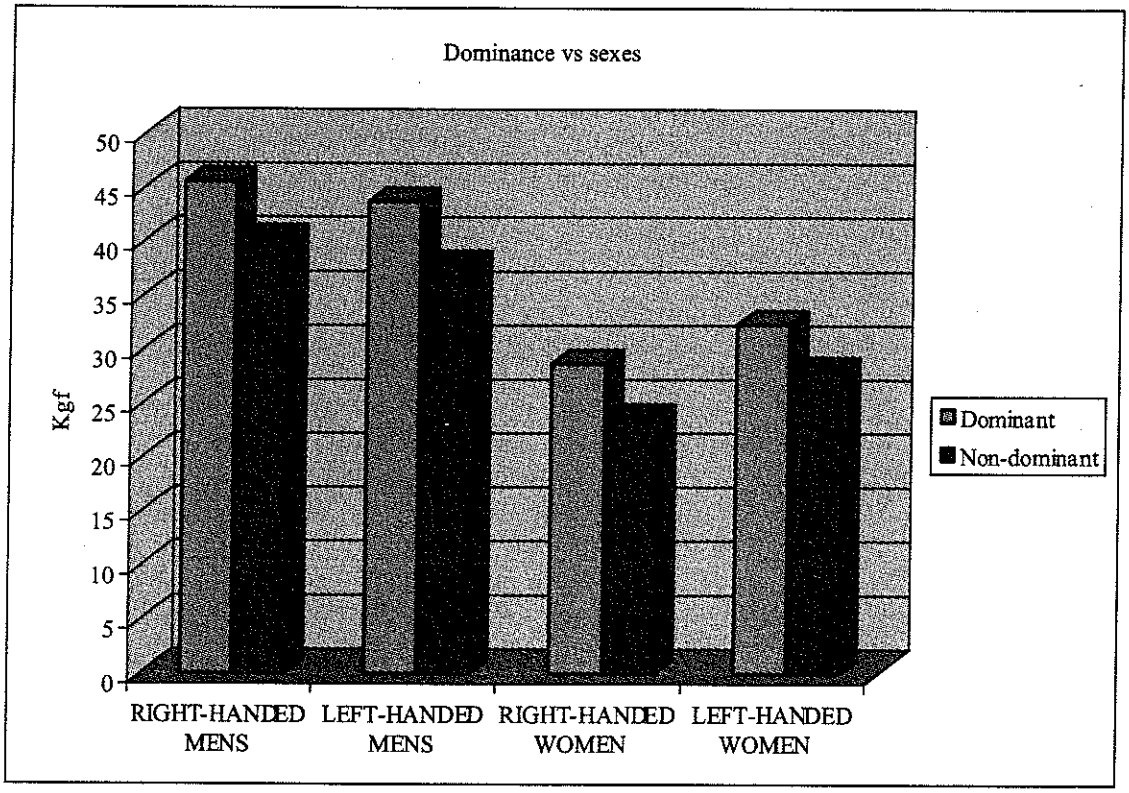

Figure 2. Comparison of the laterality and the manual dominance between sexes

These observed variations of the isometric maximal force among groups were not significant (Figure 2). Analyzing each group, these differences always were favourable to the dominant member with respect to the non – dominant:

(1) In the group of right – handed men of 88. 36%.
(2) In the group of left – handed men of 86. 71%.
(3) In the group of right – handed women of 82. 40%.
(4) In the group of left – handed women of 86. 61%.

Numerous studies have shown that the differences of force among dominant and non – dominant members are associated with the practice of asymmetric sports, causing muscular discompensations (Martínez, 1989) that

could determinate noxious scoliotic attitudes for the health.

When comparing the dominance among sexes, there are higher values in the registrations of isometric maximal force in the masculine gender in front of the feminine one in both members (dominant and non – dominant). The dominant member of the players represents 65.5% of the force not obtained in the players and the dominant of 62.1%.

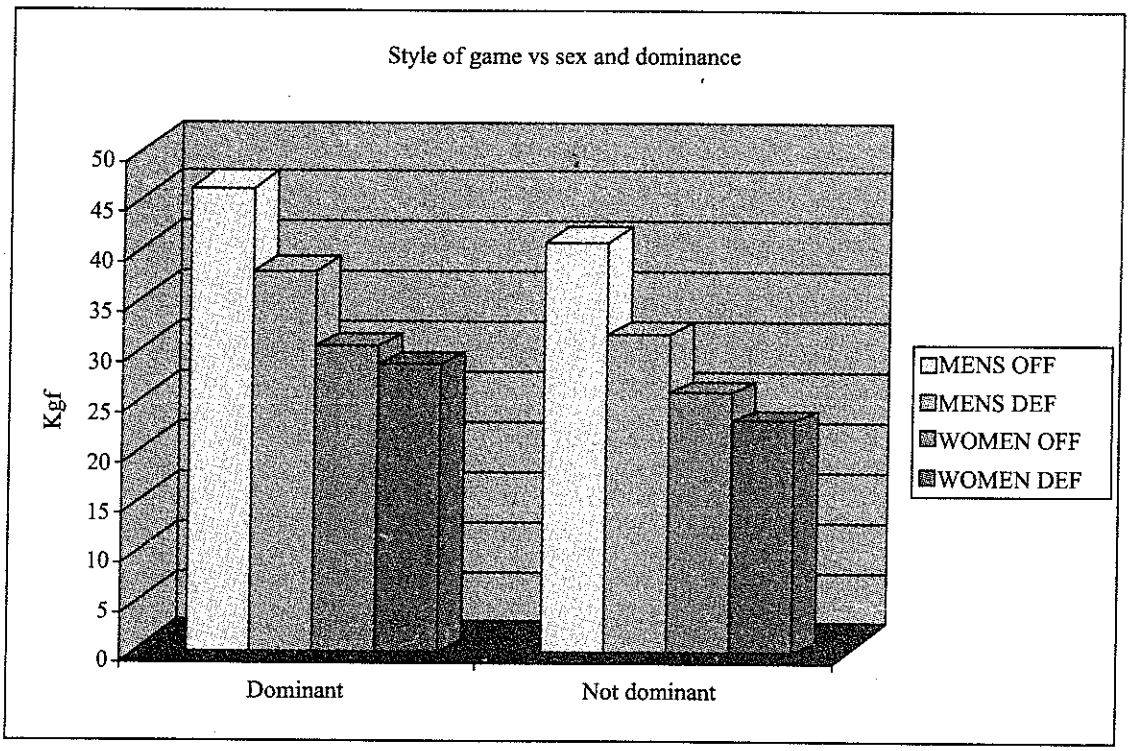

Figure 3. Comparison of the game style and sex versus manual dominance

When studying the existent relationship among the game type (defensive and offensive), the sex and the manual dominance (Figure 3), we find that the differences are statistically significant in the dominant masculine gender of offensive game in front of the defensive ones ($p = 0.05$), near to the significance in the non – dominant and not significant in any of the cases in the females.

The higher indexes of isometric maximal force always belong together with the dominant member and with the style of offensive game in both sexes, and very superior in the masculine gender compared with the feminine one. These differences in the force could be produced by the characteristics of the rackets that the offensive players use, these being heavier and speedier than those used by the defensive players (Pradas, 2004), since in their composition they have a bigger number of wooden badges, linings (rubbers and sponges) with thickness of the sponge that can oscillate among the 2 ~ 2.5 millimetres and for the use of fresh pastes that add more weight to the racket.

A variation of the favourable isometric maximum force is observed in both

sexes to the dominant member and the offensive style of game. In the males these values were of 18.6% and in the females of 6%.

4 Conclusions

(1) The isometric manual maximal force is superior in both sexes in the dominant member in front of the non – dominant in skilful and left – handed players.

(2) Knowing the dominant member's manual maximum force, one can come to know that of the non – dominant, with an explanation in the variation of 85 ~ 87%.

(3) The offensive players obtain higher levels of force in both sexes in the superior extremity that the defensive players.

(4) The differences obtained in this asymmetric sport can be associated with the development of scoliotic attitudes, having noxious consequences about the health. These discompensations can be avoided outlining from early ages a bilateral physical preparation and chord to the necessities of this sport.

(5) The maximum force of the musculature of the arm is not an important requirement to hit the ball because the resistance to overcome is very small, being more important the force resistance to the speed and explosivity in the continuous and reiterated technical executions.

(6) Low indexes of isometric maximal force can be related to the quick appearance of symptoms of neuromuscular fatigue, influencing negatively the correct execution biomechanics of a technical expression.

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2 The relationship between stimulus preceding EEG alpha power and reaction time in elite table tennis players

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1 Introduction

Although the moving speed of table tennis ball has reduced due to the shift of larger ball in 2002, table tennis is still considered a sport that places heavy demand on speed of response because of the short distance of the table that separate the two sides of players. Keele and Hawkins (1982) have argued that the ability to shift attention from spatial location to another is a critical factor for success in sports that require fast motor responses to stimuli characterized by location uncertainty. In light of the demands of sports such as table tennis it is likely that superior performers in these sports are characterized by intense anticipation of task – relevant stimuli and employ highly developed strategies in the attention and motor domains in order to prepare their speeded reactions. In stimuli – reaction study, reaction time (RT) indicates the interval from the presentation of an unexpected stimulus to the initiation of the response (Schmidt & Lee, 1999). Therefore, open skill players need shorter RT to respond to the target cues. One of the most influential factors in reaction time study is arousal level or state of attention.

One way of examining what mental state can facilitate speeded response is through the recording of brain electrical activity (EEG). Lansing et al (1959) recorded RTs to a visual stimulus and found that RTs were significantly faster when alpha block occurred before the visual stimulus was presented. Klimesch (1997) suggested that the lower alpha band may reflect attention processes, but there was no direct relating evidence to RT. Some recent studies have suggested that alpha activity may be independently related to the warning signal that produces a preparatory set to react (Leavitt, 1968; Thompson & Botwinick, 1996). In this issue, Leavitt (1968) claimed that the degree of alpha desynchronization was not related to speed of reaction. However, Spencer and Polich (1999) reported that, as attention requirements increased through different tasks, alpha1 and alpha2 power and mean frequency also increased.

Ramos – Loyo et al. (2004) found alpha1 absolute and relative power showed a tendency to be higher in high performance than in low performance group. It was also reported that the alpha frequency in good memory performers was higher than that found in bad ones and suggested that this could be because good performers are faster in retrieving information from memory and these data could indicate that alpha frequency is related to the speed of information processing or reaction time (Klimesch, 1999). To sum up, the existing finding about the association between EEG and reactive time performance is inconsistent, and thus it is imperative to further uncover the relationship between EEG and reaction time performance. As such, the current study employed a paradigm that is similar to that demanded in table tennis competition for the study of mental states and speed of response. Specifically, a cued RT task that was used by Mangun and Hillyard (1991) was adopted to further investigate if the power of EEG alpha1 and alpha2 is related to RT.

2 Methods

2.1 Participants

Fifteen male table tennis players (aged 16 ~ 35 years) who held a United States Table Tennis rating of at least 1949 points (M = 2263.7, SD = 230.6) were recruited for this study. All participants were right – hand dominant, were screened for visual and neurological problems, and were paid $40 for their participation. Participants provided written consent prior to testing on a form approved by the institution's human subjects review board.

2.2 Equipment and task

A cued RT task similar to that used by Mangun and Hillyard (1991) was employed in this study. Warning and imperative stimuli were presented on a computer monitor positioned at a distance of 50 cm in front of the participant. A trial began with the presentation of a warning cue, which was displayed in the center of the computer screen for 200 ms. The cue provided information regarding the spatial location of the upcoming imperative stimulus (i. e., to the left or right side of the screen) or was neutral regarding directional probability. The directional warning cue consisted of either a left – or right – pointing arrow. Left and right arrows were presented in random order across trials and were equally likely to occur. The arrows correctly indicated the location of the imperative stimulus 76% of the time. The neutral warning cue was a cross. The imperative stimulus was a vertical bar that subtended 3.3° (h) x 0.8° (w) of visual angle and was presented for 200 ms on the computer screen at a position 12° of visual angle to either the left or right of a central fixation point. The participant responded via a computer mouse such that the left button was depressed by the index finger of the left hand in response to stimuli presented on the left side of the screen. The right button was depressed by the

index finger of the right hand in response to stimuli presented on the right side of the screen. A fixed inter – stimulus (S1 – S2) interval of 1500 ms was employed. Imperative stimuli were presented to the left and right locations with equal probability. The inter – trial intervals were 3000 ms.

EEG was recorded from surface tin electrodes attached to the scalp at left and right central (C3, C4) and occipital (O'L, O'R) sites, each of which was referenced on – line to the left ear (A1). Recordings were subsequently re – referenced off – line to averaged ears. Sites C3 and C4 were selected because they lie over the motor cortex (Homan, Herman, & Purdy, 1987). O'L was located halfway between T5 and O1, and O'R was located halfway between T6 and O2. These occipital locations were selected for inclusion in the study rather than O1 and O2 because of their greater sensitivity to attention processes. Vertical and horizontal electro – oculograms (VEOG and HEOG, respectively) were continuously recorded using bipolar configurations of 10 – mm Grass gold – plated cup electrodes (model E5GH) located superior and inferior to the right eye for VEOG and at the temporal canthi for HEOG. Impedance at each electrode site was maintained at or below 5 k. The difference between homologous pairs of scalp electrodes was maintained within 500. EEG was amplified 50,000 times using Grass model 12A5 Neurodata Acquisition amplifiers with bandpass filter settings of 0.01 – 100 Hz. A 60 – Hz notch filter was also employed during the data collection. Amplifiers were calibrated prior to each testing session with a 10 – Hz, 50 – uV sinusoidal input signal that was presented to all channels simultaneously. Data were acquired at a sampling rate was 256 Hz using Neuroscan software (version 4.0) installed on a Gateway 2000 Pentium computer.

2.3 Procedure

After arriving at the laboratory the participant was informed about the requirements of the experiment, was given an opportunity to ask questions, and then signed the approved consent form. Electrodes were then attached and impedance was checked. The participant was then led into a sound – attenuated chamber in which the testing occurred and was given a description of the task. He was informed that the warning cue correctly indicated the location of the imperative stimulus 76% of the time and that, when the neutral warning cue was presented, the left and right imperative stimulus locations were equally probable. The participant was further instructed to fixate his gaze on a central point on the computer screen throughout the test, to respond as rapidly and accurately as possible, and to respond with the index finger corresponding to the side of the screen on which the imperative stimulus was presented. A practice session of 31 trials was then given. In following practice, the participants completed 125 – min blocks of trials; 62 trials were presented in each block. The protocol yielded a total of 744 trials, of which 456 were directionally cued in a correct manner, 144 were directionally miscued, and 144 were

not directionally cued (i. e. , neutral). EEG, VEOG, and HEOG were recorded continuously throughout each block of trials. RT was recorded to the nearest millisecond. Participants rested for 2 min between each block of trials.

2.4 Data Processing and analysis

The analysis of EEG data was restricted to the validly cued trials only. The EEG records of acceptable trials were first inspected for artifact. Epochs contaminated with EOG artifact were either corrected or excluded from further analysis. Additionally, epochs containing amplitude excursions greater than ±100 μV were excluded from further analysis. Cleaned EEG epochs of 750 ms each were Fast Fourier Transformed (FFT) into 2 frequency bands: α1 (8 ~ 10 Hz), α2 (10 ~ 12 Hz). RT data was classified into fast and slow performance based on the individual mean of RT. The EEG was obtained separately from the fast and slow correct responses. There were two epochs (each epoch 750 ms) during S1 to S2 interval. A 2 x 2 (performance x time) repeated measure ANOVA was employed on the power of α1 and α2 separately.

3 Results

3.1 Alpha 1

The mean and standard deviation of alpha 1 power for all site is shown at Table 1. The performance x time two – way ANOVA showed significant time effect at all recording site. Examination of the means indicated higher alpha 1 power at time 1 than time 2. More interesting is the two significant interaction effects at site OR and P3. As shown in Figure 1 and 2, in comparison to slow RT, fast RT is characterized by higher alpha 1 power at time 1 and lower power at time2.

Table 1. Mean and standard deviation of the alpha 1 power at all site

	F	3	F	4	C	3	C	4	T	5
	Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow
Time1	1.98	1.95	2.07	2.04	1.82	1.77	2.00	1.96	1.58	1.47
	(.58)	(.62)	(.55)	(.59)	(.52)	(.57)	(.43)	(.50)	(.57)	(.59)
Time2	1.80	1.90	1.88	1.97	1.57	1.65	1.77	1.82	1.03	1.06
	(.61)	(.67)	(.57)	(.62)	(.54)	(.59)	(.44)	(.49)	(.59)	(.58)
	T	6	P	3	P	4	O	L	O	R
	Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow
Time1	1.84	1.78	1.92	1.80	2.05	1.98	1.94	1.83	1.98	1.89
	(.57)	(.64)	(.58)	(.62)	(.50)	(.58)	(.66)	(.68)	(.59)	(.62)
Time2	1.44	1.43	1.50	1.52	1.68	1.71	1.24	1.27	1.47	1.51
	(.53)	(.55)	(.53)	(.54)	(.47)	(.47)	(.59)	(.55)	(.51)	(.52)

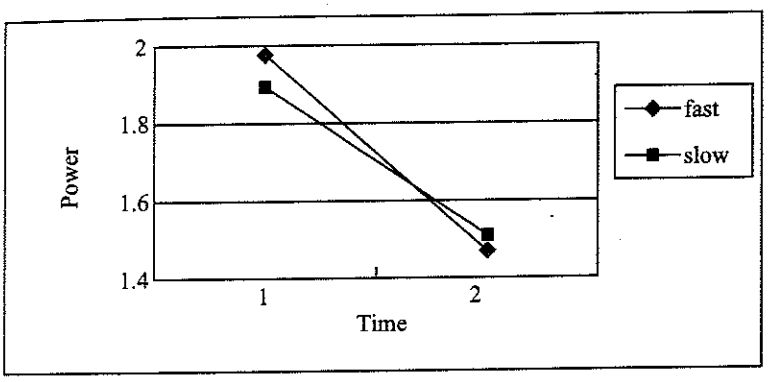

Figure 1. Performance x time interaction at right lateral occipital site (OR)

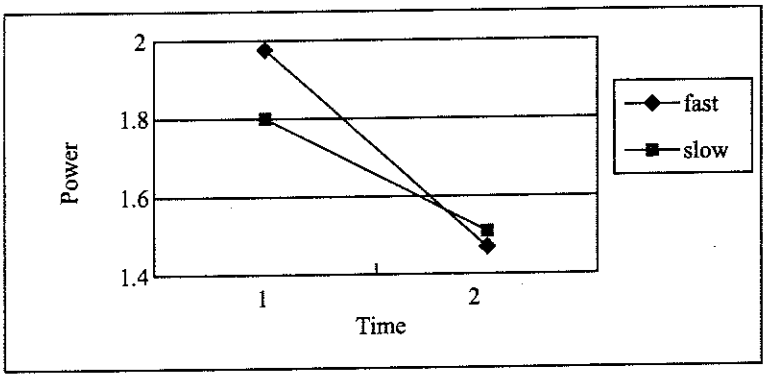

Figure 2. Performance x time interaction at left parietal site (P3)

3.2 Alpha 2

The mean and standard deviation of alpha 2 power for all site is shown at Table 2. The performance x time two – way ANOVA showed all effect but one were insignificant. The only significant effect was the time effect at site T5. The alpha 2 power at time 1 was higher than at time 2.

Table 2. Mean and standard deviation of the alpha 2 power at all site

	F	3	F	4	C	3	C	4	T	5
	Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow
Time1	1.72	1.64	1.80	1.74	1.79	1.71	2.01	1.92	1.40	1.25
	(.72)	(.78)	(.63)	(.71)	(.77)	(.87)	(.69)	(.80)	(.76)	(.79)
Time2	1.64	1.70	1.69	1.76	1.60	1.65	1.79	1.87	1.19	1.18
	(.74)	(.76)	(.65)	(.69)	(.75)	(.78)	(.69)	(.73)	(.84)	(.81)
	T	6	P	3	P	4	O	L	O	R
	Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow	Fast	Slow
Time1	1.81	1.68	1.92	1.80	2.11	1.99	1.80	1.67	1.93	1.81
	(.72)	(.78)	(.91)	(.97)	(.86)	(.92)	(.84)	(.90)	(.83)	(.88)
Time2	1.76	1.76	1.81	1.79	2.04	2.02	1.71	1.69	1.94	1.94
	(.84)	(.80)	(.96)	(.94)	(.98)	(.94)	(.99)	(.96)	(.97)	(.91)

4 Discussion

The main purpose of the current study is to examine what brain activity is conducive to fast response during a cued reaction time task in elite table tennis players. Although it is a laboratory study, it is worthy to note the similarity between the protocol and task requirement used in this study and that of the task demand in which table tennis players encounter. Indeed, the cues used in the current study provided important information that table tennis players use to prepare themselves for forthcoming events. However, the cue in the current paradigm did not provide information with 100 % certainty. This is exactly what table tennis players have to face in their sport competition. Table tennis players have to anticipate the action of their opponents and prepare accordingly. Thus examining the EEG activity in the cue – imperative interval can provide us information regarding how these players manage their mental resources in preparation for the forthcoming events.

Examination of figure 1 and 2 suggests, in comparison to slow response, fast response is characterized by higher alpha 1 power at the first half and lower alpha 1 power at the second half of the cue – imperative interval. But this interaction effect is observed at site OR and P3 only. The other sites showed significant time effects in which alpha 1 power at the first half of the cue – imperative interval is higher than the second half. Contrary, alpha 2 power showed no significant difference between fast and slow reaction in all recorded sites except OR sites. Klimesch (1997) proposed that the lower alpha band (alpha1) might reflect attention processes while upper alpha levels (alpha 2) were related to semantic memory processes. Since the cued RT task used in this study is designed to place heavy demand on participants'attention, the findings that fast response is associated with higher alpha 1 power at the first half and lower alpha 1 power at the second half of the cue – imperative interval in the current study suggest that heightened attention as reflected by higher alpha 1 power right after the cue is helpful to speeded response. Such an interpretation is consistent with that of Klimesch's (1997) proposal in which he suggest that the lower alpha band (alpha1) might reflect attention processes. The findings are also consistent with that of Ramos – Loyo et al. (2004). These authors found alpha1 absolute and relative power showed a tendency to be higher in high performance than in low performance group. The findings also partially support that of Spencer and Polich (1999). Their study found as attention requirements increased through different tasks, alpha1 and alpha2 power and mean frequency also increased.

5 Conclusion

In conclusion, this study found higher alpha 1 power at the first half of the cue – im-

perative interval is conducive to tasks that require fast response such as table tennis.

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3 The experimental research on the relationship between the biggest power of smash and the perimeter of handle

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1 Introduction

The five factors of the table tennis are velocity, strength, accurateness, the point of fall, rotating speed. The magnitudes of those factors are primarily decided by techniques, and are also decided by tools. In the last decade, within the scope of rule, the first – rank table tennis players in all countries have strongly noticed the quantity and the function of the racket. A number of the sport science researchers have studied and got results for manly deserving drawing lessons from the racket shape, weight, elasticity, feels, etc. Because ping – pong device equipments rule did not take into the concrete restrict of the perimeter of the handle, the majority of athletes rely on the experience or the help of the experienced player to choose the racket. It seems that there is no much relationship between the perimeter of handle and ping – pong sports. There has been little specialized research on the biggest power of smash and the perimeter of handle in the domestic and international literatures. From the angle of biomechanics and the Ergonomics, we can presume that when the athletes choose the certain perimeter of handle, and hold the handle with certain method, in other words, when the hand joint construction is certain and also the athlete training is certain. In this case, the biggest smash for the athlete will be within the certain scope, also this is related to the hand joint construction while the athlete is smashing, i. e. this is related to the perimeter of handle. Only if choosing the perimeter of handle fitly, can the athlete have an ideal joint construction and scope of smashing power? Improving the athlete action of already set will get the contrary result but perhaps it is the better way to change the perimeter of handle. Although the athlete can improve the power after improving the handle, on the one hand, they can gain initiative with the ball speed and revolving strongly; on the other hand, they can also threaten opponent mentally in competition. The thesis will find the fixed quantity in relation to the biggest smash and the perimeter of handle during experiments, and afford some use in refer-

ence to all kinds of athletes when they are choosing the appropriate perimeter of handle; On the other hand, the thesis will provide the way to study the shape of the racket and make the racket more characterized and humanized.

2 Methods and Materials

2.1 Participants

The subjects are 10 students who came from sport School of Beijing Sport University. All of them are male. Their ages are between 14 and 16 years old. The grade of the athletes is the first band – 1 of our country. The training time of the athletes is 8 to 9 years. The method of holding racket is straight and right hand.

2.2 Design

This research chose the maximal moment of velocity, which is the average velocity of the ball leaving the racket in 0.01 second, to replace the biggest power of smash, because it is difficult to measure the biggest power of smash. For the sake of decreasing the rotation of the ball and getting the maximal velocity of the ball, the subjects were required to smash, not to drive. In order to get the maximal velocity, we let the ball drop freely, and only with that the ball can be smashed easily.

2.3 Procedure

The box that puts on upright 1.1m from the table 20 cm, can control the single ball that choose three stars of double happiness (40 mm) to drop freely. When player is ready at the base line, operator makes the ball dropping freely from the box, and the player smashes with the maximal power at the regular action when the ball bounces on the top, at the same time, on the left side of the player 9m the other operator shoots the smashing action by high speed video (HSV – 400, 400 case/ second), and analyzes the velocity when the ball leaving the racket in 0.01 s as the maximal velocity of ping pong ball, and also the research considers that the velocity is the maximal smashing power for the athletes. Each athlete uses their own racket to smash with the maximal power three times at first and average the value as the maximal power with the perimeter of the handle for himself; once more everyone in turn smash the ball three times with the experiment – racket by the same perimeter of handle, and adopt average value of the maximal velocity as the maximal power of himself for the perimeter. There are 11 rackets, the perimeter of handle is 6 to 11 cm, and the player changes the racket per 0.5 cm, until all rackets are experimented.

Table 1. Racket and perimeter of handle

Racket number	1	2	3	4	5	6	7	8	9	10	11
Perimeter of handle(cm)	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11

3 Results and Discussion

3.1 racket parameters

In table 2 and table 3, we can see that, when the perimeter of handle is less than 7.5cm, the power of smash reduces obviously with athlete ($\alpha = 0.01$, $P = 0.0036$, $p < \alpha$); The data shows that the power of smash reduces obviously with athlete ($\alpha = 0.01$, $P = 0.0012$, $p < \alpha$) when the perimeter is over 10cm; We can also see that there is no notable difference between the maximal smashing power and the smashing velocity when the perimeter of handle is between 7.5 and 10cm. According to the data, the perimeter will affect the maximal power of smash, if the perimeter is too small or too big, only the appropriate perimeter is propitious to powerful smash. But appropriate perimeter is related to the length of fingers and palms etc.

Table 2. Players and the perimeter of handle need by themselves

Player serial number	1	2	3	4	5	6	7	8	9	10
Perimeter of handle(cm)	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2
Average of the max smashing velocity (m/s)	17.7	16.2	18.2	16.4	16.7	18.4	16.8	17.9	18.1	17.8

Table 3. The max velocity of different Players using the different perimeters of handle

	Perimeter of handle (cm)										
	6	6.5	7	7.5	8	8.5	9	9.5	10	10.5	11
1	10.2	11.8	13.5	15.8	16.6	17.4	17.8	17.4	17	14.5	12.5
2	11	12.6	13.1	15.6	16.2	17	16.8	16.4	16.2	14.8	12.7
3	10.9	12.4	14.2	16.1	16.9	17.8	18.4	18	17.6	15	12.9
4	10.6	11.8	13.4	15.9	16.7	17.6	16.8	16.4	16	14.2	12.4
5	11.1	12.1	12.7	15.4	16.6	17.4	16.8	16.6	16.1	13.8	13
6	10.2	12.2	13	16	17	17.5	18.2	18	17.2	14.8	12.7
7	10.4	11.6	12.6	15.6	16.4	17.2	17	16.2	15.8	13.6	13.2
8	10.3	11.9	13.6	16.4	17.2	17.2	17.5	17.1	16.5	13.4	12.2
9	10.6	12.1	13.2	16.8	17.4	17.6	18	17.8	17.1	14.2	13.4
10	10	11	12.9	16.5	17	17.2	17.6	17.6	17	14.2	13

3.2 The contrast analysis

In contrast to the table 2, we can see in table 3 that, the players of number 2, 4, 5 and 7 can have more power in smashing when the perimeter of handle is different from the perimeter they use usually, especially the player No 4. For the player No. 4, when he uses the perimeter of handle of 8.5, he could increase the power by 20% compared to his usual power. Perhaps the player No 4 feels that his racket has a better weight and feeling in hand etc. or the perimeter of handle is too little for him and not propitious enough to exert his maximal power, the author suggests him to reduce the perimeter of his handle in the case of keeping the constant circumstance in part of other rackets. The author suggests the player No. 2, 5 and 7 that, they could compare the result of experiment to adjust the perimeter of their handle, only with this, they could be benefit from exerting the power of smashing more.

3.3 The analytical result

From the result of experiment, we can see from the normal case that the better range for the perimeter of handle is 7.5 to 10 cm, but as to concrete player, because of individual difference and the method of holding difference, they could choose the perimeter of handle in a large range. We know that the player has better ability to adapt to the perimeter of handle, but the better range of them should not be over 1cm. Thus the athlete must consider the affection of the perimeter of handle to him, and choose the suitable racket with the suitable perimeter of handle, in other words, the perimeter must be suitable to the athelets, and not the athletes adapt himself to the perimeter of handle when they are choosing rackets.

4 Conclusions and Suggestion

4.1 conclusions

(1) The perimeter of handle affects directly to the maximal power of smash. The maximal power of smash will descend when the perimeter of handle is over 10cm or less than 7cm.

(2) Each athlete has the perimeter for him to smash with the maximal power. While choosing the racket, he must choose the racket of which the perimeter suits him, instead making himself to suit the racket.

(3) This experiment can offer a method for measuring the maximal power of smash.

4.2 suggestion

(1) Experiment belongs to the measurements indirectly to the maximal power of smash. We could measure the maximal power of smash directly by installing

sensor on racket when the technology of sensor develops and the situation of the experiment is promised.

(2) The number of the subjects is little. We could not explain all problems of the maximal power of smash and the perimeter. So the author suggest that people must enlarge the quantity of the sample and the category of the subjects in order to obtain data completely and open the relationship between maximal power of smash and the perimeter of handle.

4 Application and outlook about Sports Biomechanics in table tennis

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1 Introduction

It is well known that Sport Biomechanics players an important role in improving the technique level of all the sport events. The method and means of Sports Biomechanics have been applied in many sport events, but the application of Sport Biomechanics in table tennis is limited. In recent years, the ITTFSC has taken three great reformations in table tennis match rules, which influences the techniques of table tennis. In order to promote the development of table tennis, we should ask for the help of technological power to recognize the regulation of table tennis more completely and deeply.

According to the actuality of the biomechanical researches on table tennis, the development trend of Sports Biomechanics, and the development of table tennis, the authors analyzed the application and outlook of Sport Biomechanics about table tennis. This paper was expected to use for reference on how to apply Sports Biomechanics into Table Tennis efficiently.

2 The outlook on research contents of Sport Biomechanics in table tennis

Seeing from the angle of Sports Biomechanics, the event of Table Tennis is an activity, which includes the activity of the athlete (motor technique), the activity of ball in the air (speed, revolve, curve), and the collision activity of ball with the racket and the table. To analyze and research those three parts of activities in biomechanics, some certain equipments and methods are required. The former sport biomechanical studies on the activity of table tennis have focused on the above aspects. But the researches on the flying of ping – pong ball, the motor technique and the principle of collision are not sufficient, and the studies on the sport equipment and the sport cloth are few.

According to the developing trend of Sport Biomechanics and table tennis, it can be anticipated that the applied research field of biomechanics in table tennis is that the research on the technique research will still occupy the big comparison, at the same time, the research can be carried out in the aspects of

sports for all, sports medicine, recovering medicine, exercise machine, clothing and experimenting instrument equipments etc. The following concrete studies can be carried out:

(1) on the diagnosis of the technique of the table tennis players.
(2) on the collision of ball and the racket, ball and table tennis table
(3) on the movement of the racket
(4) on the manufacture of the racket and playsuit of the table tennis players
(5) on the character of muscle and skeleton of the table tennis players
(6) on the exploration of the experimental apparatuses fitted for table tennis
(7) on the mechanism and prevention of players'trauma

3 The outlook on research methods of Sports Biomechanics in Table Tennis

The research methods, which are about applying Sport Biomechanics to Table Tennis, can be divided into two types: the first is the research method of theoretical mechanics; the second is an experiment research method. Those two methods should be combined closely, so that Sport Biomechanics can be betterly applied to the research on the table tennis.

3.1 The outlook on the research method of theoretical mechanics in applying Sport Biomechanics to Table Tennis

This research method is to imitate the movement of human being by the method of simulation means, which includes five steps generally: First, confirming the sports character, establishing the target function; second, choosing the rigid body model and confirming the free degrees of the rigid body; third, establishing the dynamics model; Fourth, acquiring the known datum by the experimental method, and then putting the datum into the function. ; Fifth, using the result of the function to explain the sports regulation. This step is changing the mathematics regulation that acquired by the function into the sports language, which can give the sport technique a reasonable guidance.

The present research condition of applying Sports Biomechanics to table tennis is that the previous study only made use of the mechanics principle to explain the some phenomenon of table tennis, and made few use of the theoretical mechanics. Using the theoretical mechanics, many problems of table tennis can be researched.

For example, in the previous studies of the wounds of the table tennis players, there is little study on the quantitative analysis of the force and the moment of wrist, elbow, shoulder, cervical vertebra, waist vertebra etc during the process of attacking ball. And those studies are beneficial to the cognition and prevention of the wounds to the table tennis players. The joint force and moment can be calculated by the method of theoretical mechanics. According the above ap-

proach, the joint force and moment of the upper limber can be calculated. First, confirming the sports character of the table tennis player's attacking ball, and then establishing the target function; second, choosing the upper limb rigid model (upper arm, small arm and hand which includes battle), the number of the free degrees of the upper limb is 7; third, using the method of Kane to establish the dynamics model; Fourth, acquiring the kinematics parameters of the upper limb by the method of upper limb, and then calculate the joint force and the moment of wrist, elbow, shoulder; Fifth, using the result of the joint force and moment to explain the motion wounds of table tennis players.

There is no quantitative analysis on the motion extent of attacking ball with racket. The motion extent of attacking decides the quantity of the attacked ball. The work loop theory can be used.

3.2 The outlook on the experimental method in applying Sports Biomechanics to Table Tennis

The present condition of the experiment research method of Sports Biomechanics applied to the table tennis is that the dynamics research is quiet a few at all, kinetics test is some, and used biomechanics apparatus are also a few too. So, experimental research method in table tennis research has a large development space in future.

3.2.1 The extensive application of the common Sports Biomechanics apparatus to Table Tennis

The common Sports Biomechanics apparatus, such as 3 – D force platform, muscle electricity apparatus, foot bottom pressure shoe mat apparatus, have been used widely in other sports event, but they are used a little in the sports event of table tennis. 3 – D force platform can show the ground reflection force to the human body. The attacking force with racket of the table tennis player is reflected by the GRF. But the dynamics characteristic of GRF of table tennis player have not described until now. The muscle electricity apparatus can be used to describe the strength and time of the activity of participating muscle when completing a certain sports motion, making sure the primary participating muscle. When it is used in the table tennis player, it is clear to know the forcing order of participating muscle when attacking the ball, which can offer conference on the strength training in table tennis players.

3.2.2 Developing specialized and quick – feedback technique testing apparatus

Developing specialized and quick – feedback technique testing apparatus is the developmental trend of Sports Biomechanics testing apparatus. There has been no such apparatus in table tennis field so far. But such specialized and quick –

feedback testing apparatus has been applied to other sports events, such as Gymnastics, Track and Field, Boating, Swimming, Skating, etc. .

The specialized testing apparatus of the other sports events can give light to the research of Table Tennis. For example, an acceleration sensor perhaps can be fixed on the racket. With the quick development of technique, the volume and mass of the acceleration sensor can be very small, and the accuracy of it can be very high. So if such an apparatus is used, it can supervise and control the 3 – D speed, acceleration and angle speed of the racket, and then the force of the racket, the beginning speed of ball can be calculated.

The other assumption is that four pressure sensors can be fixed beneath the table of table tennis. The whole table is viewed as a big force platform. So the collision of the ping – pong and the table can be described clearly. The speed, angle speed of the ball both before and after collision, the force of collision, and the point which the ball falling can be reflected timely and accurately too.

If these assumptions can be realized, the ping – pong theories knowledge can be enriched.

3.2.3 The research of the synchronous testing in a few testing apparatus

The research of the synchronous testing in a few testing apparatus is the development trend of Sports Biomechanics research. The motion of the human being is very complicated. Therefore, the research of the synchronous testing in many testing apparatus is very important.

The technique of Table Tennis requires accuracy. But the former studies are most from the angle of 1 – D, to discover the regulation of Table Tennis more comprehensively, the study of a few dimensions is the developing trend of the application of Sports Biomechanics in Table Tennis.

For example, using the synchronous testing method of recording system and force platform system, the recognition of Table Tennis can be combined with kinetics and dynamics.

3.2.4 Applying the living creature feedback technique to the technique training of Table Tennis

It provides the data of the speed, range, direction, power etc. for athlete, coach in the sport biomechanics test directly, but the athlete perhaps hardly control in training. If such test data converted into a signal hints of sound and light directly to the athlete, which means that its current action whether come to a request or a certain scopes or not, the athlete can make the reaction right away after receiving a signal, and then, the athlete can adjust the range, strength, speed of motion more easily.

In this study field, there has made a certain progress in other sports events. For example, Yan Songhua (Ph. D of Beijing Sports University) and her tutor

Prof. Jin jichun invented a pair of "testing shoe" for short running, which can supervise the time of landing and swinging of each step. And it was proved to be successful.

This testing method can be used to the Table Tennis training also.

4 Conclusions

According to the actuality of the biomechanical researches on table tennis, the development trend of Sports Biomechanics, and the development of table tennis, the authors analyzed the application and outlook of Sport Biomechanics about table tennis. The authors'view was that the outlook of the Sport Biomechanics in Table Tennis is to apply various sport biomechanical methods including the theoretical mechanics methods and experimental methods into many research fields of Table Tennis.

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5 Development on experimental equipment for showing the differential pressure on spinning table tennis balls

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1 Introduction

In order to let students understand the differential pressure produced during table tennis spinning and flying, and the changing rules of affecting flexure of the flight path of the ball, teachers used to adopt the traditional method to show the differential pressure on table tennis balls, in which two ropes hung two table – tennis balls about 2 ~ 3 mm away were controlled by hands and gas – flow to the center space between the two balls was puffed up by mouth. The method had some disadvantages: varying puff direction, rate and intensity; keeping short time of mutual attraction between the two spinning balls, etc. These made the balls swing or come into collision and produce direct negative influence on the experimental result. To resolve the problems above, this paper has developed novel experimental equipment for showing the differential pressure on table tennis balls. It was by a small blower that the equipment could keep the blowing rate and intensity constant, concentrate the gas – flow steadily, keep long time of mutual attraction between the two spinning balls, and show remarkable difference in the extent of mutual attraction between the two balls under different blowing rate and intensity, and then the disadvantages of the traditional experiment have entirely been overcome. Basic structure of the equipment has been introduced in this paper.

2 Structure and development of the equipment

(1) Base plate: Al steel, 330 × 140 × 20 mm. There was a 100 × 5 mm flute on it.

(2) Reference frame: Al steel, 140 mm long, 105 mm high. There is a scale on its top. It connects with the flute on the base plate through a 90 mm high support, so it can move fore and after.

(3) Hung balls: standard table tennis balls, 40 mm diameter, 2. 70 g weight. They were hung on the reference frame with 0. 33 mm diameter copper lines respectively which were knotted at one of the end.

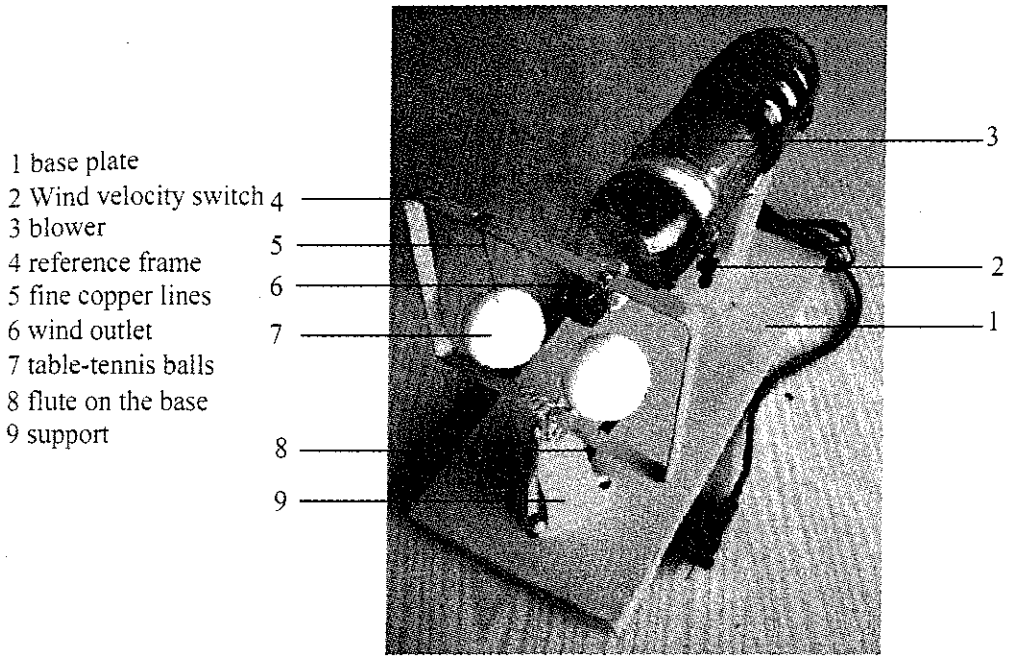

Figure 1. Structure of the experimental equipment

(4) Blower: RCY -850, rated power 850 W, rated voltage 220 V, rated frequency 50 Hz, wind velocity 4 ~ 10 m/s. Switch for adjusting wind velocity is on the bracket of the blower. Size and position of the wind outlet can be adjusted for the need of differential pressure experiment.

3 Experimental examples

Table 1. Data of some experimental examples

	Size of wind outlet(mm)	Wind velocity (m/s)	Distance from outlet to frame (mm)	Distance from outlet center to base plate (mm)	Distance between the two lines(mm)	Distance between the two balls(mm)
Weak wind	15 × 10	6	30	130	60	20
Strong wind	15 × 10	8	30	130	60	20

4 Conclusions

It was conformed that experiment with the equipment is concise and scientific and had remarkable experimental phenomenon. This kind of equipment is benefit for students to directly understand the differential pressure produced during table tennis rotating and flying, and the changing rules of affecting the flexure of the flying curve of balls.

6 Core of Dynamic Skill – the Foundation of High – speed Integration Innovation

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1 The origin of core innovation

1.1 Making a survey on the developing process of Core Innovation

Modern table tennis skill and play, we can find that, taking the integrated behavior and speed of three elements (speed, strength difference and spin) as measurement rule of the developing character, the process is clearly divided into two periods: before 1950s and form 1950s to 1990s in last century. The dominant characters in the two periods are respectively underpins speed and topspin speed. It took on a spiral – up track from underpins low – speed discomdination to topspin sub – rapid discombination to topspin rapid high – efficient disassembly to loop sub – high – speed integration to loop sub – high – speed high integration. Every stage has its own representative mainstream play.

Impelled by skill and play innovation, it realized the separation of underpins speed and top speed character. The speed restriction character of underpins speed combination in small space and acceleration character of topspin in large space was fully grasped.

It then realized the strong integration of topspin translational speed and spin speed through inversed sponge forward – rush loop skill.

At present, as high – speed burst loop skill of the new generation achieved high – quality integration of return speed and ball movement speed on the level of return speed (time) and stroke resultant momentum, the speed platform and attack – defense transition system of main – stream inversed sponge loop balance play has been broken through. Table tennis skill has entered into a major core reform stage.

1.2 Basic purpose of core innovation

High – speed integration is to evolve high – end change of space elements and rhythm on high – speed platform taking high momentum as connotation according to primary estimation, high speed means that core speed of initiative attack and transitional attack will reach such as level that return speed (time) shall be less than 0.16 seconds, forward – drive speed faster than 21m/s and topspin speed faster than 160 cycles/second.

Traditional skill dynamic mode takes handwork as dominant and body movement and footwork as coordinated. Now the core reform means to start from meeting the requirements of high – speed continuous confrontation to change the traditional mode to the core dynamic skill mode of integrated acceleration of human body m. New mode will take bodywork as dominant, namely enacting core control on stroke dynamic function.

The essential of integrated acceleration of human body m is human body m resultant speed reform. Human body, racket and ball are three connecting moving bodies in table tennis exercise. Despite their different mass and structure, the connotation of resultant speed is the same, which is the generate integration of rotary and translational speed on the basis of different rotary speed integration. So the essential of core reform is to realize dynamic reform and athletic function expansion in core aim of continuous aggregation output by the integrative enhancement mv.

When core reform completed, table tennis skill will enter into a new stage dominated by topspin speed and combined with the changes of topspin and underspin speed combination.

Basic purpose of core reform: The aim is to provide a platform of core combination and change for aggregated innovation results achieved, namely re – integration of core.

2 Three major Scientific Synthesis to Instruct the Reform

2.1 Newton synthesis

300 years ago, Newton completed a landmark dynamics synthesis: F = ma, which stared that all movement started from acting force and supportive reacting force. To get drive for continuous movement, it needs to make full use of inertia while at the same time to get over it. All changes of movement status must abide by F = ma. When we explore the rule of athletic competence, we shall realize that human possesses multiplicity, i. e. human nature, biological nature and m nature. We can find a special dynamics rule of self – speedup in human body movement.

The nature of human athletics is bio – dynamic activity. It must follow life and mechanics principle and athletics principle in addition. All kinds of balance status in athletic sports, such as function balance, diathesis balance and energy balance etc, shall be integrated in the platform of dynamic balance. Sport skill integrates energy and strength and strength to generate the dynamic pivot for body movement. It integrates 8 functions: m, movement, force, energy, vital energy, speed, sensation and intelligence.

Support link, as the starting point and transition point of movement status changes, is the basic point to grasp acceleration process and the switch pf energy – – movement conversion. The process of continuous movement is the

conversion process of four kinds of energy, elastic potential – contraction energy – kinetic energy – inertia energy.

2.2 Faster, Higher, Stronger

◆The aim of modem Olympics reveals the rule that higher is the premise of faster and stronger. The core to realize strong and fast integration of speed and strength is the dynamic structure of optimization and integration of human body m.

◆We know from muscle dynamics principle that the integration of speed and strength shall be optimized instead of maximum integration. The true interface of speed and strength contradictory unification exists in muscle action level.

◆When explosive muscle power generated by human body, it is to coordinately integrate the sensation of force generating and acceleration of m.

2.3 Quick, Firm, Spin, Exact, Changeable

●In the five elements of table tennis exercise, spin is a special one with the most abundant characters. Because of its ideal aerodynamics character, it is provided with not only spin change, spin momentum and speed character but also comprehensive characters of speed variation at rear path, diversion, are variation and eccentric impulsive force etc. So it became the core element in aggregation reform in the last century.

●In 1971, Xu Yinsheng, chairman of China Tennis Association, added "spin" to the "quick, firm, exact, changeable" guidelines of fast attacking near court, which completed the most important synthesis of table tennis theory. It changed the idea speed and opposed to each other in the age of down spin to a new theory that combined the two together in the age of up spin. In the process of core reform, we need to complete the integration of human body resultant velocity by changing dynamic structure. 3 Skill models to promote core innovation

In the skill progress of table tennis for over 70 years, new skills emerged in endlessly and quite a lot of classic model also came forth. Among them, there are 9 major aggregate skill models that promote future high – speed reform.

(1) Inversed sponge racket model: provided with excellent friction performance, it offers and indirect ideal mechanics interface for ball movement, stroke and human body force. It generates a rhythm channel of three – spin (athlete, racket and ball) synergetic effect for speed, strength and spin synthesis.

(2) Forward – drive loop resultant velocity model: It sets up a precedent for speed and rotary speed integration.

(3) High – point fast break with pips – out sponge near court model: Although it embodies single forward – drive, it sets up the first drive aggregate model for the high – point fast break by right of force generating. It is a landmark renovation in table tennis dynamics field. The model also influenced on speed level the important reforms of other ball items, volleyball and tennis for example.

(4) Intensive forward – drive loop model: It is the first ball – movement skill model of high – complex ball speed.

(5) High – speed burst skill model: The model, set up in recent several years, aggregates three elements and is also the major carrier and aggregation object of core reform.

(6) Complex spin serve model: The combination of down spin, side spin and reverse spin has unique effects in near net area.

(7) Court receive side – back underspin "twist" skill model: This is the model to be developed in core reform

(8) Fast break with pips – out sponge near court model: As the fist high – quality fast break system, it sets up the combination model for high – point stroke of forehand and backhand with the same character to obtain speed balance in near court area and thus possesses profound theoretic influence till now.

(9) Loop fast break with inversed – sponge racket with shakehands grip: It is the first fast break with inversed – sponge racket that is provided with combination of forehand and backhand with the same character and attack – defense balance system of rally transition in loop age.

4 Dynamics characteristics and basic requirements of table tennis

The core reform of human body dynamic skill is generated from subject reform on stroke and ball movement level to expand play functions. Thus it is necessary to sort out the basic dynamics environment and action relation of table tennis.

4.1 Dynamics environment and related features of table tennis

Basic definition: Table tennis exercise is a kind of small – ball exercise that two counter parties take human body dynamic as the main part, racket as transfer, movement in the converse stress direction of coming ball as carrier. The two parties have a restriction – counter – restriction dynamic counterwork.

Five elastic movement parts (including 2 subjects: human body;2 medium parts: racket; 1 carrier: ball)Two acceleration stroke chains;

One stroke process (one player): human body acceleration – racket acceleration – coming ball acceleration;

Rally: a drive chain connecting stroke time phase and movement dynamic link

One space: ball and human body space restricted by rules

Two support planes: the floor to support human body and the table for ball to fall over

Five stroke areas: near net area, court area, near court area, medium distance area and far – away area

Four ball flight sectors: 2 flight sectors and 2 bounce sectors. Bounce sector and return sector of both parties.

Nine force action relations: relative positions of both parties, relative positions of coming ball vs. human body, coming ball vs. court, human body vs. floor, hand vs. racket, racket vs. coming ball, return vs. opposite court, return ball vs. racket of the opponent, ball vs. air resistance.

Three mechanics elements: force, space and timeThree connecting elements system: athlete movement – racket movement – ball movement

One base point: supportive reacting force

One force action character: bi – direction action of racket – ball elastic impact. The momentum of coming ball is provided with double characteristics of impact and utilization.

The above basic dynamics environment and force action relations are 8Kinematics platform for skill confrontation and also the space restrictions that drive elements must abide by to exert effects. No matter how skillful the stroke is, the essential is that athlete exerts acting force on ball through racket. All wisdom and change must exhibit themselves on dynamics process and the platform.

4.2 Four important characters

The first is small. Table court is small with a net in the middle. Ball and racket is light. Ball movement space is relatively small.

In the second place, ball movement frequency is fast. As table is small and distance short, the frequency will become faster with a bit application of force.

Thirdly, human body and ball have different movement and support plane. Stroke in court space has obvious restrictions on body acceleration space, which leads to the dynamic mode that upper limbs and hands dominate acceleration.

Fourthly, table tennis confrontation has several features, such as limiting speed control guide in court space, and rapid transition from low speed to high speed, from inside court to near court and medium – near court. That is quite different from tennis exercise that has two characters. One is the same support plane and the other is open – type acceleration.

4.3 Dynamics rules of skill application

Skill can be viewed as dynamic transition means to realize confrontation function while play is a system that force action means generates athletics functions. In stroke, element integration shall take the improvement of resultant velocity (ball speed) and variability as the main line and follow the principle to take space optimum and restriction as the premise, speed restriction as the core and strength limitation as the basis.

Skill application and innovation shall be dominated by rapid aggregation character.

Enhancement of stoke strength must be provided with rapid and intensive dynamic structure and small – space acceleration mechanism.

It shall take account of active attack in the first time (service – attack sector) and attack – defense transition in the first area (inside and near court).

It shall take as pivot the forcible transition at near and medium – near court and the inside – court serve – receive transition to perfect rally transition attack system.

Advanced fast break play shall possess speed and acceleration space advantages at first and embody strength advantage on this condition, which needs to manage space character with excellent transition structure.

The dynamics condition to reach rapid attack – defense balance is to set up a core stroke mode that accelerates ball speed by making use of the momentum of received ball to realize that target of optimizing and utilizing spin of the loop.

In bounce and hit process, three elements release energy and produce comprehensive effects. Thus we shall not only think much of speed aggregation in return and flight sector but also make account of the high – speed balance of return sector – flight sector – bounce sector.

5 The connotation and aggregation points of core reform

Core skill reform is the necessary result of loop skill and play innovation and development for nearly 30 years. The key is to generate new changes further target is to fully open the space for backhand burst skill on the basis of same axle and structure so as to provide skill support for the new play of two – side full – rush and full – transition.

5.1 The Connotation of Core Reform

The connotation is to set up an integrative acceleration mode of human body m that starts from support buffer and ends in stroke breakout under the control of central nervous system. The main character is to change the function lf upper limbs and hands to generate force to the comprehensive function of momentum transition acceleration and end expanding change.

As the dynamic structure to twist and integrate lies in core parts of Human body, the dynamic balance mechanism of the unification lf general axle, general mass and center of gravity ideally control the space for link acceleration to effectively gather explosive energy and output to end links.

5.2 Core dynamic skill platform

The platform model integrates the athletics and dynamics function of table tennis into an organic whole. Subject part includes two levels that take two dynamic skill function platforms as the core. Upper level is skill and physical performance level and lower level is special skill level. The platform of the lower level is the core of the whole two platforms. All related function systems need this platform to generate comprehensive effects.

5.3 Aggregation points of core reform

5.3.1 Aggregation model of ball movement element system

Core elements: high aggregation elements of speed, strength and spin

Core ball speed character: a resultant speed of side topspin integrating topspin translational velocity and spin speed;a resultant speed integrating underspin, side spin and back spin speed

Core speed aggregation: aggregation balance of return speed, translational velocity and spin speed; high – speed balance of return speed, flight speed and bounce speed

5.3.2 Aggregation model of stroke element system

Core action interface: a high aggregation and high burst interface of stroke friction and impact forceCore force generating line: The core of stroke momentum is force generating – borrowing and force borrowing – generating.

Core mechanism: unification of drive chain of stroke skill in all areas

Core track: track of the loop

Core stroke drive structure is twist – stretch aggregation and whipping burst.

Core speed: high aggregation of stroke speed and racket speed

Core feeling: integration of force generating feeling and the acceleration feeling of upper limbs in the time phase of stroke

5.3.3 Human body core dynamic system

Core quality: human body m

Core pivot: human body core

Core link: the dynamic triangle of buttock, coax and waist

Core drive: muscle group in buttock, coax and wait

Core drive structure: twist – stretch aggregation whipping

Core support: complex support of lower limbs articulation controlled by hip joint

Core mechanism: aggregation and burst mechanism

Dynamic balance of general center of gravity, general center of mass and general axle

Supportive reacting force in triangular aggregation of core drive dominated by hip joint

Rapid integrated acceleration of active support buffer and elastic myotasis reflection

Dynamics time phase infiltration aggregation

Combination transfer of main

Body dynamic and concentrated burst at end

Concerted unification of kinesthetic sense

High – efficient conversion and utilization of mechanical energy and aggregative adjust and control of elastic potential

Core mode: integrative acceleration mode of human body m

Core character: unification of body and hands and unification of three kinds of spin(human body, racket and ball spin)

5.3.4 Stroke skill

Core skill group: inversed sponge loop skill) and derived skill

Core forehand aggressive skill: Inversed sponge high – burst rush skill)

Core rally skill: forehand back rush and backhand rush and carry

Core court skill: side topspin rush and stir – up

Core footwork: half – open, open type and mixed style

5.3.5 Play Function System

Core function structure: The brand – new function structure, adopting attack on the offensive in both sides, transition rally and defence – counterattack, is provided with excellent flexible space.

Core function area: rapid transition of two sides in medium and near court

Core play: forehand – backhand complete – rush complete – transition high balance

As core on all levels is integrative, it is to form a core aggregation chain dominated and controlled by human body dynamic skill core.

6 Conclusions

(1) Skill platform of sports dynamics is a platform integrated with complex energy. The true value of scientific training of modern athletics is to improve on this platform the human function and skill level to the maximum extent

with high – tech methods. Our final target is to obtain the optimum integration lf modem science and athletics consciousness and human biotic potential

(2) Dynamic skill core reform can be concluded as:

Human body m→human body core→unification of four rotations→identity of three rotations→integration of speed, strength and spin as well as integration and change of five elements

7 Comparison of injuries between top Slovenian table tennis players and top Slovenian tennis and badminton players

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1 Introduction

Millions of people around the world regularly participate in sports and physical activities. Sports and physical activities are usually considered beneficial for an individual as well as for the society as a whole, as a certain amount of exercise is an important element in health promotion. Interest in sport activities has grown in recent years because of the increase in leisure time as well as the belief that general health can be enhanced by improved physical fitness (Peterson, & Renström, 1986). Table tennis is not only one of the most popular sports in the world but also one of the most common sports for people in aged from 7 to 99 not only as recreational sport, but also as sport for rehabilitation. Table tennis is an ideal sport for young and old because of its extremely low risk of injury (Kondrič, Furjan – Mandić, Mišigoj – Durakovi ć, &Karpljuk, 2001). The statistical data on acute and chronic injuries in sport show that table tennis is way at the end of the list. There are hardly any injuries reported in recreational table tennis (Weber, 1982; Scott, 1992; Hochenbichler, 1992). The sport itself and through this also table tennis has to be fun and rewarding. It has to capture a large number of lifetime participants. Table tennis meets all the criteria and that's why it is the most played racquet sport in the world for young and old.

A number of top athletes in Slovenia is increasing which means that we are facing a problem of sport injuries. Because these injuries occur during sport activities (training and competition), the role of physicians goes beyond a mere diagnosis and injury treatment; Physicians are required to take part in the rehab process, training advisory, they help athletes get back to practicing sport and help decrease the risk of potential injuries. Having this in mind, we must be aware of the problem complexity. Namely, not only we need to treat an injured athlete, the treatment must start as soon as possible as most

athletes wish to return to training and competitions in the shortest time possible. As a result, sport physicians must very well know the strains athletes are exposed to in a particular sport. In addition they must have the knowledge of patho – physiology of sport injuries. It can be stated that a sport physician, who only treats the injured not offering help to get the athletes back to sport activities, is only doing half of his/her job (Dervi? evi?, & Had? i?, 2002).

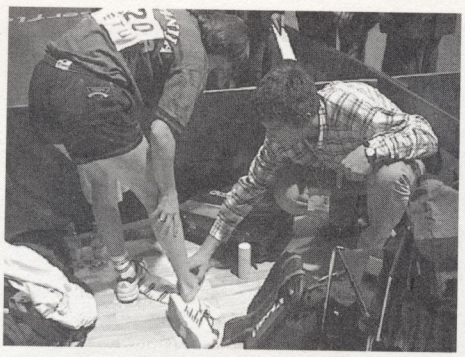
The potential risk of injuries in sport seems to increase for all levels of athletes with increasing participation, intensity and demands, as well as longer training periods.

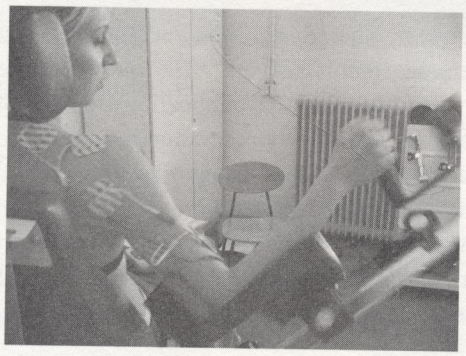
As with any other sport, there are some injuries that are typical of table tennis. Sport medicine findings, along with medicine and science findings, inevitably contribute to injury prevention and injury treatment programs for table tennis players. For effective prevention, it is important to understand the functional anatomy and patho – physiology of injuries of different tissues. For injury prevention it is also necessary to understand the importance of excessive load and how these loads are distributed, sports – injury mechanisms, and the biochemical response of body tissues to impact and overuse (Kondri č, &Furjan – Mandić, 2003).

Sports medical examinations of table tennis players should not merely be an additional examination by a primary care physician. A physician must have, in addition to expertise in anatomy and physiology of the human body, also a profound knowledge of various loads, which often reach the limit or even exceed an athlete's physiological capabilities.

Generally, sport injuries can be classified as trauma and overuse injuries. Trauma injuries occur as a consequence of a specific accident or event. Such injuries are sprains and dislocations. Overuse injuries develop gradually and they can occur during a training or competition, or they gradually develop for weeks or months. A typical example of overuse injury is Achilles tendon injury. The player first feels a slight pain after a training process. Over the night, the pain is gone but reappears after each consecutive training. The damage progressively becomes worse and results in serious problems. Causes of sport injuries vary, from inadequate warming up, insufficient physical shape, inappropriate training, short rehabilitation process, biomechanical equilibrium and anatomic factors, improper sport technique, inappropriate footwear, inappropriate protective equipment, inappropriate practicing surface, violating the fairplay, previous injuries and other.

Common injuries in racquet sports are rotator cuff tendinitis ("dead arm"), "King – Kong" arm (over – development of dominant arm), tennis elbow, forearm nerve entrapments, low back pain, abdominal wall sprain, tennis leg and eye injuries (Sherry, & Bokor, 1997).





The aetiology of overuse injury is multifactorial, involving both intrinsic and extrinsic factors. Intrinsic factors are related to the athletes themselves, including anatomical, alignment, growth/age, muscle tendon imbalance, genetic endowment, general health, nutritional status and prior injury (Sparrow, 2001; in Maffullin et al, 2001). Extrinsic factors include training error, equipment inadequacy and environmental factors (Brukner, & Khan, 1997). The impact of each of these factors on the clinical presentation needs to be evaluated in order to gain an accurate diagnosis around which the treatment can be planned.

A good knowledge of these factors and appropriate measures taken to solve them is a prerequisite to prevent a number of injuries, or at least to decrease the injury incidence and severity.

The incidence of injury levels needs to be reduced and it can be achieved by concentrating more on preventative measures.

2 Material and methods

Within the project Epidemiology of sport injuries in Slovenia, 83 top Slovenian athletes (table tennis 29, tennis 39 and badminton 15) were questioned. At the time when the questionnaires were distributed, these athletes had an

international or national ranking (as per Slovenian Olympic Committee criteria). For the purpose of this study, a questionaire of 15 questions pertaining to sport injuries among top Slovenian athletes was used.

Data has been processed by the SPSS software for PC at the computer data processing department of the Institute of kinesiology, Faculty of Sports. The basic statistical parameters have been calculated (mean, standard deviation, frequency of answers). To ascertain differences between individual sports, the analysis of variance ANOVA has been used.

3 Results

In this project, 83 questionnaires were mailed to top Slovenian athletes, among which 29 are table tennis players. The questionnaires were mailed to those athletes who were listed in the publication by The Slovenian Olympic Committee "Obvestila – seznam kategoriziranih ? portnikov v Republiki Sloveniji" [Announcements – list of categorized athletes in the Republic of Slovenia], and whose medical records were at the same time at the clinic of sports medicine CM? in Ljubljana. According to the instructions provided, all 83 athletes returned the questionnaires – 50 male (60.2%) and 33 (39.8%) female athletes. The average age of the athletes questioned was 19,5 years.

Table 1. Basic data of monitored athletes (source: Epidemiologija športnih poškodb v RS [Epidemiology of sports injuries]; Derviševi ć, Hadžić, 2002)

	TABLE TENNIS				TENNIS				BADMINTON			
	N	Mean	Std. Error	Std. Dev.	N	Mean	Std. Error	Std. Dev.	N	Mean	Std. Error	Std. Dev.
AGE	29	19.52	.78	4.21	39	19.23	.71	4.42	15	21.53	1.10	4.26
HEIGHT	29	177.34	1.19	6.40	39	178.64	1.36	8.47	15	174.67	2.21	8.57
WEIGHT	29	669.31	12.33	66.40	39	685.90	13.17	82.23	15	670.00	20.95	81.15

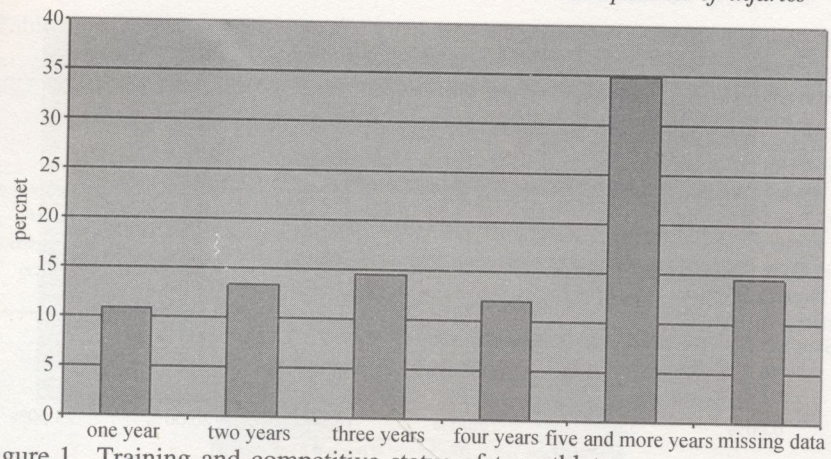


Figure 1. Training and competitive status of top athlete

Table 2. Injury location

	Table tennis	Tennis	Badminton	Racquet – sports	Racquet sports Cumulative
Head	0.00%	0.00%	2.78%	0.72%	0.72%
Neck	0.00%	4.62%	0.00%	2.16%	2.88%
Shoulder	21.05%	13.85%	11.11%	15.11%	17.99%
Upper arm	0.00%	0.00%	0.00%	0.00%	17.99%
Forearm	0.00%	1.54%	2.78%	1.44%	19.43%
Wrist	10.53%	13.85%	11.11%	12.23%	31.66%
Fingers	0.00%	0.00%	0.00%	0.00%	31.66%
Trunk	2.63%	3.08%	0.00%	2.16%	33.82%
Spine	15.79%	15.38%	19.44%	16.55%	50.32%
Hip	15.79%	1.54%	2.78%	5.76%	56.08%
Femur	7.89%	12.31%	8.33%	10.07%	66.15%
Knee	2.63%	1.54%	5.56%	2.88%	69.03%
Shank	0.00%	3.08%	13.89%	5.04%	74.07%
Ankle	13.16%	20.00%	11.11%	15.83%	89.93%
Foot	10.53%	9.23%	11.11%	10.07%	100.00%

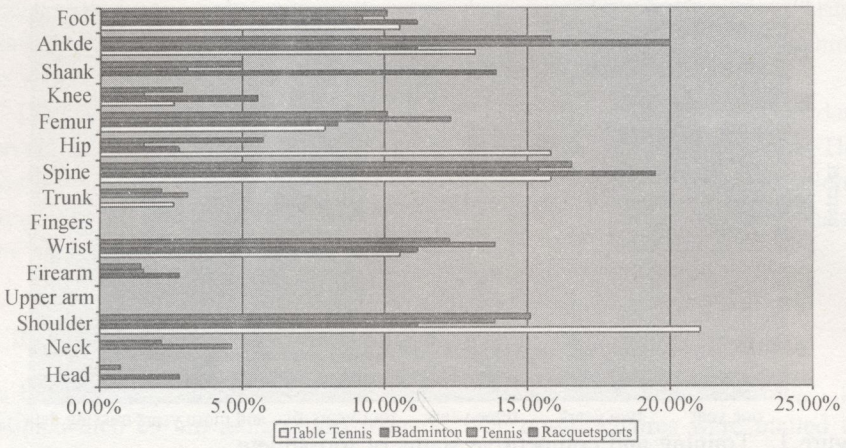


Figure 2. Injury location

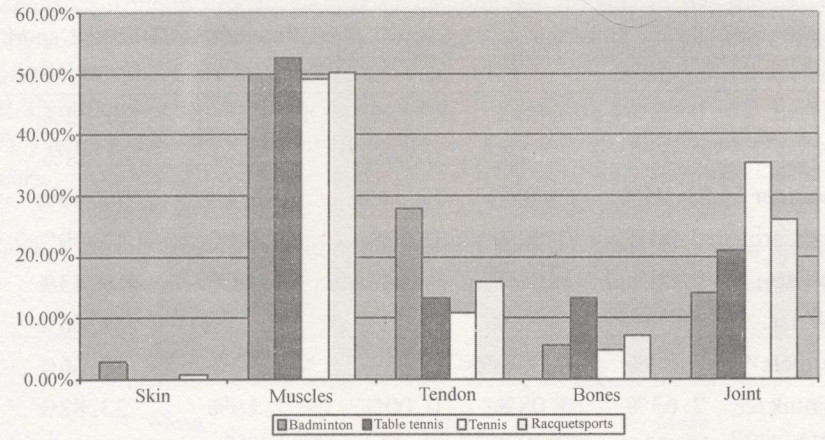


Figure 3. Injuries of individual parts

Table 3. Percentage of injuries per individual sport

	Skin	Muscles	Tendon	Bones	Joint
Table tennis	0.00%	52.63%	13.16%	13.16%	21.05%
Tennis	0.00%	49.23%	10.77%	4.62%	35.38%
Badminton	2.78%	50.00%	27.78%	5.56%	13.89%
Racquet sports	0.72%	50.36%	15.83%	7.19%	25.90%

Legend for table 1 (Together 1 – total number of injuries in preparation or competition periods Together 2 number of injuries during a training session or a competition event – at the beginning, in the middle, at the end)

Table 4. Injury occurrence in table tennis during preparation and competition period

	Together1	During practice			During competition		
		In the beginning	In the middle	At the end	In the beginning	In the middle	At the end
In preparation period	14	4 28.57%	4 28.57%	4 28.57%	1 7.14%	0 0.00%	1 7.14%
In competition period	25	4 16.00%	5 20.00%	4 16.00%	2 8.00%	6 24.00%	4 16.00%
Together2		8	9	8	3	6	5

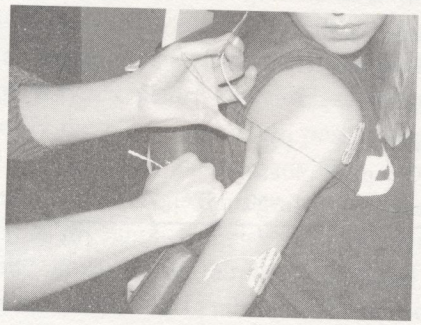


Table 5. Sum of all injuries reported by athletes (table tennis)

	Skin	Muscles	Tendon	Bones/ fracture	Joint/sprain – dislocation		% Of all
Head	0	0	0	0	0	0	0.00%
Neck	0	0	0	0	0	0	0.00%
Shoulder	0	6	1	1	0	8	21.05%
Upper arm	0	0	0	0	0	0	0.00%
Forearm	0	0	0	0	0	0	0.00%
Wrist and palm	0	1	1	2	0	4	10.53%
Fingers	0	0	0	0	0	0	0.00%
Trunk	0	1	0	0	0	1	2.63%
Spine	0	4	0	1	1	6	15.79%
Hip	0	3	1	0	2	6	15.79%
Femur	0	3	0	0	0	3	7.89%
Knee	0	0	1	0	0	1	2.63%
Shank	0	0	0	0	0	0	0.00%
Ankle	0	1	0	0	4	5	13.16%
Foot	0	1	1	1	1	4	10.53%
	0	20	5	5	8	38	
% Of all	0.00%	52.63%	13.16%	13.16%	21.05%		

Table 6. Comparison between table tennis players and other players (tennis and badminton) (One – way ANOVA table)

		Sum of Squares	df	Mean Square	F	Sig
NUMBINJ	Between Groups	10.378	1	10.378	5.262	.025
	Within Groups	142.000	72	1.972		
	Total	152.378	73			
TREATM2	Between Groups	.269	1	.269	4.919	.029
	Within Groups	4.430	81	.055		
	Total	4.699	82			
PAYMEN1	Between Groups	1.287	1	1.287	5.424	.022
	Within Groups	19.219	81	.237		
	Total	20.506	82			
MEDTREAT	Between Groups	.098	1	.098	4.134	.450
	Within Groups	1.852	78	.024		
	Total	1.950	79			

4 Discusion

Participation in competitive sports places the athlete in a situation in which injuries are possible at any given time.

The aims of this study were to establish:

Frequency of sport injuries among top Slovenian athletes,

Types of injuries,

Severity of injuries based on data of players absences from training and/or competition processes. These would serve as a base for further in – depth studies.

Based on the results of the study, it can be presumed which prevailing risk factors are causing an injury to occur, and plan the injury prevention measures accordingly.

Traditionally, table tennis has been associated with a low injury rate. However, the number, distribution and nature of injuries within table tennis have not been well defined due to poor injury definition reporting.

Overuse disorders can be considered injuries to normal tissue as a result of cumulative, repetitive sub maximal micro trauma due to inadequate time for recovery between stress episodes (Krivickas, 1997).

The highest in number of injuries (21.05%), as expected, are shoulder girdle injuries. However, interesting is the constellation that the number of these injuries is far lower in tennis and badminton. According to extreme loads of the shoulder girdle in all three racquet sports it can be concluded that

a higher number of injuries in table tennis is a result of short, abrupt and extremely rapid movements, particularly in forehand strokes. With the introduction of a bigger ball, these strokes have become even more abrupt. (Kondri?, Furjan – Mandi?, & Medved, 2003).

The integrated functions of the rotator cuff muscles and the scapular stabilizers, coupled with the large multiplanar movements inherent in table tennis skills, make the shoulder complex vulnerable to injury. Successful rehabilitation programs for injury to the shoulder complex must be tailored to the individual, based on accurate diagnosis of the tissue damage and pathomechanics, clinical signs, stage of growth and specific table tennis skills demands. As many table tennis players experience pain only during specific skill execution, normal physical testing of the shoulder is often not sufficient to reproduce the table tennis player's pain. Therefore, functional testing must be used in order to identify the pain – provoking position with estimation of the force, direction and magnitude of muscle activity.

There are more injuries that occur during a competition period (table 4). The result is expected as the number of risk factors increases – such as considering the opponent, violation of fairplay, increased motivation – and consequently athletes are overdoing (enthusiasm), and considering all other factors putting players at risk outside the competitions. The majority of injuries occur in the middle of a training process or a competition event. This is particularly interesting because it possibly indicates inadequate warming up, lack of stretching exercises prior to practicing and similar. Unfortunately, even at major events such as World or European championships, it is evident that some top athletes are either not familiar or are not well informed about proper warm – up and stretching.

Although there are few studies focused on the medical aspects of table tennis, Shida et al (1994) reported 25. 1% injuries of waist (lumbago), 15.7% of shoulder and 14. 1% of knee joint. Many of reported disorders were referable to the specific nature of the practice. After treatment, more than 95% of players had no hindrance in resuming the game.

The most frequent injuries in table tennis pertain to muscle tissues (table 5), followed by joint and tendon injuries. These records more or less correspond to the epidemiology of sport injuries records in the world literature. Percentage wise, the shoulder joint injuries are ranked highest, which again corresponds to the world epidemiology records. Shoulder is the most flexible body part and therefore most vulnerable. However, the sum of all leg injuries (34%) is higher than the sum of all arm injuries (31. 58%). As for thigh muscles being the knee stabilizers, thigh muscle injuries (all of which are muscle injuries) and knee joint injuries (tendon injuries as passive knee stabilizers, and joint injuries) could be considered as a functional unit –

meaning it is the most liable part to injuries (more than the shoulder joint).

In table tennis, the trunk is significantly involved in all strokes players perform. Any factor that reduces the range of motion or impairs the muscle control of the trunk inhibits the efficient transference of force, leading to compensation and potential injury. Accurate figures for the incidence and nature of low back pain and injury in table tennis players are difficult to establish due to the limited prospective sport – specific research. There are various sites around the hip that are weak as a consequence of open physeal plates. Quite large pieces can be pulled off, particularly with sudden unexpected loads. The anterior – inferior iliac spine tends to go in table tennis when the front leg is suddenly blocked. Because of these abrupt blocking movements, the percentage of hip injuries is as high as 15. 79%. Spine injuries (15.79%) more or less pertain to lower back pain or overuse injuries. Overuse injury to the pars interarticularis is quite common in the young athlete (Pizzutillo, 1985).

To perform an efficient initial stroke (serve), the player must have a very flexible wrist. This is also true for some other types of strokes, performed from the wrist, or performed by the penholder players. The wrist is a complex functional unit. Percentage of wrist injuries is in table tennis players lower (10.53%) than by the tennis players (13.85%) but still very high. While acute injuries can, and do, occur, the greatest presentation is for non – specific wrist pain often associated with chronic stress – related reaction implicating the growth plates. Grip strength testing can be used as a useful screening and evaluating tool in managing chronic wrist pain.

The complex structure and function of the foot and ankle are essential for effective footwork of table tennis players. Like the wrist, the ankle has little local muscle support, relying for its function on mechanical efficiency of its capsular and ligamentous structures; and unlike the knee, the ankle joint has no major surrounding stabilizing muscles. The lateral collateral ligaments and the medial collateral ligament, or deltoid ligament, establish the ligamentous integrity of the ankle joint, and these structures limit and stabilize the range of motion at the ankle joint. Because of fast lateral movements in table tennis, the integrity of the foot is essential, as shoe support and orthotic devices cannot be used to modify poor foot biomechanics. A high percentage of injuries of ankle and foot joints (23. 69% in total), indicates that table tennis players should pay more attention to choosing appropriate footwear to avoid those injuries. All muscles acting to move the foot at the ankle joint arise in the leg, and so the ankle joint is susceptible to injury in the frontal plane (i. e. inversion/eversion).

It is surprising that the percentage of bone injuries or fractions is this high (table 3; 13. 16%), which is likely not to reflect injuries occurring during

training or competition. Namely, the questions did not ask for the place the injuries occurred at. The fact is also that we do not normally test bone density or exercise bone tissue consciously, bone is a dynamic tissue that responds to exercise. On the other hand Geusens and Dequeker (1994) conclude that exercise for at least 14 weeks, which loads bone positively, influences bone density in both males and females.

There are some differences among table tennis players and other racquet players. Table tennis players have fewer injuries and they prefer separate medical treatment for each sports discipline. Injuries of table tennis players namely differ from injuries of other sports athletes.

5 Conclusion

The poor recognition, localization and reporting of pain by young table tennis players can often delay access to appropriate and timely intervention to prevent injury chronicity. The first requirement for effective management of table tennis injuries is therefore prevention, based on an understanding of the factors involved in overuse injuries generally, and table tennis injuries specifically.

The high repetition of activity necessary to develop and perfect table tennis skills produces the potential for chronic overuse injury. The epiphyses and apophyses of the growing skeleton are specifically at risk. Poor technique, coupled with the anomalies of growth and improper equipment, produce skill errors, which may result in an increased stress on the muscoloskeletal tissues and produces pain in response to micro trauma or overload. To minimize the pain response, the body adopts compensatory mechanisms, which ultimately add to the skill errors, and the never – ending circle of overload is established.

One major responsibility of the table tennis trainer is to make the training and competitive environment as safe as possible to reduce the risk of injury. If an injury could have been prevented initially, then there would have been no need for first aid and subsequent rehabilitation. The table tennis trainer, in cooperation with the team physician and doctor, should obtain a medical history and conduct physical examinations of the athletes before participation as a means of screening for existing or potential problems. If the trainer knows at the beginning of the season that an athlete has a physical problem that may predispose that athlete to an injury during the course of that season, then corrective measures that may significantly reduce the possibility of additional injury may be implemented immediately.

In addition, the database records obtained in such studies contribute to health care planning and organization for top Slovenian athletes, who inevita-

bly require a better and qualitative medical supervision primary care physicians could offer.

From that point of view it is therefore very important that a table tennis trainer works closely with and under supervision of the team physician and team doctor.

Playing table tennis does, however, have many benefits. It is an effective and fun way to maintain cardiovascular exercise and provide the benefits for the player. Table tennis is also a means of maintaining weight – bearing activities to resist bone loss and to provide coordination training to maintain balance and function.

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8 Comparison between table tennis scoring system (11& 21 points) by probabilistic simulation

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1 Introduction

Substantial research work has recently studied and analysed the effects of the rule changes concerning the point scoring system in table tennis since the implementation of those modifications (2001 – 2002 season).

Among them, decreasing the set length from 21 to 11 points as well as alternating serves in series of two therefore seem to have modified certain principles of efficiency influencing the match, sometimes prompting players to go as far as changing their way of dealing with and/or handling their opponents (C. Sève, 2003).

Research has been focused on the scoring systems but also on the techniques and tactics adopted, the structures and their mechanism, as well as the modifications generated among players.

In all this research work, various scientific models were used to analyse the transformations. (For example, Markov's chain for Hohmann, Theureau's course – of – action for Sève)

We are going to look at the changes having occurred concerning the set and its structure using probabilistic simulations. The latter will enable us to compare the decrement of the scores in both real and simulated matches.

The aim is therefore to link the rules and their logic with the transformation in the induced game in order to better understand the problems posed for the players and the transformations that need to be triggered in their games to optimise their performance.

Our study is focused more on the analysis of the scoring system observed in video sequences, to extract a few essential elements of operation.

This view carried out via probabilistic system seems pertinent to us with respect to the subject of our study. Moreover, these analysis systems have already been used in other practices and research (for example, for Klaassen & Magnus 2001 in tennis – Study on the probabilities of winning a match).

The sport's period of transformation (2001 – 2003) is also a determining factor. It is at that time that the athletes were confronted with those changes for the first time. The first world championship played in such a way therefore offered a privileged investigative situation before too many major adaptations were made or before new players arose having been trained solely under the new scoring systems.

The match used for the case study was played during the latest world championship in 2003. It opposed Kong Linghui and Werner Schlager, two of the best players at the time, in the semi – final.

2 Materials and methods

We propose modelling a match with a logistic regression. Where y_i the ith point of the match (y_i if the point is won by the reference player) and $\mathbf{x}_i$, the vector characterising the position of the ith point in the match, this approach proposes modelling $\mathbf{P}\left\{y_i = 1 \mid \mathbf{x}_i\right\}$ for every i. To do so, the following parametric form is supposed:

$$\mathbf{P}\left\{y_i = 1 \mid \mathbf{x}_i\right\} = \frac{1}{1 + exp(-\alpha_0 - \sum_{j=1}^{k} \alpha_j x_{ij})}$$

In this approach, the vector of parameters $\boldsymbol{\alpha} = (\alpha_0, \cdots, \alpha_k)^T$ is unknown and must be estimated. To do so, the method of maximum likelihood is used:

$$\hat{\boldsymbol{\alpha}} = (\hat{\alpha}_0, \cdots, \hat{\alpha}_k)^T = \arg\max_{\alpha} \prod \mathbf{P}\left\{y_i = 1 \mid \mathbf{x}_i\right\}^{y_1} \left(1 - \mathbf{P}\left\{y_i = 1 \mid \mathbf{x}_i\right\}\right)^{1-y_i}$$

The model obtained in the end thanks to the observation of a match will first make it possible to measure the impact of the serve, the position of the point in the set and the position of the set in the match. Then, via Monte – Carlo simulation, the possible outcome of the match will be studied if it had been played in 5 sets of 21 instead of 7 sets of 11.

The principle is to simulate each point of the match with the probabilities resulting from the logistic regression. Hence, each point is the result of a Bernoulli random variable with parameter $\mathbf{P}\left\{y_i = 1 \mid \mathbf{x}_i\right\}$. As the points are concatenated, a result for the set is obtained then for the match. By reiterating the simulation several times, an accurate estimation of the probability of victory of each of the two players is obtained.

These simulations are conducted for a match in 7 sets of 11 points and in 5 sets of 21 points. The impact of the match type such as the serve at the beginning that can be measured in terms of probability of winning the match.

The study was conducted based on the Table Tennis World championship semi – final in 2003 in Paris between Werner Schlager and Kong Linghui.

3 Results

The logistic regression identified the "server" variable as the single significant variable (p = 0. 004). To enhance the quality of the modelling, the variable measuring the point difference between the two players was maintained (p = 0. 18). As the model constant was naturally significant, the latter is also part of the final model.

Hence, by taking Schlager as a reference player, the logistic model obtained is as follows:

$$\mathbf{P}\left\{ \text{"Schlager wins the point } i\text{"} \mid (\Delta_i, S_i) \right\} = \frac{1}{1+\exp(0{,}525 + 0{,}106 * \Delta_i - 1{,}020 * S_i)}$$

When is the score difference in the set at the time of playing point i and characterises the server at the time of playing point i ($S_i = 1$ if Schlager serves and 0 otherwise).

The probability function obtained in this manner can be represented by the figure 1. The figure 1 shows that the probability of winning the point is a decreasing function of the point difference between the two players. As a result, the player who is losing sees his probability of winning the point increase. This follows a trend of situation turnarounds within the set.

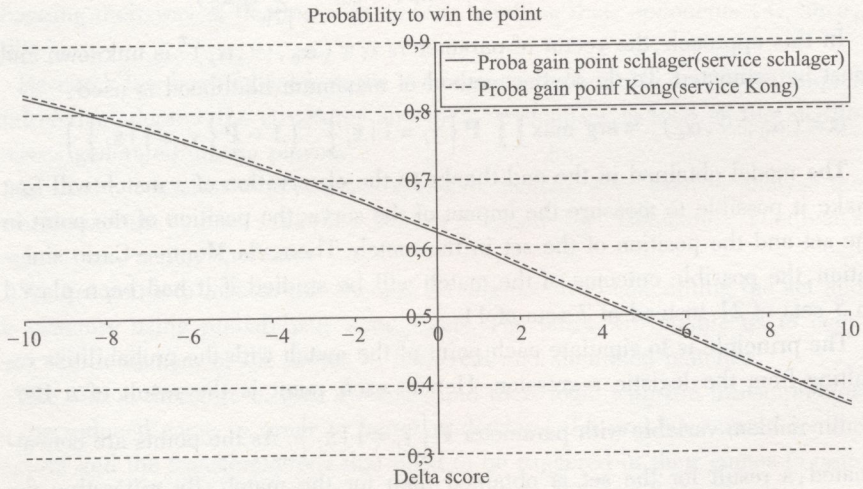

Figure 1. The probability of winning the point

It can also be observed that Kong has a higher probability of winning the point upon serving than Schlager and such is the case whatever the score difference.

Lastly, when the score difference is nil, the probability of Kong winning the point when he serves is 0. 63 whereas the probability of Schlager winning the point when he serves is 0. 62.

This difference, which seems insignificant, is in fact important enough for seeing substantial differences in the probability of winning the match.

The numerical simulations conducted based on the preceding logistic model do indeed show a substantial repercussion on this probability difference of winning the point.

In figure 2, it can be seen that Kong is the one who had the highest probability of winning the semi – final. With a match in 7 sets of 11, and with Schlager serving at the beginning of the match, Kong had a probability of winning of 0.53 versus 0.47 for Schlager. This result does not contradict the actual semi – final (victory for Schlager). An event with a probability of 0.47 naturally remains possible.

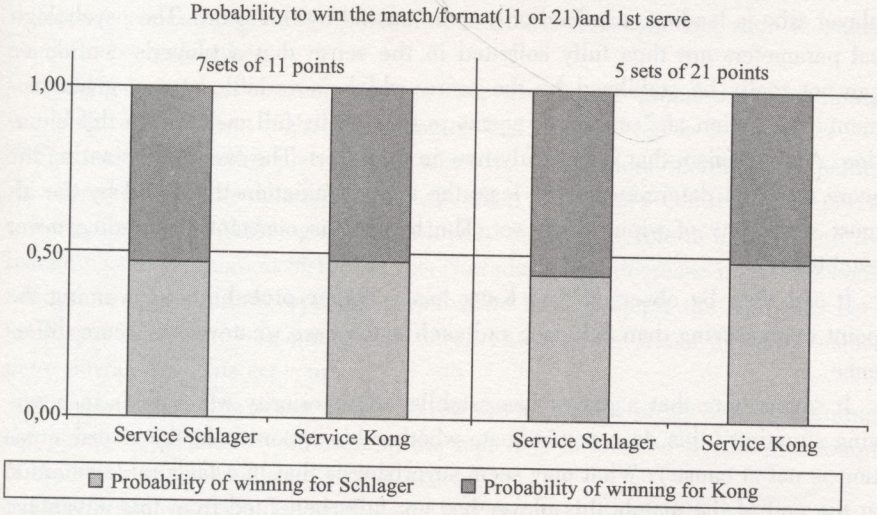

Figure 2. The comparision between Kong Linghui and Schlager in the probability to win the match

It is interesting to see that Kong's probability of victory would have been even higher if the match had been played in 5 sets of 21. The graph shows that the Kong's probability of victory would have been 0.56 versus 0.44 for Schlager.

One last noticeable result is that, given the advantage of serving for winning the point, the probability of winning the match is influenced by the attribution of the serve at the beginning of the match. Clearly, it is better to choose to receive. This strategy had more influence with a match in 5 sets of 21. It can be seen that the probability of victory increases from 0.44 to 0.48 for Schlager with a match in 5 sets of 21 as opposed to going from 0.47 to 0.48 with a match in 7 sets of 11.

Initially, the analysis of this semi – final of the world championship shows

that the scoring system and the designation of the first server have an influence on the probabilities of winning the match. The change to scoring in 7 sets of 11 points decreases both the differences between the players and the impact of choosing to serve first.

4 Discussion

The study shows us, first of all, that the player who is losing sees his probability of winning the point increase. This follows a trend more favourable to situation turnarounds within the set.

As paradoxical as this may seem, it allows us to better understand the constant uncertainty which can translate into score instability. The position of the player who is leading is indeed only to be envied by this score. The psychological parameters are thus fully solicited in the sense that a player's confidence can not really be stabilised by the score, which is variable at any given moment. The notion of "pressure" seems to take on its full meaning in this situation. A mechanism that is not truly new in this sport. The fact of dominating the score does not determine in the least the total domination translated by the almost – certainty of winning the set. The balance is constantly wavering, never established.

It can then be observed that Kong has a higher probability of winning the point upon serving than Schlager and such is the case whatever the score difference.

It seems here that a player has established superiority when he is in a serving situation (this does not indicate whether his opponent in the return situation is not at cause). What may seem surprising is that in a favourable situation at the end of the match, this player has not fully benefited from this advantage (observation of the score). Beyond becoming aware of this state of fact at the time (lucidity), it must be indicated that athletic performance produced is never based on a single factor; there would obviously be other components to take into account in the performance to explain it better. Among those, the history of the performance in the competition (path to victory) and of the duels played between the two players might provide a few clues for understanding. The other player in the duel is also important. Schlager's performance in this championship can also lead us to believe that he acted via tactical choices and risk – taking on the fragile and uncertain balance of this match. The rule allows the relation between players however the latter (especially at this level of expertise) can "play" with it; Schlager would also have optimised this opportunity in this match (in this championship).

It can be seen that when the score difference is nil, the probability of Kong winning the point when he serves is 0.63 whereas the probability of Schlager

winning the point when he serves is 0.62.

That does not seem very important; yet it is what determines Kong's "theoretical" domination. The numerical simulation transforms the probability of winning the point into a probability of winning the match (10,000 matches in each of the 4 situations).

Reading the second graph also indicates that Kong had the highest probability of winning the semi – final.

The real – virtual difference also appears here. It would be simplistic to think that probability makes a total and infallible prediction possible in complex situations.

Even if all the points have the same value in scoring, some seem to be worth more, at certain moments in the match. Schlager would have perhaps made the difference concerning those essential points. To truly say so, another study needs to be undertaken.

Complementarily, it is interesting to note that Kong's probability of winning would have been even higher if the match had been played in 5 sets of 21.

The number of points played emphasizes the domination. Scoring in 11 points therefore reduces the latter. That is an effect that could confirm this sport's rules tendency of upholding a certain loyalty to the principle of equalization by balancing the alternation of the serves. Nowadays, this decrease in the set contributes to upgrading the opposition ratio. The latter prompts the supposed better player (favourite) to confirm his level. The outsider status therefore seems more enviable in this set – up.

One last noticeable result is that, given the advantage of serving for winning the point, the probability of winning the match is influenced by the attribution of the serve at the beginning of the match.

This is not new. The 1% difference for the 11 – point sets, 4 % in 21 – point sets continues to provide a certain weight to this favourable situation. It therefore needs to be kept in proportion based on the relation of force instituted throughout the match between the server and the receiver.

The rule of ball visibility throughout the serve has undoubtedly also participated in balancing those dynamics.

5 Conclusions

This study's essential findings concern the importance of the serve, the domination in the set and the situation turnaround effect.

Generally speaking, scoring in 11 points decreases the dominance between the players as well as the impact of the serve choice (although still present).

More specifically in the match observed, the winner is not necessarily the one who has the highest probability of winning the match.

Lastly, situation turnarounds during the match are favoured by a probability of winning the point that increases when the player is losing.

That confirms and quantifies the other conclusions and studies conducted whatever the model and methodology used.

This study was also conducted using the logistic regression methodology which seems suitable for our study subject and which could be reused perfectly well in other similar studies.

We take caution in drawing conclusions about the scope of these findings. We cannot expect intangible general rules of such studies. On the explanatory side more than on that of the prediction, we hope to provide a few axes of reflection to trainers. They, alongside their players, have a large role of invention in these times of adapting to changes.

Rules are changed and remain important factors of evolution in sport practices in general and in table tennis in particular. They enable players to show and develop ever – renewed capacities of adaptation and to participate in these changes by sometimes marking them personally (invention). These modalities commit the table tennis player today to a total duel, ever – more uncertain, but the favourable outcome of which is still possible. Above and beyond the spectacular effect, it is also, to a certain extent, a way for us to re – enhance the playful aspect of the game, until its ultimate competitive practice. The outcome which has been made more uncertain by the rule also prompts a bigger focus on aspects of the table tennis player's personal management. Training and preparation methods for competition will certainly integrate these aspects more and more, throughout the athlete's training, so that he can meet these requirements.

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9 Technical contrastive analysis after ping-pong diameter altering

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1 Introduction

When the diameter of table tennis ball officially changed from 38 mm to 40 mm in 2000, someone believed that the changes would have negative effects on Asian players including Chinese athletes while benefiting European players. But in fact, we will find that the results of Asian players have been greatly improved comparing the match results now with the results of the match in which smaller balls were used. It can be concluded that this change may be more suitable to the skill execution of Asian players. So what is the reason? In this paper, we will discuss the problem in two aspects: (1) basic biomechanical knowledge will be used to analyze the principles and the features of force, revolving, flight path of table tennis ball, which will help the athletes to realize the table tennis perceptually and rationally better, and enhance their ability of judgment to nature of ball, and also perfect the skill; (2) by studying the alternation of table tennis angular velocity, flight path, and discussing this kind of alteration would bring the effect of Chinese athlete further, and it is able to supply the service better for the athletes executing the movement technique level, producing a better movement effect and improving scientific degree of movement training .

2 Methods

Measuring method of spin speed of table tennis: The way of testing the table tennis ball spin speed and spin angle by means of a US Ariel three – dimensional resolution system is explained as followings: Design of color ball: the table tennis ball was coated with three pigments of red, yellow and white colors. Design of lights: In order to identify three colors on the table tennis ball more clearly and exactly through images, the lights in the table tennis hall (experiment place) must be very bright. Therefore, all the lights in the hall were turned on and also additionally mount 4 iodine – tungsten lamps at four corners.

Videotaping: We extend at the side of the ball table a high – speed digital camera with a sampling frequency of 300 frames per second to record the

movement situation of topspin ball and under – spin ball respectively.

3 Results and Discussion

The movement of a table tennis ball is determined by the external forces acting on it, which mainly includes the normal force and frictional force from the paddle, gravity, and the air resistance (fluid force). Influence of gravity can be neglected since a table tennis ball is very light. In the course of table tennis moving, table tennis revolving will lead to air revolving around the surface and cause the difference of air velocity, and thereby the ball will suffer an air – press and flight along a curved path. As for the reasons, which lead to the complication of the movement of table tennis ball in the air, especially, after increasing the diameter of table tennis ball. We will make mechanical analysis on it at the following points.

3.1 Change of forward striking velocity after increasing diameter of table tennis

After increasing the diameter of a table tennis ball, an increase in weight is not obviously. If the impulse imposed on a ball is fixed, we can conclude from the impulse – momentum relationship ($F \cdot t = mv_2 - mv_1$), that the off – paddle speed of table tennis ball will not decrease drastically. In the course of flight, owing to the influence of air resistance, table tennis forward velocity will decrease appreciably. Diameter increasing will bring an increase in head – on area, according the formula $s = \pi r^2$, and thus lead to an increase in air resistance, according $f = c\rho v^2 s$. Owing to the small increase in air resistance, the influence on flight velocity can be neglected. As a result, for athletes of fast – attack style of play, increasing diameter of table tennis will not have much influence on them. As the skill feature of Chinese athletes is combining fast attack with loop attack, especially the former, an emphasis in speed is the key reason why Chinese athletes can still win matches. So it is proved that the advantage of fast attack still exists. Comparing the result in major competitions, it is demonstrated that Chinese athletes have not been affected by the change in ball size. In other words, the fast attack style is as effective as before.

3.2 Change of spin speed after increasing diameter of table tennis

Spin of table tennis ball can be classified as topspin, under spin, sidespin and composite spin. Table tennis ball rotates in the air around its own center. This will cause changes of its flight path and therefore changes the speed and angle of the ball when it rebounds off the opposite table. Therefore, one should understand and grasp the underlying principles of table tennis ball movement by starting from understanding the spin of table tennis ball first. The table tennis

ball spin speed and spin direction are normally analyzed from two aspects: A. Analyzing the table tennis ball's spin speed and spin angle through analyzing the forces acting on table tennis ball; B. Measuring the table tennis ball's spin speed and direction through tracing special marks of color ball by means of high – speed photography or high – speed videotaping – image resolution method.

3.2.1 Analysis on the forces on the ball and spin

The forces imposed on the ball by a paddle can be resolved into two components: one is the normal thrust (F), and it acts through the cg of the ball and translate the ball forward; the other one is imposed frictions on the surface of the ball owing to the viscosity of the paddle gooey, and it can "sticking to the ball" and thereby the ball can be "brought" upward or downward or left or right from its backside. In this way, the ball will be subjected to an additive upward or downward or left or right torque (T) and causes the ball to rotate. From the formula $T \cdot t = mr\omega_2 - mr\omega_1$ we know that: The larger the T, the greater the angular velocity (ω).

Composite spin is a kind of spin that combines topspin or under – spin with sidespin. Taking a panoramic view of important matches in local and international competitions, it will not be difficult to find that the composite spin is commonly used by the player, because it is not easy for an opponent to predict and judge the ball speed, spin and rebound angle.

3.2.2 The change of revolving speed after increasing diameter of table tennis

As the size of a table tennis ball becomes larger, its radius increases accordingly. According to the definition of moment of inertia ($I = m \cdot R^2$), we can conclude that the increase in the radius will increase the moment of inertia greatly. If the impulse the paddle imparts on the ball (C) is fixed, it can be inferred from the equation $I \cdot w = C$ that the angular speed of the ball will decrease. As European athletes rely heavily on looped flight path, for his threat towards his opponent roots from the angular speed of the ball, the effectiveness of this style of play will certainly decrease greatly. In other words, the change from small ball into big ball will have more negative effects on the loop style. However, some coaches don't agree with my viewpoints, they argue that spin speed of the larger ball will not reduce in practice, so the next thing to do is to measure the spin speed of table tennis.

3.3 Analysis on flight path of table tennis ball

When analyzing flight path of table tennis ball, we need to take into account the degree, angle and direction of the acting force imposed by the paddle on the ball and the way it is imposed firstly. However, the acting force imposed by the

air also affects the flight line of the ball because it is light and small.

3.3.1 Influences on the flight path of table tennis ball from air resistance

In this sect, we'll mainly discuss how to bring air – press acting on the ball by using some fluid theories. In the course of table tennis ball's flight, two velocities exist usually (one is normal speed, and the other is spin speed), correspond to its suffered force (Figure 1).

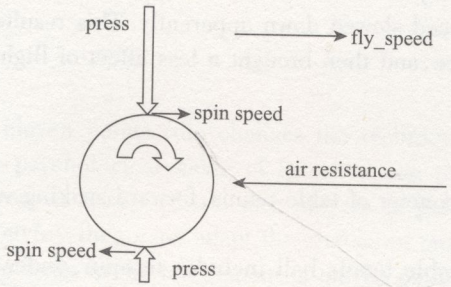

Figure 1. Influences on the flight path of table tennis ball from air resistance

For a topspin ball, owing to viscosity of the ball's surface, the air around the ball will spin with it in the same direction. In addition, when a ball flies forwards, the air's head – on resistance is backward, the direction of the air immediately above the ball is opposite to one of the air's resistance, and the air's flowing speed decelerates; while the direction of the air revolving speed below the ball is the same as one of the air's resistance, and the speed accelerates, which leads to the speed difference between the air above – below surface of the ball, the flowing speed of the air above the ball is slower than that below. According to the principle of hydromechanics, the faster the speed of air current is, the less the pressure intensity is. So when the ball flies forward, the pressure intensity on the lower part of the ball – P'is less than that on the upper part of the ball. And there is a difference – P between above – below surface of the ball and the direction of P is downwards. Therefore, the ball falls down under the action of P. However, under spin is the opposite way. The pressure intensity on the lower part of the ball – P'is larger than that on the upper part of the ball and the difference between above – below surface of the ball causes the ball to floats upwards.

3.3.2 Variety of flight path owing to the small ball being replaced by the big ball

What discussed below is a change of pressure difference with a ball's size changing, by formula $i \cdot \varpi = C$ and $I = m \cdot R^2$ and $V = R \cdot \omega$,

We can obtain $V = C/mR$, assuming: ΔV is a variety of the air flying speed of the above – below surface of the ball owing to acting of the air resistance. So for a topspin ball, $V_{UPPER} = V - \Delta V$ and $V_{UNDER} = V + \Delta V$,

And therefore $\Delta P = \frac{1}{2}\rho\,[(V+\Delta V)^2 - (V-\Delta V)^2]$, $\Delta P = 2\rho V \cdot \Delta V$

$$= \frac{2\rho \cdot C \cdot \Delta V}{mR},$$

The bigger the R is, the less the ΔP is. While the small ball changed into big ball, its revolving speed slowed down apparently. This resulted in the decrease in pressure difference, and then brought a less affect of flight path.

4 Conclusions

(1) Increasing of diameter of table tennis, forward striking velocity will not reduce.

(2) The spin of table tennis ball includes topspin, under spin, sidespin and composite spin. Each kind of spin suffers from a kind of the frictional force of the different direction.

(3) Revolving speed after increasing diameter of table tennis will reduce greatly.

(4) Increasing of diameter of table tennis brings a less affect of flight path.

10 The analysis of the table tennis technique – tactics of eleven points rule

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1 Introduction

The application of eleven points rule changes the technique – tactics and the technique – tactics psychological mode of twenty – one points rule. Whether penholder grip players or shake – hand grip players or players of all kinds of technique – tactics styles, they must adapt the change in order to break through and take active superiority in the tournament of eleven points rule. The Chinese table tennis team must change thought, keep the good experiences of Chinese players in twenty – one points rule play, particularly go to research the laws of the technique – tactics application of service stage actively and return stage and persistent stage of eleven points rule and the methods adjusting the psychology of trainings and tournaments in order to explore a road to make Chinese players still keep superiority in the new rules of table tennis tournaments. This article analyses the Chinese and foreign excellent players' tournaments of eleven points rule from different perspectives, finds some laws of the technique – tactics change of eleven points rule and gives some instructive advices.

2 Methods

Watching video method, Statistics method and Logical analysis method were used.

3 Results

3.1 The technique – tactics change of the beginning, the middle and the end of the tournament

From the data of every points stage, the percentage of getting points of Li Nan's middle service stage, 79% was highest, which made Li Nan take points superiority in order to defeat Boros. The more reasonable technique – tactics application of the return stage and persistent stage of the crucial balls after nine points reflects Li Nan's stable mental capability, which is the crucial factor of winning the tournament.

Table 1. The statistics table of Li Nan's getting points percentage and using percentage effect of the beginning and the middle and the end of the eleven points rule tournament.

Points	Service stage		Return stage		Persistent stage		General effect	
	Getting%	Losing%	Getting%	Losing%	Getting%	Lose%	Getting%	Lose%
1 – 4	55	26	47	45	33	29	45	35
points	+6 – 5		+9 – 10		+4 – 8		+19 – 23	
5 – 8	79	46	29	34	50	20	59	34
points	+15 – 4		+4 – 10		+4 – 4		+23 – 18	
After	64	39	33	42	71	19	53	31
9points	+9 – 5		+5 – 10		+5 – 2		+19 – 17	
Total	+30 – 14		+18 – 30		+13 – 14			

The psychology of players who are adaptable to the twenty – one points rule tournament must correspondingly change and be adjusted. The eleven points rule tournament is more competitive and more stressful, which asks players to have stable mental capability. The performance of Li Nan's mental capability is more outstanding.

3.2 The evaluation of Li Nan's general capability

(1) Service stage: getting 30 points, losing 14 points, getting points percentage 68%, using percentage 37%.

(2) Return stage: getting 18 points, losing 30 points, getting points percentage 37%, using percentage 40%.

At present, every country mainly studies the forehand break – through tactics. The chop of return should be combined with powerful drive. The active return technique will be the future developing trend. The effect of only using chop technique is not obvious.

(3) Percentage stage: Most of the players still scramble the first four – ball in the singles tournament. When Boros changed to attack Li Nan's backhand point, the quality of Li Nan's offence and forehand continuous drive was worse. However, Li Nan's forehand point losed 11 points in the passive persistence. We find out easily that the capability of Li Nan's penholder grip backhand controlling balls' direction change is better. Boros also tried to break through from Li Nan's forehand point in the persistent stage. In the persistent stage, Boros got 16 points from Li Nan's forehand point, which should attract us.

4 Conclusions

(1) Li Nan used close – net service mainly met with Boros' middle quick service. The change of Li Nan's service direction was more dexterous. When Boros' return was bad, Li Nan's block should be more powerful. Li Nan should impart

spin to the ball and change fall – point rather than be too powerful when the first return is the half – outside – table ball. If there are chances, Li Nan should drive or chop Poros'backhand point powerfully. But Li Nan should pay attention to defend the active direction change of loop, swing back quickly, impart power to chop and strengthen the fourth ball of return.

(2) As long as players adapt to the 11 points rule tournament actively and strengthen the helpful adjustment of psychology, they can show their capabilities better and win tournaments. If players ignore the adjustment and the change of psychology and study technique – tactics only, they probably cannot show full of their capabilities when they meet with the powerful balls of their rivals.

11 The exploration of the three – stage law of 11 points rule

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1 Introduction

A table tennis tournament is made up of service stage, return stage and persistent stage. How do the getting – point percentage and using percentage of three stages change in the 11 points rule? By the statistics and analysis of 56 tournaments of 11 points rule in the recent year, this article provides some thoughts to be referred to. The time of a 11 – point – rule tournament is short. The rate of appearance of its crucial balls is high. Its casual rate is high. Its rhythm is faster. Especially, a table tennis tournament has more changes than other events. These ask the exact study of technique – tactics of every stage of training and tournament to find the 11 – point rule law.

2 Methods

Video analysis method, references method, and statistics logical analysis were used.

3 Results

3.1 Service stage

Compared with 21 – point rule, the getting – point and using percentage of the 11 – point – rule service stage has not much change. The 11 – point rule uses the circulating service rule of 2 balls per player. Players'service and drive after service in this stage is mainly flexibile and powerful. Drive after service is the important means of getting points. Excellent players'getting – point percentage in this stage is often excellent. Moreover, the data of the statistics table also proves that whether a 21 – point – rule tournament or a 11 – point – rule tournament, the average getting – point percentage in this stage is 66% , which is excellent.

3.2 Return stage

Chinese players have more change in this stage. The getting – point percentage in

this stage rises from 44.9% to 53%. The using percentage decreases from 32% to 20%. There are two reasons. The first reason is that Chinese players strengthen the quality of high balls and chop balls. The second reason is the inherent law of 11 – point rule. (Chinese players don't completely master the 11 – point – rule law.)

Player should first play powerfully and then steadily. Players should attach great importance to the quality of return. Whether driving or controlling balls, players should be active to create advantageous conditions for persistent stage. In the way of tactics, players should attach great importance to increasing the forehand break – through tactics on the basis of present tactics and make efforts to get good chances and superiority. In addition, players' first judging and consciousness of returning balls should be fast. Players should be ready to deal with changes.

3.3 Persistent Stage

The using percentage of persistent stage of 11 – point rule tournament is increased by 12%. Chinese players' getting – point percentage in this stage hasn't obviously changed. Compared with tournament of 21 – point rule, the technique – tactics used in persistent stage of 11 – point rule tournament has more change. Players' mostly play on the basis of their own technique – tactics' characteristics, playing style and planned tactics. Players should play on the basis of their own rhythm. Players should first play powerfully and actively on the basis of reasonably and effectively using technique – tactics in persistent stage and make efforts to be active, speedity and flexiblely. Players should be not only playing powerfully but also accurately. As long as combining power with accuracy, players can make it. From the statistics, it is found out that few players are good or excellent in persistent stage. There are two main reasons. The first reason is that over – power leads to the increase of turn – over. The second reason is that over – stability leads to the bad quality of balls and being passive.

4 Conclusions

(1) Because of the increase of key and crucial balls in the 11 – point rule tournament, players should decrease the turn – over of continuous attacks.

(2) Players should strengthen the use of two straight balls when offence becomes defense.

(3) Players should persist in playing on the forehand break – through tactics.

12 The analysis of Zhang Yining's technical cha ra cteristics in the 11 – point – rule match

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1 Introduction

A series of reforms of the contest rule have been carried out by the International Table – tennis Federation since 2000, among which a bigger ball with a diameter of 40mm has made an increment both in appreciating and the bout number; Open hand service surely seems to be much fairer; but what will come about after the rule changes to 11 points? It is universally acknowledged that it depends on more contingency to win. The 47th Table Tennis World Championships, the top – class games of table tennis, put it into practice for the first time. Compared with the 21 – point game before, the core of the 11 – point game is the requirements to getting into the competing state as quickly as they can. Because the process of the game is relatively shortened, the contingency to win has increased considerably, leading to more ruthlessness in contesting. Because of the implement of the new rule, the advantage of Chinese ping – pong athletes is no longer so obvious, and the level among the athletes from Europe, Asia including China has become much closer.

As the time goes by, the ping – pong technique has developed continuously. The loop – on – sides – style has already stood in the foremost of the time. Consequently, how to find a new way to succeed, how to face the huge competitive power of the athletes from Europe, Asia and overseas Chinese regiment, and how to find a new way and a new orientation of self – development have become the most urgent subjects that Chinese table – tennis team should put emphasis on.

Nowadays in China, there are a lot of young excellent table tennis players, among them is Zhang Yining, as a representative of manlike and loop – on – sides – style athlete. Faced with many difficulties, she did not give up and has become one of the best table tennis athletes today.

Maybe the proper use of tactical skill and full adaptation to the new rules are the main factors for her great achievements. Zhang Yining is quite outstanding for her tactics and the way she plays . The implement of the 11 – point game results in her continuous rising of result as well as the exaltation in technique.

Some articles have been published on the Characteristics of the 11 – point game, but research on a certain athlete after the reform is rarely seen, and therefore this thesis aims to give a description of the changes of the scores and the characteristics of her tactical appliance, searching for the way of tactical skills she uses in opening, middle games and end games and trying to find out the factors contributing to her success. Moreover, in contrast to the 21 – point game, we can also get a further study on some techniques in the 11 – point game. I hope to provide some useful references for the aftertime training and the research on loop – on – sides style.

2 Methods

2.1 Participants

Zhang Yining, a member of Chinese Women Table Tennis Team

2.2 Methods of research

2.2.1 Statistics based on kinescope

We can get a simple statistic of her tactics and techniques by analyzing the kinescope. I watched some video games carefully to make tactical statistics and analysis such as the 46th World Table Tennis Championships (women single / team), 2002 Europe vs Asia Table Tennis women games, 2003 – 2004 China Table Tennis Club league match and the 14th Asian Games where Zhang Yining played with many famous athletes such as Wang Nan、Li Jiawei、Sang Yachan and so on, then the author made the technical statistics and analysis on these video games , which are altogether 6 matches and 21 games (3 matches and 13 games of 11 points, 3 matches and 8 games of 21 points).

On the basis of the evaluating methods of expert Wu Huanqun , this thesis mainly adopts the method called subsection analysis which belongs to Wu Huanqun, a member of the National Athletics Bureau , who is taken up with the research of table tennis. This method divides the contest into three segments: third ball attack, receiving and holding segments. Then we can make a comparison between the rate of getting a goal and utilization rates in the three segments so as to make an assessment of the technique . And it does favor to the transverse and vertical comparison, making the obscure observation method more exact . We can not only get to the whole level of our athletes'tactics, but also realize the advantages and disadvantages of their single tactics. Let us have a look at the formulas:

Scoring rate of third ball attack segment =

the scores of the segment/ the scores of the segment + losing scores

Utilization rate in third ball attack segment =

the total scores of the segment + losing scores/ whole game scores + total losing scores

Scoring rate of the receiving segment =

the total sore of the segment / the scores of the segment + losing scores

Utilization rate in receiving segment =

the scores of the segment + losing scores/ whole game scores + total losing scores

Scoring rate of the holding segment =

the total score of the segment / the scores of the segment + losing scores

Utilization rate of the holding segment =

the total scores of the segment + losing scores/ whole game scores + total losing scores

Periodical assessment method (single games) technique valuation standard (see the table 1)

Table 1. Technique valuation

3 segment	rank	get rate%	utilization rate%
Service and attack	excellent	70	25 ~ 30
	fine	65	
	pass	60	
Returning service and attack	excellent	50	15 ~ 25
	fine	40	
	pass	30	
Rallies	excellent	55	45 ~ 55
	fine	50	
	pass	45	

2.2.2 Interviews with experts

Aiming at the statistics and analysis of the data mentioned above, I have visited several senior experts on table tennis, including coaches in Beijing table tennis teams and professors and associated professor in Beijing Sports University. They helped me a lot in completing the thesis.

2.2.3 Reference to literatures and data

The authors of this article have read 10 theses on this subject in total , including several articles in Table Tennis World . From reading, many important materials which play an important role in finishing the thesis had been collected.

3 Results and Discussion

3.1 Zhang Yining's characteristics of score changes in the game

3.1.1 Zhang Yining vs. Wan Nan 3:1

Table2. Score changes: Zhang Yining vs. Wang Nan

	Game number	Number of win	Scoring rate
First to 5 points	2	2	100% s
First to 9 points	3	3	100% s

In the two games during which Zhang Yining first reached five points, she won two games with the scoring rate 100% ; In the 3 games during which Zhang Yining first reached nine points, she won 3 games with the win rate 100% ; In the two games during which Zhang Yining didn't first reach five points, she won one game with the scoring rate 50% ; In one game during which Zhang Yining didn't first reach nine points, she lost the game with the win rate 0% ; Zhang Yining showed remarkable perseverance and high spirit in this game.

3.1.2 Zhang Yining vs. Steef 3:2

Table3. Score changes: Zhang Yining vs. Steef

	Game number	Number of Win	Scoring rate
First to 5 points	4	3	75% s
First to 9 points	3	3	100% s

In the four games during which Zhang Yining first reached five points, she won three games with the scoring rate 75% ; In the three games during which Zhang Yining first reached nine points, she won 3 games with the scoring rate 100% ; In the two games during which Zhang Yining didn't reach five points first, she won the games with the scoring rate 0% ; In the two games during which Zhang Yining didn't first reach nine points, she lost the games with the scoring rate 0% ; Zhang Yining also showed remarkable perseverance and high spirit in this game, but failed to win the second game at the important moment by a small margin of points although she reached the medium game first, which indicated that she was not decisive enough when dealing with the key ball.

3.1.3 Zhang YiNing vs. Boros 3:1

Table 4. Score changes: Zhang Yining vs. Boros

	Game number	Number of win	Scoring rate
First to 5 points	3	2	75% s
First to 9 points	3	3	100% s

The three games during which Zhang Yining first reached five points, she won two games with the scoring rate 75% ; The three games during which Zhang Yining first reached nine points, she won 3 games with the scoring rate 100% ; In the game during which Zhang Yining didn't first reach five points, she lost with the scoring rate 0% ; In the game during which Zhang Yining didn't first reach nine points, she lost the game with the scoring rate 0% ; Zhang Yining showed certain perseverance and spirit in this game, but she was still not decisive enough when dealing with the key ball, which resulted in a lot of meaningless lost.

With the comparative analysis of score changes in the three matches, we can discover that Zhang Yining lost two of the nine games during which she reached five points first, and that she won all the nine games during which she reached 9 points first. Thus, we can see that the tail game is rather more important to Zhang Yining than the opening and medium games.

3.2 Zhang Yining's tactical usage characteristics in the leading games

3.2.1 Zhang Yining vs Wang Nan

Under the situation that Zhang Yining first reached 5 points, there were both two segments in opening, medium and end games with a scoring rate over 50% , the advantage of third ball attack segment was more obvious with the scoring rate above 70% and high utilization rate. Receiving segment was relatively weak, especially in the opening and the medium games, the rate she got a goal was slightly low. The utilization rate of the holding segment presented to be up – trend mutually, indicating that the processes of the two games "first to 5 points" was from fierce to steady, and mainly got a goal from the third ball attack .

Table 5. The analysis of Zhang Yining's tactical usage characteristics in the leading games VS Wang Nan

		Service and attack		Returning service and attack		Rallies	
		get%	use%	get%	use%	get%	use%
First 5 points	1 – 4	76	44	33	36	25	18
		(+6 –2)		(+1 –2)		(+1 –3)	
	5 – 8	71	38	33	30	50	26
		(+5 –2)		(+2 –4)		(+3 –3)	
	9 – 11	78	47	50	20	86	31
		(+5 –1)		(+3 –3)		(+6 –1)	
First 9 points	1 – 4	71	50	50	29	25	19
		(+5 –2)		(+3 –3)		(+1 –3)	
	5 – 8	73	37	60	26	56	37
		(+8 –3)		(+3 –2)		(+4 –3)	
	9 – 11	100	45	33	27	100	26
		(+5 –0)		(+1 –2)		(+3 –0)	

In each game previously to 9 points there were two segments in opening and tail games that with the scoring rate over 50% , the scoring rate was over 55% in the three segments of the medium game. That was why Zhang won when first reached 9 points. The third ball attack segment was still a main method to get a goal for Zhang Yining, but receiving segment was better than the index sign of "first to 5 points". Utilization rate of the holding segment present mutually low – high – low, showing that this 3 processes of the total game "first to 9 points" are fierce – steady – fierce. In the end game, the third ball attack and holding segment's scoring rate was even up to 100% , but compared with the medium games of the game, the utilization and scoring rate had very obvious exaltation in the third ball attack segment of the tail games. This indicated Zhang Yining had no hand go limp when dealing with the key ball and still kept the style that dared to beat straight out.

3.2.2 Zhang Yining VS Steef

Table 6. Tactics analysis Zhang Yining vs. Steef

		Service and attack		Returning service and attack		Rallies	
		get%	use%	get%	use%	get%	use%
First 5 points	1 – 4	60 (+3 – 2)	25	40 (+3 – 2)	45	75 (+3 – 1)	33
	5 – 8	75 (+3 – 1)	40	50 (+2 – 2)	22	100 (+4 – 0)	33
	9 – 11	67 (+2 – 1)	55	50 (+1 – 1)	40	100 (+1 – 0)	15
First 9 points	1 – 4	67 (+4 – 2)	30	35 (+3 – 6)	45	80 (+4 – 1)	25
	5 – 8	75 (+5 – 2)	42	40 (+2 – 3)	31	100 (+4 – 0)	25
	9 – 11	75 (+5 – 2)	56	60 (+3 – 2)	38	100 (+1 – 0)	10

In each game that Zhang Yining first reached 5 points, the medium games and the end game's three segments got a goal with the scoring rate come to above 50% . Receiving segment kept a high scoring rate. And there was good exaltation in opening, medium and the end games, thus break the service of the opponent's service, creating a very big opportunity to win. The trend of the holding segment to presented to descend , but the third ball attack segment presents the up – trend, particularly in the attacking service segment of the tail games, the utilization rate and scoring rate all exceeded 50% , this is proved in 3 wining games that "get first 5 points", Zhang Yining's usage of tactics was from steady to fierce.

In each game got first 9 points, the third ball attack and holding segment in opening, medium and the end game kept scoring rate above 65% , showing strong ability of attacking and holding . Each segment's scoring rate came to a excellent standard in the end game, proving Zhang Yining's nice performance in the end game, and the application was also very outstanding. In 3 games of "first to 9 points", although the utilization rate of the holding segment is not very high, its rate to win kept above 80% , this certificated that in

this 3 games , Zhang Yining have a very big advantage in the holding segment. This becomes the key of winning the game.

3.2.3 Zhang Yining vs the Boros

Table 7. Zhang Yining vs. Boros

		Service and attack		Returning service and attack		Rallies	
		get%	use%	get%	use%	get%	use%
First 5 points	1 – 4	75	40	67	28	67	35
		(+6 – 2)		(+3 – 2)		(+3 – 1)	
	5 – 8	63	42	50	38	40	15
		(+5 – 3)		(+3 – 3)		(+2 – 3)	
	9 – 11	70	50	25	35	50	19
		(+7 – 3)		(+2 – 8)		(+4 – 4)	
First 9 points	1 – 4	75	40	30	45	80	30
		(+9 – 3)		(+3 – 1)		(+4 – 1)	
	5 – 8	63	43	55	40	67	18
		(+5 – 3)		(+6 – 5)		(+2 – 1)	
	9 – 11	83	36	40	35	50	28
		(+5 – 1)		(+2 – 3)		(+4 – 4)	

Zhang Yining won by 2: 1 in 3 games of "first to 5 points", lost one under the condition of leading a lot to reach the medium game, its main reason lied in the not well performance in the third ball attack and receiving segments of the tail game. The utilization rate of the segment in this 3 games' medium and tail games presented to descend. The third ball attack was the main method of scoring and she can hardly have the advantages if there aren't high utilization and scoring rate in a game.

In 3 games "first to 9 points", the scoring rates of the three segments in the opening and medium games came to above 50% , but the scoring rates of the third ball attack and holding segments in the two games presented to descend, both of the utilization and scoring rates rose in the tail game though descended in the medium game, proving that Zhang Yining mainly got a goal by means of the third ball attack in the 3 games "first to 9 points", and the trend of the tactics was fierce – steady – fierce. In the 3 games "first to 9

points", the scoring rates of the three segments in opening were all above 75%, which became the basis here to be able to reach 9 points first and the main reason to win.

3.3 Zhang Yining's tactics usage characteristics in the winning or losing games

3.3.1 Zhang Yining VS Wang Nan

Table 8. Zhang Yining vs. Wang Nan

		Service and attack		Returning service and attack		Rallies	
		get%	use%	get%	use%	get%	use%
	1 – 4	70	46	55	32	33	20
		(+7 – 3)		(+5 – 4)		(+2 – 4)	
win	5 – 8	67	35	44	35	50	31
		(+6 – 3)		(+4 – 5)		(+4 – 4)	
	9 – 11	83	47	33	21	100	32
		(+2 – 1)		(+1 – 1)		(+1 – 0)	
	1 – 4	65	43	0	14	33	43
		(+2 – 1)		(+0 – 1)		(+2 – 4)	
fail	5 – 8	0	20	0	25	0	50
		(+0 – 1)		(+0 – 1)		(+0 – 2)	
	9 – 11	50	50	0	20	0	25
		(+1 – 1)		(+0 – 1)		(+0 – 1)	

In the match of Zhang Yining VS Wang Nan, the main methods to win was the high scoring rates she kept in the third ball attack segment, especially giving much pressure to the opponents in the turning point and directly got 5 points by servicing and attacking the tail game. But the scoring rates in the receiving segment tended to descend. The utilization rate was highest in the third ball attack among these segments.

In the games she lost, the scoring rates was rather low in each segment and the medium game was the worst as the three segments got a goal with the scoring rate 0%. However, during the three segments, the receiving segment was the worst as the scoring rates were zero in the three games. The scoring

rate of the third ball attack which was the main scoring method was obviously lower in losing games than winning games. Therefore, we can see that it will have much to do with the receiving and holding segments if Zhang Yining doesn't perform well in the third ball attack.

3.3.2 Zhang Yining VS Steef

Table 9. Zhang Yining vs. Steef

		Service and attack		Returning service and attack		Rallies	
		get%	use%	get%	use%	get%	use%
	1 – 4	67	30	33	45	80	25
		(+4 – 2)		(+3 – 6)		(+4 – 1)	
win	5 – 8	70	44	40	33	100	20
		(+7 – 3)		(+2 – 3)		(+2 – 0)	
	9 – 11	71	54	63	38	100	8
		(+5 – 2)		(+5 – 3)		(+1 – 0)	
	1 – 4	50	25	33	37	67	38
		(+1 – 1)		(+1 – 2)		(+2 – 1)	
fail	5 – 8	0	17	50	55	0	15
		(+0 – 1)		(+2 – 2)		(+0 – 1)	
	9 – 11	50	30	100	25	0	33
		(+1 – 1)		(+2 – 0)		(+0 – 2)	

During the match of Zhang Yining vs Steef, the scoring rate reached up to above 80% in the holding segment of the winning games and only lost 1 point in the three games she won . Being able to kept absolute advantage all the time in holing segment, it can not only bring much confidence in psychology, but also brought very big pressure for the opponents. By the tail game of the wining games, the utilization rate of the attacking service segment had got to above 50% and kept a very high scoring rate, which showed that Zhang Yining created scoring opportunity depending on the attacking service.

In the losing games, both of the third ball attack and holing segments were 0% in the medium game. Though there was a exaltation of scoring rate in the tail game, the utilization rate was rather low. During the lost matches, the utilization rate was always low in the third ball attack segment, which showed

that she was conservative when playing, and completely didn't perform her actual ability and good appliance of her tactics in the medium game. It brought herself certain psychological pressure in that case, so it was hard to turn the situation in the end and that was the main reason Zhang lost 2 games in the match.

3.3.3 Zhang Yining VS Boros

Table 10. Zhang Yining vs. Boros

		Service and attack		Returning service and attack		Rallies	
		get%	use%	get%	use%	get%	use%
Winning match	1 – 4	83	40	75	30	80	33
		(+5 – 1)		(+3 – 1)		(+4 – 1)	
	5 – 8	63	45	50	40	67	20
		(+5 – 3)		(+4 – 4)		(+2 – 1)	
	9 – 11	75	50	40	31	33	16
		(+6 – 2)		(+2 – 3)		(+1 – 2)	
Losing match	1 – 4	19	50	50	36	0	18
		(+1 – 4)		(+1 – 1)		(+0 – 1)	
	5 – 8	67	50	80	31	0	19
		(+2 – 1)		(+4 – 1)		(+0 – 2)	
	9 – 11	75	18	33	41	57	41
		(+1 – 1)		(+0 – 1)		(+0 – 1)	

In the match of Zhang Yining VS Boros, the main scoring methods was depended on third ball attack which had a high rate of scoring, proving that she could got the scoring chance completely depending on third ball attack. The quality of the third ball attack segment and can affect the whole trend of the game directly, which can be well seen in her lost games.

In one of the games Zhang was defeated by Boros. The scoring rate in the opening and the utilization rate were neither over 20% , this is very seldom seen in the matches Zhang Yining competed in. Judging from it, most of the reasons she lost were the not well performances in third ball attack. In the tail game, there were much meaningless lost, such as she lost 3 points when attacking after receiving, cover 70% of the total lost points in the receiving seg-

ment of the tail game. Third ball attack, as the main scoring method for her, if she doesn't perform her normal level, it will result in direct influence to the receiving segment. The utilization rate of the holding segment presented to be up – trend, showing her conservation in play.

According to the comparison of the matches Zhang joined in whether lost or won, The author discover that the scoring and utilization rates were high in the wining games, especially they tended to rise in the tail game. On contrary, the third ball attack segments in the losing games were not so satisfactory. We can conclude that the scoring rate has much to do with the performances in the third ball attack segments.

3.4 Score processes and the tactics usages

In the match vs Steef, the scoring rate kept a middle level all the time in the third ball attack, but it didn't have much advantage in the whole game and had some exaltations in the medium and tail games but not obvious. It tended to rise in the receiving segment, which showed that she was not so conservative but fierce in the key moment. The holding segment's scoring rate was dropped from excellent to failed, indicating that she was fierce but not steady enough in this match, making too many meaningless lost and having too much changeable emotion. Judging from the utilization rate, despite the up – trend in the third ball attack segment, it descended in the receiving and holding segments. We can see that Zhang basically created scoring chances by third ball attack when dealing with the key ball.

In the match VS Boros, the scoring rate of the third ball attack segment presented to up – trend and it was the main scoring method, especially that there were 6 points directly got by third ball attack in the second game, which showed her strong ability in her positive attacking. The receiving segment's scoring rate tended to descend, and the 5 points in the tail game was due to negligence. And the scoring rate appeared to be high – low – high trend in the holding segment. As to the utilization rate, in addition to the descent in third ball attack, the other two segments were quite steady. The usage rate was nearly the same in the tail game, proving that Zhang mastered the change of the appliance of the tactics very well in the key moment.

According to the comparison of the three matches above, the utilization rate was obviously higher in the third ball attack segments than the receiving and holding segments and that was the main method to get points, indicating Zhang's positive attacking to create opportunities to win, but she still needs to make sure to reduce the meaningless lost in the positive attacking processes. In that three matches, she play steadily when dealing with the key balls, mainly making full use of her advantages (third ball service) to be positive, then holding with the opponents and defeating them eventually.

Table 11. Score processes and the tactics usages

		Service and attack		Returning service and attack		Rallies	
		get%	use%	get%	use%	get%	use%
Vs. Wang Nan	1 – 4	69 (+11 –5)	45	50 (+5 –5)	29	33 (+3 –6)	25
	5 – 8	67 (+6 –3)	33	40 (+4 –6)	33	40 (+2 –3)	33
	9 – 11	80 (+4 –1)	49	20 (+1 –4)	25	83 (+5 –1)	30
Vs. Steef	1 – 4	63 (+5 –3)	29	33 (+1 –2)	45	71 (+5 –2)	30
	5 – 8	67 (+5 –3)	36	33 (+1 –2)	45	71 (+5 –1)	30
	9 – 11	67 (+6 –3)	50	71 (+5 –2)	37	33 (+1 –2)	18
Vs. Boros	1 – 4	55 (+5 –4)	40	63 (+5 –3)	31	57 (+4 –3)	27
	5 – 8	70 (+7 –3)	46	62 (+8 –5)	37	33 (+2 –4)	17
	9 – 11	73 (+8 –3)	33	25 (+3 –9)	37	50 (+4 –4)	35

3.5 Comparisons and analyses of the tactical skill of Zhang Yining in the 11 – point – rule and 21 – point – rule matches

3.5.1 Comparisons of the score rate in 3 segments of Zhang Yining in the 11 – point – rule and 21 – point – rule matches

According to the comparisons of the score rate in 3 segments of Zhang Yining in the 11 – point – rule game, we find that Zhang has a little change in the tactical skill since the new rule was carried out. Considering the third ball attack segment, third ball attack is always the main method of getting points, in which she keeps a high score rate whether in 11 or 21 – point – rule during the contest(70% and 77%). Judging from the third ball attack, Zhang has more advantage in the 11 – point – rule, mainly focusing on strengthening the continuous ability on the second, the third, the fourth rallies.

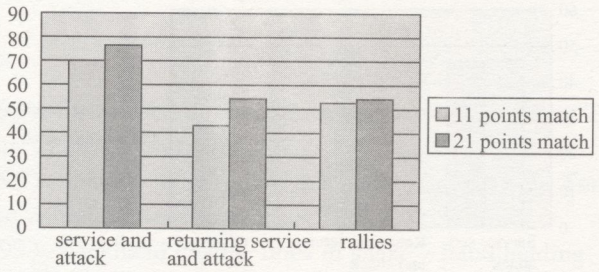

Figure 1. Comparisons of the score rate in 3 segments of Zhang Yining in the 11 – point – rule and 21 – point – rule matches

She has a large change in the receiving segment and keeps a high scoring rate in 21 – point – rule contest. And the main method of getting scores is that attacking after receiving the ball.

But in 11 – point game Zhang Yining had a obvious descent in scoring rate in the receiving segment, the ball lost after receiving covers 33% of the total score.

But the rate of holding segment is relatively near (54% and 56%), proving Zhang Yining's well performance in the 11 and 21 – point – rule matches, its main reason is that the Zhang Yining's ability of forehand and backhand is quite strong, basically compete with opponents in the medium and near front during the process of holding segment, especially backhand, sometimes can still get a goal directly. This becomes her scoring advantage in the holding segment.

3.5.2 Comparisons of the rate of three segments utilization between Zhang Yining's 11 – point – rule and 21 – point – rule contest

According to the comparison of the utilization rate in the telegram 2, the utilization rate of receiving segment in 11 – point – rule game is lower than 21 – point – rule contest. The third ball attack and holding segment is generally the same, proving that Zhang Yining's tactics utilization aims at the third ball attack and holding segment after the 11 – point – rule is adopted . This tactical skill utilization provides Zhang Yining with good opportunity to win. The improvement of the ability in third ball attack and holding segment gives much pressure to the opponents in psychology and has certain influence on the opponent's performance. This ability gives Zhang certain help to win.

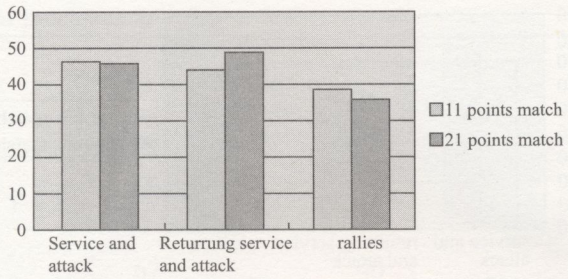

Figure 2. Comparisons of the rate of three segments utilization between Zhang Yining's 11 – point – rule and 21 – point – rule contest.

4 Conclusions and Suggestion

4.1 Conclusions

(1) Just on the basis of the facts above, Zhang Yining gave a good third ball attack in the won games, but got a low rate of getting points at third ball attack in the failed games. We can get a conclusion that the third ball attack is the main method of getting the points. You see, Only if Zhang Yining acts well in the third ball attack segments, she will win; Otherwise probably not.

(2) If Zhang Yining leads in the game, she usually beats rather fiercely at the beginning. In the medium game she will then be inclined to hold the ball mutually. So a third ball attack segment at the beginning is a key to beating the opponent. What's more, a bad opening will directly influence the medium and tail games, so we should pay special attention to the skill and tactics at the beginning.

(3) Compared with the 21 – point – rule game, Zhang Yining strengthens the ability of continuously attacking by the forehand and the holding ability by the backhand after the new rules were carried out. Also, the exaltation of the comprehensive ability is the effective security for her success.

4.2 Suggestion

(1) According to the tradition of the Chinese table tennis team, we consider the first three rallies as the key. And consider the forehand attacking as the main part. So only if the advantage is gained during the first three rallies, the women players can show the manly characteristic . We suggest the ability of forehand offensive play and middle way attacking should be strengthened.

(2) The data often indicate fluctuations when Zhang Yining receives the ball. We suggest more training on receiving and offensive play be taken to improve the ability of receiving and third ball attack.

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13 Changes and development: influence of new rules on table tennis techniques

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1 Introduction

ITTF has made a great reform on the table tennis laws. Firstly, from Oct 1st, 2000, the ball was enlarged from 38 mm to 40 mm and was made 0.2 g heavier from 2.5 g to 2.7 g. Later, from Sep. 1st, 2001, the 21 - point system of each game was altered to the 11 - point system of each game. Furthermore, in each game the service right shall be changed after each 2 points have been scored. From Sep. 1st, 2002, unblocked service began to be carried out. It is evident that the adoption of new rules, such as large ball, 11 - point system and unblocked service, has made a great influence on table tennis. With modifying greatly on the table tennis laws, ITTF intended to make this sport more interesting and attractive to the spectators and the TV networks. However, this research has no intention that if the execution of new rules has reached the original purpose of ITTF. What the authors concern are: what effect has made on the development of worldwide table tennis techniques under the execution of the new rules? What changes would occur in the contest between the elite players under the influence of the new rules?

Zhang and Wu's research showed that both spin and speed would be decreased by using the 40mm ball, which had the effects of increasing rallies and making the match more attractive than before (Zhang & Wu, 2000). In addition, the effect of unblocked service on players was studied by many researchers. Zhang shot the services of several Chinese players from multi - angle and found their movements against the new service rules, and some suggestions were provided (Zhang, 2002). Hu and Chen discussed the influence of unblocked service on the service techniques. In the research the services from different set - up positions and by different ways were compared. Besides, the effects of new service rule on table tennis matches were studied by several researchers and some new training ways were provided (Zhao, Luo, Zhao, Zhang, & Ma, 2003; Chen, 2003, Lin, Cao, 2003).

There were a few of researches in which the effects of new rules on players were discussed and various suggestions were provided (Wei, 2003; Liu & Chen, 2003; Lu, 2002, Zhang 2002; Wu & Liu, 2002; Dong, Sun, & Tao,

2003; Song, 2002).

Wu and Zhang summarized systematically the effects of large ball, 11 – point system and unblocked service on table tennis techniques. It was concluded that (1) the speed of large ball was reduced by 4% and the spin was reduced by 13%. Because speed and spin were limited, power had a bigger effect. (2) Under the 11 – point system, the result of a game was more accidental, therefore excellent players would endure much heavier mental pressure than before. (3) Under the new service rule, the proportion of the using rate of the phase of rally might increase significantly (especially for women players). The new rules had a negative effect on those players whose backhand was poor (Wu, & Zhang, 2002).

In summary, although there were many researches in which the effects of new rules on the development of table tennis were discussed, most of them used the qualitative approach and the researches using quantitative were very few. This research had used the three – phase method to make the technical statistics and analyses of the world's elite players after the execution of new rules. Then the authors compared the data in each phase with corresponding evaluations, hoping to explore what changes have occurred of the worldwide table tennis technical development under the influences of the new rules.

According to the review of the literature, the hypotheses of this research were:

(1) The using rate of the phase of rally would be higher than the former evaluation;

(2) As the advantage of servers was limited, it was more possible for receivers to adopt attacking ways in reception. Therefore, the using rate of the phase of reception should be higher than before, and the using rate of the phase of attack – after – service should be lower than before.

2 Methods

2.1 Participants

14 excellent men players, including WANG Liqin, MA Lin, WANG Hao, KONG Linghui, LIU Guozheng, HAO Shuai, BOLL Timo, SAIVE Jean – Michel, KREANGA Kalinikos, SCHLAGER Werner, OH Sang Eun, Rye Seung Min, CHUAN Chih – Yuan, and CHIANG Peng – Lung, were selected as the subjects of this research.

2.2 Video – observation

30 matches of the video tapes of the subjects, all of which were selected from the important international competitions after the new rules applied, such as 2003 men World Cup, 2003 pro tour final etc., were observed.

2.3 Three – phase method

The three – phase method was adopted to analyze the subjects'techniques in this study. By calculating the scoring rate and using rate of the phase of attack after service (AAS), the phase of reception and the phase of rally, the subjects'features of techniques and tactics were analyzed. The calculating formulas were the following:

Scoring rate of a phase = (scoring points of the phase/ (scoring points of the phase + losing points of the phase)) * 100%

Using rate of a phase = ((scoring points of the phase + losing points of the phase) / (total scoring points + total losing points)) * 100%

3 Evaluation

In each phase, the evaluations of the scoring rate and using rate of these players were offered. The evaluating criteria were the following.

Table 1. Evaluation criteria for singles in three – phase method

	AAS		Reception		Rally	
	SR	UR	SR	UR	SR	UR
Excellent	70%		50%		55%	
Good	65%	25 ~ 30%	40%	15 ~ 25%	50%	45 ~ 55%
Pass	60%		30%		45%	

(See Wu and Zhang, 1996)

Notes: SR: Scoring Rate; UR: Using Rate.

4 Results and Discussion

4.1 Excellent players' using rate of the three phases under the new rules

In the existing evaluation criteria, in a match there were almost half of the points ended in the phase of rally, which indicated that players'skill in rally determined, at a large extent, the result of the match. In addition, the using rate of the phase of AAS was 1/3, implied that this phase had an important effect as well. On the other hand, the criteria of using rate in reception was only about 20% , showing that players'performances in this phase had an smaller effect on the result of a match than in the phase of AAS and reception.

However, under the new rules, the players'proportion of using rate in three phases changed a lot. The distribution had a significant tendency of "regression to average". i. e. , unlike the former, the using rate of three phases did not have the significant difference. The using rate of the phase of reception increased greatly, from 15 ~ 25% to 34% . On the contrary, the using rat of

the phase of rally decreased from 45 – 55% to 35%. However, the using rate of the phase of AAS did not have much difference from the before. (See table 2)

Table 2. Using rate of three phases under new rules

n	AAS	Reception	Rally
14	31	34	35

These results did not support the first hypothesis of this study that the using rate of rally would be higher than the former evaluation criteria. However, it supported the second hypothesis that the using rate of the phase of reception would increased.

It was easy to understand the rising of the using rate of the phase of reception. Since the receivers could clearly see the whole course of his opponent's service, it is simpler for them to anticipate the spin and the placement of the service. Therefore, the receivers had more chances to attack, rather than control, the service, which caused the result of this study.

It was surprised that the using rate of the phase of rally decreased significantly. Because the using rate of reception went up and that of the AAS did not decreased much, the decreasing of the using rate of the phase of rally is inevitable. The new distribution of using rate of three phases revealed that under the new rules, elite men players more often ended a rally during the first – three balls. It could be predicted that for the elite players the contest in the first three balls would be more drastic. The result of this study supported the opinion of Wu and Zhang that the elite players'basic thinking guides, i. e., be positive, fast, various, and powerful, would not change (Wu & Zhang, 2002).

4.2 Comparison of using rate of three phases between Chinese and other players under new rules

There was difference between Chinese and other players in the using rate of three phases. Although the difference in the phase of AAS was small, Chinese players'using rate in the phase of reception was higher than that of other players by 5 percent. Meanwhile, their using rate of the phase of rally was 6 percent lower than the other players.

It was found that Chinese players were more active than the other players in the first three balls. On the other hand, players of other associations were more likely end a point in the phase of rally.

Combining with above analysis that one of the significant tendencies nowadays was that elite players'using rate of the phase of reception increased greatly, it implied that Chinese players adapted to the new rules better than the other players.

Table 3. Comparison of using rate of three phases between Chinese and other players (%)

	n	AAS	Reception	Rally
Chinese players	6	32	37	32
Other players	8	30	32	38

4.3 Scoring rates of three phases

The 14 players'average scoring rates in the phase of AAS and reception were good. However, their scoring rate in the phase of rally was fail. Except Wang Liqin, all of the rest 13 players got a fail mark in this phase. Given the fact that all the subjects of this research were most elite players in the world, it suggested that the evaluation criteria of the three – phase method were not practicable under the new rules. Therefore, they should be amended.

Li, Yang, and Zhao (2004) pointed out that it was necessary to amend the standards of evaluation of three – phase method. The results of this research supported their conclusions.

Table 4. Elite players'average scoring rates of three phases and their evaluation

n	AAS	Evaluation	Reception	Evaluation	Rally	Evaluation
14	67	Good	47	Good	42	Fail

5 Conclusion

After the new rules were adopted, the distribution of using rate of three phases among elite men players changed a lot. There was a significant tendency of "regression to average". The using rate of the phase of reception increased significantly and that of the phase of rally decreased. It was concluded that after the new rules applied the contest in first three balls among elite players would be more severe than before In addition, Chinese players showed higher using rate of the phase of reception than the other players, indicating that they adapted to the new rules better. Finally, because most of the subjects of this research, who were most elite players in the world, demonstrate a fail mark according to the evaluation criteria which were established before the new rules were applied, it is necessary to amend them.

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14 Comparative analysis and reseach of the impacts by 40 mm ball on the first – 3 – stroke skills of shake – hand looping style of world – class male table tennis players

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1 Introduction

The 40mm table tennis ball has been used since October 2000. Mastering the basic skills of playing with 40mm ball is of utmost importance to keep the invincible image of China's Table Tennis Team. The aim of this study is to identify the characteristics of the effects of 38mm ball and 40mm ball on the application of shake – hands grip loop skills to world – class elite male table tennis players.

2 Methods

2.1 Participants

Skills of Shake – hand Looping Style of World – class Male Table Tennis Players (Table 1).

Table 1. Basic circumstance of research object

name	countries	classification
Wang Liqin	China	1
Vladimir Samsomov	White Russia	2
Liu Guozheng	China	4
Kong Linghui	China	5
Jan – Ove Waldner	Sweden	9
Werner Schlager	Austria	10
SaiveJean – Michel	Belgium	15
Ma Wenge	China	16
Oh Sang Eun	Korea	17
Jorgen Persson	Sweden	18

Note: The world ranks of the players is according to the international ITTF announcement of December 31 2001 the No. 2001 – 12.

2.2 Literature searching method

2.3 Investigation method

Table 2. Questionnaire investigation

	officers	experts and scholars	coach	Players
Sent Out	7	16	28	112
Receive	6	13	22	96
Useful	5	13	22	87
Validity recovery rate	71.42%	81.25%	78.57%	77.68%

2.3 Observational study

2.4 Statistical approach

2.5 Comparative analysis technique

3 Results and Discussion

3.1 Serve

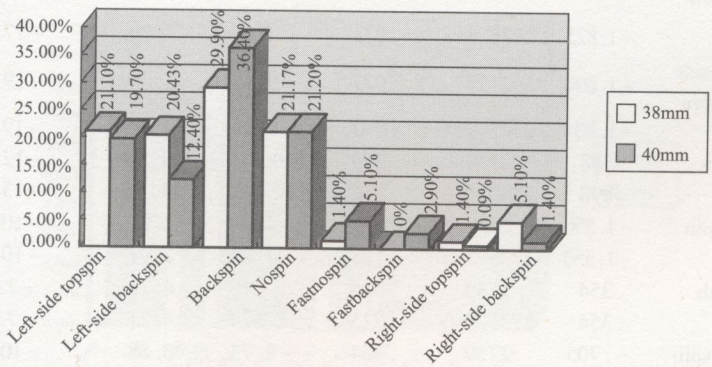

Figure 1. Serve spin

Table 3. Serve Style

	38 mm	40 mm
Forehand serve	2650	2648
Backhand serve	90	91
High toss service	2634	2629
Low toss service	106	101

The serve stance is an important index to determine the power of serve. Based on our technique statistics (Table 3), we can see that all the top ten players used left half court as their ready stance at most of time no matter in the 38 mm ball period or the 40 mm ball period.

Furthermore, according to our survey in a group of Chinese top players and their coaches, all of them agreed attack after serve is still the crucial technique to win the game for Chinese players which should only be enhanced instead of being weakened, except only one coach said that the role of attack after serve is not so important in the 40 mm ball period.

Table 4. 38,40mm ball spin T test effect

	t	n	Sig. (2 – tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference
Left – side topspin	–1.825	2739	.073	–12.93	7.09	–27.12
	–1.825	2738.346	.078	–12.93	7.09	–27.42
Left – side backspin	–1.804	2739	.077	–9.13	5.06	–19.27
	–1.804	2737.815	.077	–9.13	5.06	–19.27
Spin	.898	2739	.373	10.27	11.43	–12.62
	.898	2730.115	.376	10.27	11.43	–13.08
No spin	–1.550	2739	.127	–4.60	2.97	–10.54
	–1.550	2735.772	.127	–4.60	2.97	–10.56
Rush	.354	2739	.725	1.67	4.71	–7.75
	.354	2737.961	.725	1.67	4.71	–7.76
Rush spin	–.705	2739	.484	–2.73	3.88	–10.49
	–.705	2736.939	.484	–2.73	3.88	–10.49
Right – side topspin	–.538	2739	.592	–1.27	2.35	–5.98
	–.538	2733.320	.592	–1.27	2.35	–5.98
Right – side backspin	–1.703	2739	.094	–2.97	1.74	–6.45
	–1.703	2734.637	.096	–2.97	1.74	–6.48

In my opinion, it is more difficult for players to produce spin as the diameter of ball increases since 40mm ball was used in games. Players have to make some changes when they choose the types of serve to keep the ball's spin strength.

3.2 Reception

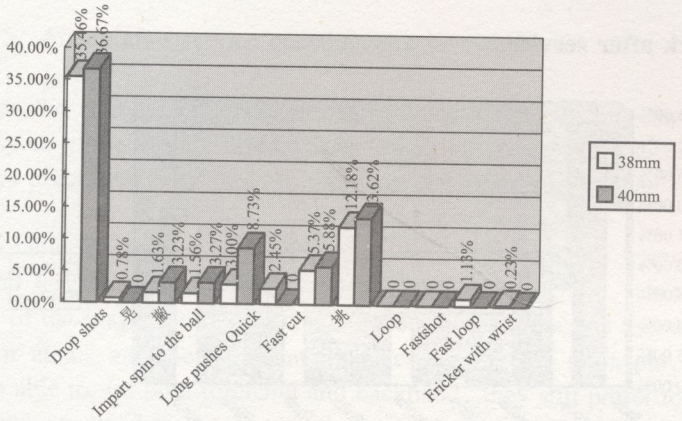

Figure 2. Recieve left – half court short ball of FOREHAND STROKE technical statistics

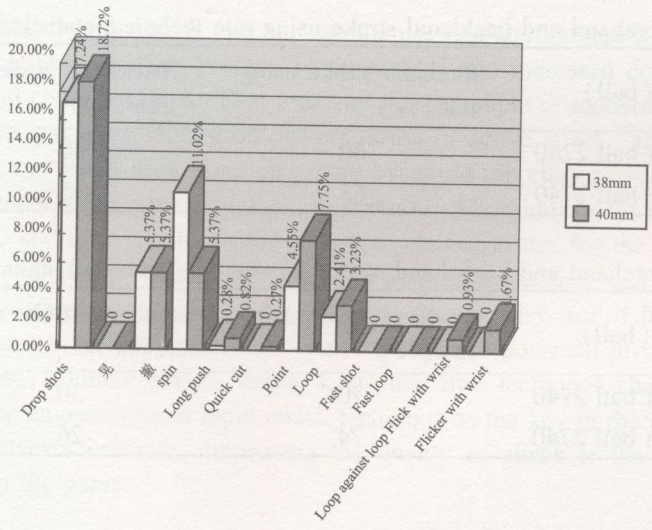

Figure 3. Receive left – half court short ball of BACKHAND STROKE technical statistics

The ball's placement for serve return is an important index to determine players' purpose for serve return. Table 2 showed that the left back court and the left short court are the areas to receive most server return among all the nine areas for replacement of serve return.

It is outstanding athlete that method towards size ball connect hair ball see, puts the short is the most common use to connect the hair ball the method, reason is Aggression of valid control the other party.

3.3 Attack after service

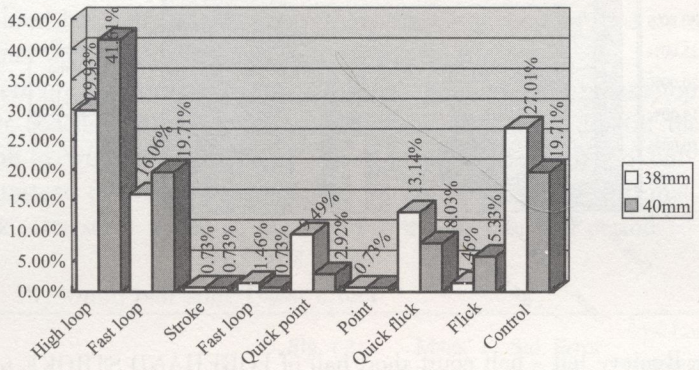

Figure 4. Attack after service

Table 5. Forehand and backhand stroke using rate technical statistics

all(ball)	forehand stroke using rate(%)	backhand stroke using rate(%)
38 mm ball 2740	60	40
40 mm ball 2740	65	35

Table 6. Forehand and back hand stroke success rate technical statistics

all(ball)	forehand stroke using rate(%)	backhand stroke using rate(%)
38 mm ball 2740	70	30
40 mm ball 2740	74	26

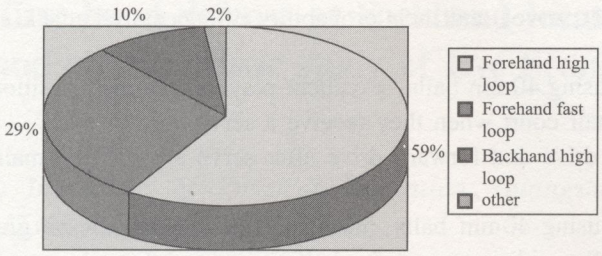

Figure 5. Attack after service questionnaire investigation

Based on the analysis of technique statistics of the top twenty shake – hand grip players in the world, a researcher found the use rate and success rate of sideways pivot attack for them in the game are much higher than other players.

From table 5, we can see forehand serve was used more frequently than backhand serve in modern table tennis games. Furthermore, about 59 percentage of the players in our survey believed forehand loop is the major technique for attack after serve. That indicates for the top class players, even they are able to use both forehand and backhand, they still prefer to use forehand pivot attack, because forehand attack always provides far more threat and aggression to the opponent, so frequent and effective use of that can give the opponent more psychological pressure, and help themselves win the game.

From table 5 and table 6, we can see the use rate and success rate of forehand attack used in 48th World Championships had increased compared to 47th World championships. That indicates the technique of modern table tennis is more and more relying on players' sense of active attack, and so forehand attack is being used more and more by world top class players.

In the modern table tennis games, aggression and rapidity is the key to win the game, and they are the major technique characteristics for the world top class players. Players should use forehand as possible as they can no matter on serving, receiving or other time, because the effective use of forehand is easier to create the opportunity for them to use more powerful pivot attack.

Therefore, Chinese players should keep their own technique charactistics, and use the aggressive and rapid attack technique as the key in the game. Increasing attack's use rate, improving the quality of attack is the important key to win the game.

4 Conclusions

(1) After using 40mm balls, the excellent players still attach importance to

the attack after serve, and their probability of success of attack after service is on the rise.

(2) After using 40mm balls, excellent players' standing position is usually at the left – half court when they receive a serve.

(3) Lifted drive and forward drive after serve are still the main technique of attack.

(4) After using 40mm balls, the excellent players always give forehand services standing sideways on left – half court, and they always serve knuckle short balls or heavy – spin short balls.

15 The first hand defense at backhand location technology and characteristic study of Rye Seung-min

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1 Introduction

With the regulation change of big ball, 11 score rule and the no shelter serving, the advantage of the serve, attacking after serve was restricted. At the same time, it is an opportunity for players to defend, especially the first hand. Through the observation and statistical analysis on the first hand defense of backhand location technology of Rye Seung – min, it explained the using rate towards different serving ball of forehand and backhand and the characteristic of the strength, placement and result of Rye Seung – min's returning serve. The common law and development trend of first hand defense at backhand location process of pen – hold grip player was discussed.

2 Methods

2.1 Participants

Rye Seung – min, the 27th Athens Olympics men's singles champion, who is the representative of paying attention to enriching and development of the offensive characteristic on the basis of keeping its backhand technology in tradition.

2.2 The method of watching video

Using the method of movie & TV materials, the three matches of Rye Seung – min (vs Wang Hao, vs Val, vs Liang Zhu'en) was analyzed.

Table 1. Defense technology and characteristic statistical table in the first hand defense of Rye Seung – min backhand location

NO.	First bat ball quality			First bat ball defense		The first bat defending intensity			Placement that the first bat is defended to return serve			The first bat defending Result				Finally result	
	Strong	Medium	Weak	Foreahand	Backhand	Strong	Medium	Weak	Left	Middle	Right	Score	Initiative	Passive	Stalemate	Win	Lose
1																	
2																	
3																	
4																	
5																	

2.3 The method of statistics

The relevant data and information that are obtained was analyzed statistically.

2.4 The method of logic and induction

The relevant data were sorted out and analyzed, trying to find out the potential law of the first hand defense at the backhand location of Rye Seung – min.

3 Results and Discussion

3.1 Strong and weak of ball in the first bat at the backhand location

For better distinguishing the different technology and characteristic in the first bat grasp of the player, the author has put forward the concept of strong and weak grasp, which issued on the third issue of 2003 of Guangzhou Physical Culture Institute journal . In this text we still use the concept and term for explain the consciousness and intensity of player when voluntarily grasping and defending , (This text is grasped strongly = Strong + relatively strong; Grasped weakly = medium + relatively weak + weak; Defend strongly = Strong + relatively strong; Defense weakly = medium is weaker + weak).

Table 2. The different character of the first bat of Rye Seung – min's defending technology in the backhand location%

Name	Strong %	Relatively strong %	Medium %	Relatively weak%	Weak %	Total %
Wang hao	2%	33%	49%	10%	6%	100%
Jan – Ove Waldner	7.4%	7.4%	29.7%	33.3%	22.2%	100%
Liang ZhuEn	–	22.2%	55.6%	11.1%	11.1%	100%
total	3.5%	24.1%	43.7%	17.2%	11.5%	100%

Table 2 showed the percentage of strong grasp was less than weak grasp in the first bat of Wang Hao, Val and Liang Zhuen. The percentages of strong and weak grasp in the three players were as followings: in Wang Hao was 35% and 65%, in Val was 15% and 85%, and in Liang Zhuen was 22% and 78%. The result gave us some suggestions. Firstly, the new service regular implementation increased the difficulty of the attack after service. Secondly, development of short court ball technology has suppressed the other side's quality of the grasp. Thirdly, it offered realistic foundation and development space for improving player's first hand defense ability, strengthening strategic intention and tactics change of the player's first hand defense.

3.2 The ones that defend in the first bat of backhand location are strong and weak

Table 3. Defend the statistical form of the intensity in the first bat of Rye Seung – min backhand location (%)

Name	Forehand that lean to one side %	Backhand		
		strong%	weak%	Total
Wang hao	42.5%	21.3%	36.2	100%
Jan – Ove Waldner	36%	15%	49%	100%
Liang ZhuEn	44.4%	–	55.6%	100%
Total	40.7%	17.3%	42%	100%

As everyone knows, after changing the big ball, table tennis has not become gentler according to what people looked forward to, oppositely, fighting and fierceness still are leading factors influencing the developing direction of the table tennis. In order to probe into the consciousness trend of strong and

weak defense when the first hand defense of Rye Seung – min backhand location, the author has carried on the comparison on two levels. First, carrying on comparison using the forehand technology on one's side and backhand technology, Second, when using backhand technology, the comparison between the size of strength and speed of baee. The table 3 displayed the first hand defense of Rye Seung – min, the strong defense and weak defense is 58% :42%. Result shows the first hand defense Rye Seung – min backhand location is objective, and defending consciousness moving towards and characteristic are influenced by strong defense.

3.3 Defend and compare with the weak result that defends strongly

Table 4 has showed the effect of three kinds of multi – form defense of Rye Seung – min. First, remarkable characteristic of using the strong defense of forehand technology to have high scores (36.4%), and high losing rate (33.3%). This is a typical mode of a fighting with a weapon type, the risk of this form lies in that once it is at a stalemate to enter, its passive characteristic (21.2%) relatively obvious too; Second, as a result of using strong defense backhand technology is the high score rate (50%) and relatively smaller mistake (28.6%). In addition, it is the greatest brilliant point of this kind of defense form that it seldom presents the passive situation. Third, using weak defense have the most high rate of stalemate (41.2%), however, the highest passive rate (32.4%) is its characteristics that can't be ignored too.

The author thinks, attacking means and grasped ability at many levels of the world excellent players in our times, influencing the player to choice and apply of the defending form differently more and more deeply, meaning and value of strong defense are paid close attention to by people, the choice and application of forehand and backhand in the first hand defense at the backhand location, the strong defense was regarded as future main developing direction of backhand technology by author.

Table 4. the statistical table of the result in the first hand defense of Rye Seung – min backhand location (%)

Defense form	Score%	Lose%	Initiative%	Passive%	Stalemate%	Total%
Forehand	36.4%	33.3%	–	21.2%	9.1%	100%
Forehand strong	50%	28.6%	14.3%	–	7.1%	100%
Backhand weak	5.9%	14.6%	5.9%	32.4%	41.2%	100%

3.4 Overall result of the first bat defense of backhand location

Table 5 showed that the whole match begins with the first hand defense at the

backhand location of Rye Seung – min, the score rate is higher than losing rate in the match of Wang Hao, Valdner, Liang ZhuEn. This result told us clearly that trying to be the first to grasp, attack actively is still the victorious key in the match, which is a future leading direction. On the Contrary, strengthening and improving the first bat of player's defense ability and level seem particularly important too.

Table 5. The score rate and loss rate of Rye Seung – min's first hand defense at backhand location%

Name	Score %	Loss %	Total%
Wang Hao	37.3%	62.7%	100%
Jan – Ove Waldner	40.7%	59.3%	100%
Liang ZhuEn	44.4%	55.6%	100%
Total	39.1%	60.1%	100%

4 Conclusions

(1) The rate of weak grasp was higher than the rate of strong grasp in the first bat of some excellent players.

(2) The main characteristic consciousness of the first hand defense at the backhand location of Rye Seung – min was the strong grasp.

(3) The percentage of strong defense was more than the weak defeuse in the first hand defense at the backhand location of Rye Seung – min.

(4) Score rate of the strong grasp was still higher than that of the first hand defense in the first bat.

16 New discussion on the table tennis tactics

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1 Concept of table tennis tactics and strategy

By table tennis tactics we mean ruses and actions used in table tennis competitions in order to beat one's opponent.

The biggest difference between tactics and strategy is that the former probes into the partial guiding law of a competition and the latter researches into the whole guiding law.

The core tactics of table tennis is to gain a partial advantage. The condition that all the skills of the player in our team are superior to those of the player in other team, which is called an absolute advantage, is rare in practice. In many circumstances superiority and inferiority are relative, and sometimes the technical level of the two players is equal. Therefore, the player must use rational tactics to win a partial advantage. It is the best thing for the player to attack his opponent's disadvantages with his advantages, but sometimes it is a little difficult to realize. Let's take service for example, the player's specialty in our team is spin or without spin service, whereas his opponent's weakest point is to receive high toss service. Although high toss service is the player's weakest point in our team, he still takes an advantage compared to his opponent. Under this condition the best tactics is to attack his opponent's weakest point by using the player's weakest point in our team because he has a partial advantage.

Next, we analyze the differences and connections between tactics and skills.

For example, how to use strength to make the ball spin more about the action methods of service belongs to skills, while where is the service falling point, and how to make a group of service belong to tactics.

Table tennis skills mean the action methods of taking the ball. For example, the action methods of service belong to skills, whereas the placement of service belongs to tactics.

Skills are basic to tactics. The player can use various kinds of tactics as long as he masters the comprehensive and practical skills. Accordingly, the player can fully utilize his skills as long as he uses the tactics rationally. So the player can master practical skills as long as he practices skills with tactical consciousness. In addition, skills and tactics develop continuously. Generally speaking, the development of skills is faster than that of tactics because new tactics can't

appear until the original skills are improved and new skills are created. However, advanced tactics can promote the improvement and development of skills in return.

2 The research scope of table tennis tactics

The focus of the research in Table Tennis tactics should include the following:

First, we map out a detailed set of tactics used in receiving services, attacking after services, and long rallies based on an analysis of different types of play or individual play. Numerous tactical articles enumerated in many textbooks basically belong to it.

Second, we analyze the development of tactical situation. When starting a competition, the two players will change the tactics unceasingly, which requires using appropriate tactics in the light of the development of tactical situation. Let's take the chop shot player versus the attacking player for example. How should the chop shot player cope with it, when the attacking player smashes the ball continuously, or smashes during consistency, or seeks the consistency only. These are several tactical situations. The player loses the game if he can't see the tactical situations very clearly and changes his tactics as well. When the competition goes smoothly towards the player in our team, the player can speed up the rhythm of the competition in order to win the game more quickly. When the competition goes smoothly towards the opponent, the player should slow down the rhythm of the competition in order to turn the situation around.

Third, we probe into the score. The score is the actual mark of the battling result. It directly influences the player's mental state which can directly affect the player's bringing his skills into play.

When the opponent's scores stand behind, he usually uses continuous smashes and sound attacks. In this situation he will use without spin service, topspin service and long service, and accordingly the player in our team should bravely hit the ball over the table and attack. Based on the opponent's characteristic of more pivot attacks, the player in our team should change the direction of the ball in time to move the opponent. Based on the opponent's characteristic of more hard attacks or drives, the player in our team should strengthen control of the ball in order to increase the difficulty of hard attacks or drives, and try to attack the ball on his own initiative to deflate the opponent's arrogance.

When the opponent's scores stand front, the player in our team should show a dauntless spirit, fortify his confidence, analyze the situation calmly, grasp the principal contradiction, and change the tactics resolutely. Sometimes the player can turn the situation around if he can have a better deal with certain ball attack, or change the direction of the ball a little.

When his scores stand front, the player in our team should pay more attention to the control of service reception in order to destroy the opponent's attacking after service. When his scores stand behind, the player in our team should make full use of service to attack boldly. This is an effective method to enlarge the advantage and shorten the gap of the score.

The eleven – point scoring system shortens the competition process because the score decreased to half. The influence it brings to the player's competitive psychology and use of tactics is far beyond our imagination. It requires that the player must go into the competitive state as quick as possible, and that on starting the competition (or called the starting game), he should use his special skills, change his tactics continuously, and pay attention to the accuracy of his skills to decrease the misses, so that he can take the lead in the starting game. In the 21 – point scoring system the player usually takes sounding so that the scores are very close in the former ten – score balls, whereas the eleven – point scoring system doesn't permit the players to take sounding because the game is close to be over when the score comes to seven or eight. When the score stands from 5 to 8, it belongs to the middle game in which the two players have an understanding of each other. Under the circumstances, the player should use the most practical tactics, which detailed speaking are his specialty versus his opponent's weakest point, his specialty versus his opponent's, or his weakest point versus the opponent's weakest point. In a word, the player can hit the ball hard and initiatively to win the partial advantage in order to provide a sound basis for gaining the game. The ending game refers to the one after nine scores, in which the player decides whether he should use continuous smashes or flexible tactics based on the spot situation. There are many occasions in which the score is 9 to 10 or 10 to 10 in the eleven – point scoring system, so the players should pay attention to dealing with these key balls. Generally speaking, the eleven – point scoring system demands much more energy than the 21 – point scoring system. It emphasizes the reckoning of every ball. The remark stated in the book on the art of war "more reckoning, more winning, and less reckoning, less winning, and no reckoning, no winning" is used here much more properly than anything in the world.

Another important characteristic of the eleven – point scoring system is to increase the risk. In the 21 – point scoring system, the average value of one score is 1 to 21, that is 0.048, and whereas in the eleven – point scoring system, the average value of one score is 1 to 11, that is 0.091. Clearly enough, the value of one score in the 11 – point scoring system is nearly twice as much as that in the 21 – point scoring system. The higher the value of one score is, the more influence and role it brings to and takes in one game. When the score is 10 to 11, in which your scores stand behind your opponent's, you will lose the game if you lose one score again. Therefore, the value of your next ball is 1 to 1, which

is 1. Such a high value can easily give rise to nervousness. The 11 – point scoring system brings much more advantages to the player who is apt to run the risk and struggle tenaciously and whose specialty is prominent than to the one who is reluctant to run the risk and longs for consistency. The boost of the value of one score in the 11 – point scoring system requires that the player should cherish every ball to decrease the misses as much as possible. At the same time, it also requires that the player should go into the competitive state as quick as possible, and go all out, and change his tactics according to the spot situation. In return, it will bring disadvantages to the player who goes into the competitive state slowly and has a poor capacity to handle changes.

The rule regulates that "One player or two doubles players can ask a time – out, which is not beyond one minute." It is a tactical problem with practical significance for players when to ask the time – out. Many players are accustomed to asking the time – out at the last game. In fact, there are several opportunities for players to ask a time – out. For example, the competition is best of 7 games, in which the player takes the advantage of 2 to 1 in the first three games. In the fourth game, he has no idea when the score transforms into 9 to 7 under the condition of taking the advantage of 9 to 2, on which occasion he could lose the game if the game continuously goes on. If he asks the time – out on this circumstance, he could alleviate the spot atmosphere and adjust his state of mind on one hand, and he could get wise counsel on the other hand. There is a big difference between the player's taking the lead of 3 games to 1 and equalizing the game, 2 to 2.

3 The content of tactical training

Tactical training should cover both the development of tactical consciousness and the use of tactical actions. During trainings, many players ignore the importance of the development of tactical consciousness, and have the misleading notion that tactical training is only about tactical action. After many years'training, these players, who were not flexible enough to change their tactics according to the circumstances in a match, often have shown little or no improvement. One of the important reasons attributes to this phenomenon is that, these players do not have sufficient training in the development of their tactical consciousness.

The training of tactical action has been recognized before, and a lot of precious experience has been accumulated in practice. So here unnecessary details about it will not be given. Next, I want to emphasize the training of tactical consciousness.

The training of tactical consciousness includes three parts which are as the followings:

(1) Tactical attainments. That is, the player's tactical accomplishment in daily life. The players should understand indispensable theoretical knowledge about tactics, be clear about the concept of tactics, and have a command of the developmental law of table tennis tactics. It is quite necessary for the players to learn some theoretical knowledge about tactics in order to boost their tactical attainments.

(2) To foster the correct tactical guiding ideology. That is to say, some theoretical knowledge about tactics should be combined with the analysis of the current situation of table tennis. The tactical guiding ideology is very important because it is not only the principal of setting up the concrete tactical program, but also the outline of the whole training in table tennis skills and tactics. There is a saying "When the general plan is laid out, the details are easy to arrange." Some problems in the general tactical guiding ideology will lead to the misses in whole training and competition.

(3) Tactical thinking powers. This is the reflection of psychological activities to tactics, which asks the players flexibly change his tactics according various kinds of circumstances to win the competition.

Tactical thinking has the characteristics of audio – visualness and vividness. That is to say, the tactics used by the players in the competition relates to the direct consciousness, not to abstract concepts. Tactical thinking also has the characteristic of agility. That is to say, there is a rigid limit of time between deciding tactical strategies and finishing tactical actions in the competition.

Tactical thinking powers mainly depend on the level of players'understanding and classifying the competitive situation. In order to boost tactical thinking powers, the following contents for learning and training should be arranged on purpose. Players must master necessary theoretical knowledge about tactics.

(1) To arrange specially the training for the purpose of observing tactical changes from both players in the competition. After the competition is viewed and emulated, a seminar should be organized in order to analyze the conditions of both players'using tactics in typical competitions.

(2) Coaches should hold a lecture on the tactical analysis in a planned way in which the tactical changes in a representative competition should be analyzed carefully and thoroughly.

(3) When players participate in training of the concrete tactics and skills, coaches should make players understand the role and methods of using them.

(4) After each competition is over, players should cultivate the habit of recollecting timely the tactical situations of both players to increase the presentation ability of tactical actions.

(5) Set up file system. To sort out in wording the conditions of using tactics by other nations, other teams and other players, this is best to be combined with watching a video.

4 References

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17 The analysis of the forehand break-through tactics of 11-points rule

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1 Introduction

In different historical period, the development of the table tennis rule and technique-tactics must result in the specific and effective technique-tactics changes. Every technique-tactics depends on the five crucial factors such as speed, strength, spinning, falling (placement) and accuracy. The forehand break through tactics evolves from all kinds of tactics and is adaptable to the modern table tennis development. In 1990s' European players never found the method which defeated the Chinese first three-ball technique and all-round technique. After the forty fifth World Table Tennis Tournament, some players such as Swedish etc are bold to use the forehand break through tactics to defeat our super players many times. At present, every country studies the forehand break-through tactics and training. Although there is not an integrated theoretical system to guide, the fashionable and effective tactics has been formed. This article analyses and studies the forehand break through tactics through the tournament between Zhang Yining and Niu Jianfeng in order to offer some instructive advices for Chinese table tennis tactics system.

2 Methods

Video observation, statistics and logical analysis were used.

3 Results and Discussion

3.1 The concept of the forehand break-through tactics

The receiver first transfers his rival's forehand point with the combination of long drives and drop shots and they do the forehand – attack – counterattack exercises. During the exercises, the main player attacks straight after three balls. When a left – hand player and a right – hand player do the exercises, the left – hand player can do the exercises of the forehand – straight attack of a half table after transferring his rival's forehand point and attacks backhand after the first ball.

The main player first attacks upspin and then attacks and counterattacks. (The number of balls shouldn't be too much). After two balls, the main player transfers his rival's forehand point and attacks backhand after his rival's angled backhand counterattack. If the level of players is high, they may irregularly do the exercise. The requirements are to early start to attack and transfer widely and attack straight

3.2 The analysis of the forehand break – through tactics application

The statistics of Zhang Yining's service stage: From the data, we find out that the proportion between Zhang Yining's backhand attacks and her middle – forehand attacks is 10: 13. Zhang Yining mainly attacks Niu Jianfeng's forehand. Moreover, Zhang Yining backhand – straight attacks'effect is better, which avoids the bad conditions of restraining backhand attacks each other.

The statistics of Zhang Yining's receive stage: The stage is wonderful. In the stage, Zhang Yining doesn't lose one point. Zhang Yining uses the short – ball – attack technique and forehand break – through technique reasonably and persists in attacking forehand after two backhand balls or immediately attacks forehand. (The tactics effect: +8 –5) Zhang Yining restrains Niu Jianfeng's backhand speed with spinning, combined with pivot backhand attacks. This tactics is effective.

The statistics of Zhang Yining's midst stage: Zhang Yining's forehand break – through tactics gets five points and loses three points; the tactics to restrain Niu Jianfeng's backhand attacks gets three points and loses two points; the tactics to restrain Niu Jianfeng's backhand attacks gets five points and loses one point. Zhang Yining mostly plays on the basis of her own tactics to restrain backhand, restrain backhand and then attack forehand or immediately attack forehand, change offensive direction quickly and attack widely, which embodies the tactics thought whose soul is change.

4 Conclusions

(1) As the technique – tactics level of every country player rises and tournaments are more competitive, the contradiction of offence and defense often changes. So, on the basis of bettering the forehand break – through tactics, it is necessary to improve all – round technique.

(2) Although the forehand break – through is an effective tactics, a player can't entirely copy others'technique – tactics. A player should do his best to actively transfer his rival and form the technique – tactics system which is adaptable to him.

18 Analysis of the 11 – point system of table tennis from the communication point of view

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1 Introduction

Every sport has its regulations, while all of them experienced many revisions in their history. Since Ping-Pong was invented, its regulations have been revised for many times because of certain reasons and background. Every revision promoted the development of Ping-Pong to a certain extent.

Since year 2000, International Table Tennis Federation has made three important revisions on Ping-Pong regulations. The first one was that the diameter of ball was increased from 38 mm to 40 mm; the second one was that the 21 – point system was changed to 11 – point one; the third one was that while serving, players were not allowed to veil the serving action by their bodies. As a whole, these three revisions brought favorable influence on the development of Ping-Pong techniques.

However, whether revisions of regulations are reasonable and scientific, it should be tested and reviewed from different aspects. This essay raised some objections towards the 11 – point system from the communications point of view.

2 Analysis of table tennis live broadcasting from the connections between sports and media

Nowadays, it goes without saying that TV live broadcasting greatly influences and promotes a certain kind of sport. According to agenda setting in communication theory, if a sport is on TV very often and for a long time, it will draw more attention. For example, although China is not a powerful country in football, because there are many football programs on TV, football has the same influence as other sports.

But considering its own benefits, TV stations won't show a sport for no reason. Most of the time they think about audience rating, which lies on the following factors: (1) the importance of the match. Generally speaking, the wider the range is, the more important the matches are. Top – ranked matches draw more attentions. (2) The intensity of the competition. For example, the intensity is higher in semi – finals and finals. (3) The dramatics. Without dramatic

factors or changes the audience rating couldn't be high, since people in front of television care much about the result of the match. The more changes are, the stronger the stimulation to the audience is.

To live broadcasting, the attraction lies on the unpredictability of the matches. Therefore, during regulation revision it is very important to take problem of how to add dramatics of the matches into consideration.

3 Problems of Ping-Pong live broadcasting in 11 – point system

From the former part of the essay, we can find many problems of 11 – point system.

First of all, 11 – point system reduces the dramatics of Ping-Pong matches. In high level matches, it is always hard to say who is a better player. The key factors to win are physical strength, willpower and tactics, so the regulations should help all these factors to be brought into full play. But in this 11 – point system, if a player doesn't play well at the beginning of a set, it is very hard to win at last, since there is only very few chances left. For example, if the match goes 3 to 8, it is barely possible for the player who lags behind to win. Then the player will give up this set and put hope on the next one. If two sides are both holding this idea, the matches would be flat and dull. That is to say, 11 – point system shortens the process of each set, at the same time reduces opportunities and probability of dramatic changes.

11 – point system was revised from 21 – point one, which has some reasons. For example, it forces players to get into playing state sooner, while reduces the chances of players to win with changeful serves. But after several years of practice, people may gradually find that this 11 – point system is not the best choice for Ping-Pong matches.

Second, 11 – point system makes TV live broadcasting flat and dull. The attraction of TV live broadcasting lies on its process, which is composed with dramatics and changes. 11 – point system shortens time of each set, while reduces changes, which makes the match a straight line. Without ups and downs, the audience rating will be lowered.

Third, 11 – point system reduces the brilliant attacks; increases the key points at the same time, which puts more pressure to the players. Players are not able to play well under heavy pressure, and then the competition is not as splendid as before without wonderful attacks. According to the statistics of International Table Tennis Federation, in table tennis matches, spectators clap if one point has 7 or 8 rounds, while they gave thundering applause if the point has more than 10 rounds. The applause means interest and preference of spectators. And spectators mean market. In market there are commercials and funds which bring basic conditions for the development of Ping-Pong.

4 Revision of table tennis regulations

Based on the analysis above, we think the 11 – point system should be revised to a 16 – point system, in which serve is shifted every 3 points. If the score is 15 to 15, then serve is shifted every other ball. One side wins if he gets best out of 5 sets.

The advantages of the revision are: first, while making the match longer, it increases the possibility of reversing the result and adding more dramatics to the competition. Second, it reduces the set points, which makes players concentrate on every point. The wonderful attacks will attract more audience.

Like other sports, Ping-Pong should go to market and be professional in order to get more sponsors that promote the development of techniques, so that it could attract more audience. Then it would develop in a positive circle, in which regulations and systems are the baton that leads its development. That is why we raised this topic – revision of table tennis regulations.

19 Research on the technique diagnosis model based on artificial neural network in table tennis

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1 Introduction

Since the 1980s, the theory of the artificial neural network has become mature gradually and has made the plenteous achievement in many fields. In recent years, the application of the artificial neural network has gone deep into many fields. Compared with the traditional methods such as estimation, forecast and decision-making etc., mathematics models dose not need to be designed. We can establish a model only according to input and output of data. The interior information of the network is saved in a mass of power matrices. Possessing the unique power of self-adaptation, self-organization and self – training, the network has a bright future in complexly nonlinear field and undefined physical athletical system.

2 The theory of artificial neural network

The artificial neural network is a system of information process, the purpose of which is imitating structure and function of human brain. The network is a great deal of artificial nerve cell combined extensively with each other. Artificial nerve cell is a mathematical model of imitating the living creature nerve cell. And each artificial nerve cell will accept information from all the others which offer the power data and connect with it. A total power value added up the entire power datum is compared with the artificial nerve cell one by one, if it is more than cell's bias number being the inherent number in the cell, the cell is activated and its signal is delivered to the next-layer nerve cell connected with it.

Currently, the artificial neural network has lots of varieties used for the different purposes. Among them BP network, short for back-propagation, is one of the most noticeable and the most extensive neural network used at present. It is capable of self-adaptation, self-organization, self-training, simulation and prediction. The construction diagram of BP network is shown below:

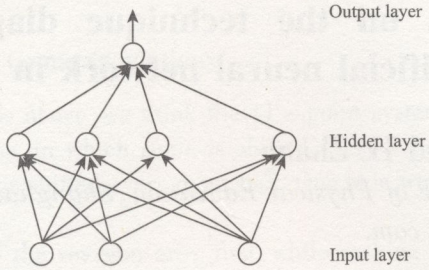

Figure 1. construction of BP network

To each nerve cell, its input and output's data relation is as follows:

$$net\ i,k = \sum W\ i,j,k\ O\ i,,j,k-1-\theta\ i,k$$

$$O\ i,k = f(\ net\ i,k)$$

Among them, j (j = 1, 2, ⋯n) is a number about nerve cell in each layer; O i, k is the output data about No. i cell in the k layer; neti, k is the input data about No. i cell in the k layer; W i, j, k is the power data between No. j in the k − 1 layer and No. i in the k layer; f(.) is the delivering function which generally adopts the linear function or the function of sigmoid.

BP's training procedure is composed of propagation and back − propagation. In course of propagation, importation from the input layer spreads one by one to the hidden layer by means of the delivering function. And then if one cell is activated, its power value spreads to output layer also by the delivering function. State of every layer nerve cell only affects the next layer nerve cell. If we can not get the expected exportation at the output layer, the process turns into back − propagation. The errors between the actual data and simulating output data will return along the original conjunction path. During this course, each power datum of each layer nerve cell is amended by means of the training function in order to make the error smaller. This training process does not stop cycling again and again until the error is smaller than the one that was given beforehand. Thus we acquire BP neural network and the covered power matrix.

It is important to choose the structure of network model. If it is done well, we can reduce the cycled times of network training and improve the accuracy; whereas, it may cause the failure in the network train. The BP structure is related to how many the nerve cells of the input layer, the output layer and the hidden layer are offered, which delivering function is fit and training function of the network BP can be used.

3 Methods

3.1 Participants

The Subject was the excellent ping − pong player Wang Liqing, who was the

first at men's doubles in 2000 Sydney Olympic Games, the champion of men's singles in the 46th Table Tennis World championships in 2001, and the third place in men's singles of 2004 Athens Olympic Games.

3.2 Procedure

(1) Wang Liqing's 23 matches, which have been played at domestic and international games from 2003 to 2004, were selected at random. They were divided into two groups. 20 matches were used for establishing the diagnosis network model; the others were for examining the model.

(2) The BP neural network was adopted and the model was built. A special tool of Matlab7.0 software was used to complete all calculations.

4 Results

4.1 Building of the table tennis technique diagnosis model

The diagnosis network model adopted three layers of BP network. Data of input layer which had 6 nerve cells were six indexes which were selected according to the traditional skill analysis method of the ping - pong match. These are scoring rate of the phase of attack - after - service (AAS), scoring rate of the phase of reception, scoring rate of the phase of rally, using rate of the phase of AAS, using rate of the phase of reception, and using rate of the phase of rally. Data of output layer which had only 1 nerve cell were winning probability of Wang Liqing and hidden layer which had 18 nerve cells. The delivering function of every nerve cell was Purelin(n) function. The training function of network was Levenberg - Marquardt.

4.2 Calculation of model

The calculation of the process of the neural network was very big. Here we made use of the Matlab7.0 software to build the diagnostic model. Its procedure was as follows:

```
p =
Columns 1 through 11
0.6000  0.6875  0.6667  0.5652  0.5294  0.7500  0.7273
0.6250  0.8000  0.7778  0.7000
0.3333  0.6316  0.5278  0.5385  0.4333  0.5000  0.6000
0.4688  0.4444  0.5263  0.3750
0.4565  0.4583  0.5000  0.4483  0.5909  0.6316  0.7037
0.5000  0.5200  0.6842  0.5526
0.1765  0.2712  0.2903  0.2949  0.1868  0.2909  0.2292
0.2500  0.2586  0.1915  0.2439
0.2824  0.3220  0.3871  0.3333  0.3297  0.3636  0.2083
```

```
0.3333  0.3103  0.4043  0.2927
0.5412  0.4068  0.3226  0.3718  0.4835  0.3455  0.5625
0.4167  0.4310  0.4043  0.4634

Columns 12 through 20
0.6190  0.7368  0.6471  0.5556  0.6757  0.6774  0.5714
0.5789  0.6087
0.6364  0.4444  0.3548  0.3200  0.4375  0.3243  0.5135
0.5926  0.4667
0.5769  0.4545  0.5806  0.5778  0.3696  0.4595  0.6333
0.5217  0.4667
0.3043  0.3333  0.2152  0.2748  0.2824  0.2981  0.2947
0.2754  0.3382
0.3188  0.4737  0.3924  0.3817  0.3664  0.3558  0.3895
0.3913  0.4412
0.3768  0.1930  0.3924  0.3435  0.3511  0.3558  0.3158
0.3333  0.2206 % to train the imported data of the sample
t =
Columns 1 through 11
0.4607  0.5738  0.5567  0.4819  0.5161  0.6071  0.6600
0.5204  0.5763  0.6471  0.5357
Columns 12 through 20
0.6081  0.4809  0.5556  0.5122  0.4769  0.4808  0.5889
0.5652  0.5147 % to train the exported data of the sample
Net = newff (minmax (p),[18,1],{'purelin','purelin','trainlm'}; % to
establish the nerve network construction
Net. trainPaŕam. show =5;
Net. trainParam. epoch =5;
Net. trainParam. goal =1e-4; % to establish training parameter
Net the = train (net,p,t) % to train the neural network
```

4.3 Relation between times and error in the model

Acquiring the relationship between the errors of training and the times of training were shown in figure 2.

In the figure, these coordinates showed that x – axis was training times (epochs) and y – axis was training error. Here we supposed that the expectation of the error accuracy was $10-4$. While the training was merely the third time, the error had arrived at steady state. Its value was about 0. 00063 and closed to the accuracy expected. It revealed that the model established was nearly ideal and had good stability.

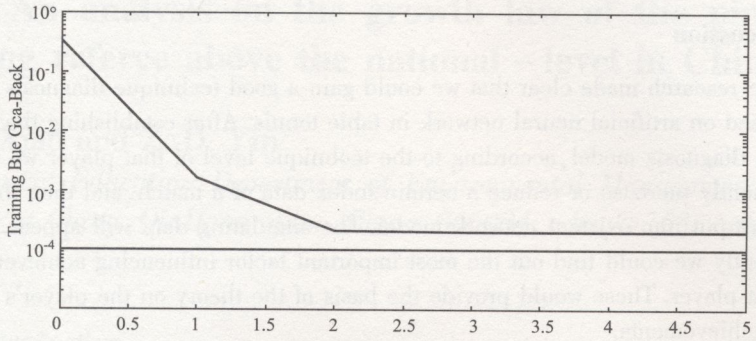

Figure 2. Relation about the errors and the times

4.4 Accuracy of the model

The rest data about Wang Liqing's3 matches were put into the neural network model.

q =

0.6897 0.6667 0.7037
0.4848 0.5476 0.3438
0.4483 0.4074 0.6308
0.3187 0.2195 0.2177
0.3626 0.3415 0.2581
0.3187 0.4390 0.5242 % Used for the imported data of the examination model

r =

0.5376 0.5122 0.5351 % Used for the exported data of the examination model

Acquiring the difference between actual data and simulating data were shown in table3.

Table 1 expresses the error was very small between actual data and simulating data on the winning probability of Wang Liqing. Its maximum was 0.02996 and minimum was 0.00417. Above technique diagnosis model established according to the method was successful and could be used for forecasting the achievements that had certain accuracy.

Table1. Comparing actual data with simulation data

	Match 1	Match 2	Match 3
Actual data	0.53763	0.51219	0.53509
Simulation data	0.51732	0.51261	0.56504
Error	0.02032	−0.00417	−0.02996

5 Discussion

Above research made clear that we could gain a good technique diagnosis model based on artificial neural network in table tennis. After establishing the technique diagnosis model, according to the technique level of that player we could pertinently increase or reduce a certain index data of a match, and then the data were put into existent network model. The simulating data will appear. Consequently we could find out the most important factor influencing achievements of that player. These would provide the basis of the theory on the player's creating achievements.

Another feature of the artificial neural network was to enable network to reserve the internal information of existent network model in a mass of power matrices. When skill of the athlete changed, recent data came into being. Only when we required to input new data and to train the artificial neural network again, could we still establish the new model based on the existent model. The model appeared to the latest technique and achievements of the player. Meanwhile, the past achievements were still saved.

20 An analysis on the growth law of the ping – pong referee above the national – level in China

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1 Introduction

The growth of the talented person is a complicated process; it can be influenced by a host of factors, including both the subjective and the objective factors. The subjective factor includes the physical body、moral qualities, capacity, and knowledge etc. The objective factor includes the society demand、and working and living environment、and the education of the government etc. Here, we talk about the growth law of the ping – pong referee above the national – level in China under the instruction of the theories of the talented person. The growth law is a recapitulation and induction of the growing process of the ping – pong referee. If we can truly understand and master the growth law of the ping – pong referee, we can reduce the blindness and the unscientific elements in bringing up the referee, and make it be advantageous to better the work of the referee. According to the theory, the growth law of the Chinese ping – pong referee has the following key points. Through the research of the promotion from the second class to the first class, and the promotion age、number of year、ruling work on the spot and the training of the referee above the national – level, try to find out the common law in the growth of ping – pong referee in China.

2 Methods and Materials

2.1 Participants

The ping – pong referee of the national – level registered in the Table Tennis Association of China.

2.2 Research methods

2.2.1 Reference materials

Refer to both domestic and foreign materials about the ping – pong referee, and a lot of relevant articles.

2.2.2 Survey and research

2.2.2.1 The consultations of the experts

Interviews with the experts and scholars of the Referee Committee of the Table Tennis Association of China and related experts.

2.2.2.2 Questionnaire

150 referees above the national – level who took part in the ruling work of the national formal ping – pong games in 2003 and 2004 joined the questionnaire.

3 Results and analysis

3.1 The best period of age in the growth of the referee

Studies show that there is a best period of age in the person's development. Around the world and in a certain period of time, the best period of growing of the brainworkers is relatively stable, that is between age 25 ~ 45, and the climax is at 37. Researches (Table 1) show that the average age is 28 when becoming the primary class referee; of the national class is 34; and of the international class is 37. From the point of this theory, the growth of the higher – level referees in China fit in with the theory.

In recent years, the Association of China attaches great importance to the age structure of the referees, the average age of the referees who took part in the 9th, 10th, and 11th national referee examinations is around 35, however, due to the young age in the promotion to the national – level, their chances of ruling on the spot in the second class and first class games were decreased, then this influenced their ruling experience, and their ruling abilities developed slowly. The situation urges us that we have to provide the young referee with more chance so that they can enrich their experience. Only through this way, we can promote the general level of the referees at the same time. According to the law of the best age, the bringing up of the referees above the national – level should focus on those in the best period of age, and thus be helpful to the growth of the high – level referees.

Table 1. The age of ranked referees

Age	Primary		National		International	
	Number of people	Percentage	Number of people	Percentage	Number of people	Percentage
18 ~ 20	5	3.7				
21 ~ 25	28	20.7	12	16.3	2	1.5
26 ~ 30	56	41.5	29	19.3	7	5.1
31 ~ 35	40	29.6	38	26.7	11	20.3
36 ~ 40	6	4.4	43	31.9	21	38.9
41 ~ 45			8	5.9	10	18.5
46 ~ 50					3	5.6
Total	135	100	135	100	54	100
Average age	28		34		37	

3.2 The law of accumulation effect in the growth of the referee

The growth of the referee is an accumulation process, including time and experience, hence we'll talk about the law of accumulation effect in two aspects: the number of year for the referee's promotion, and the average ruling times each year.

3.2.1 The number of year for the promotion of the ping – pong referees above the national – level in China

Survey (Table 2) shows that the average number of year for the promotion of the ping – pong referee from the second level to the first level is 3.7 years, and the shortest is 1 year, and the longest 13 years, so the time span is quite large. But most of the promotions are between 1 ~ 3.9 years, from the point of the common law of a person's development, this average number of year for the promotion of ping – pong roferee relatively reasonable.

There is a huge gap in the number of year of promotion from the first – level to the national – level, and the distribution is quite scattered. After researches and visits to the referees, the main reasons are: first, although the national examination is held biennially, there is a limitation of 50 people on the number of the participants. Considering the referees distribute around different areas throughout the country, the association distribute the quota to the sports associations of each province, autonomous region, direct jurisdiction city and occupation, thus the quota each province get is only 1or 2. This led to the slim chance of the first – level referees'promoting to the national – level, and the long time

promotion. Second, because the participants of the examination are designated by each province, there might be a huge influence of interrelationship, this leads to some of the referees who are just promoted to the first – level get the chance to be promoted to the national – level, whereas, some others have to wait over 10 years even 20 years to get the chance of promotion. This phenomenon has a great negative impact on the study and the enthusiasm of some referees, so some measures should be taken to prevent such kind of phenomenon spread to the healthy development of the referees above the national – level, for instance, before the national examination take place, each province has got to hold selective exam, and the exam form should be in accord with the national examination. In the process of the exams, we should stick to the honesty, equity, and open – to – all principles, and let the real talented referees come out on top.

Table 2. The number of year for the promotion of the ping – pong referee in China

Number of year	Promotion from the second – level to the first – level		Promotion from the first – level to the national – level		Promotion from the national – level to the international – level	
	Number of people	Percentage	Number of people	Percentage	Number of people	Percentage
1 ~ 3.9	80	59.2	31	23.0	17	31.5
4 ~ 6.9	32	23.7	55	40.7	23	42.6
7 ~ 9.9	15	11.1	34	25.2	6	11.1
10 ~ 12.9	7	5.2	11	8.1	8	14.8
13 ~ 15.9	1	0.7	2	1.5		
16 ~ 18.9			1	0.7		
19 ~ 21.9			1	0.7		
Total	135	100	135	100	54	100
Average number of year	3.7		5.8		5.5	

3.2.2 The Chinese ping – pong referees' ruling work on the spot

An excellent ping – pong referee should not only have a solid knowledge of the theory, but has an abundant experience of ruling right on the spot. The experience is accumulated through numerous games. In succession we will talk about how many games a high – level referee took part in his different referee stages. (Table 3).

Table 3. The average on -the-spot games referees took part in each year in China

Games	Promotion from the second – level to the first – level		Promotion from the first – level to the national – level		Promotion from the national – level to the international – level (so far, the national – level)		So far, the international – level	
	Number of people	%	Number of people	%	Number of people	%	Number of people	%
0 ~ 1	9	6.7	3	2.2	16	11.9	20	37.0
2 ~ 3	35	25.9	40	29.6	85	63.0	32	59.3
4 ~ 5	52	38.5	61	45.1	34	25.1	2	3.7
6 ~ 7	39	28.9	31	23.0				
Total	135	100	135	100	135	100	54	100
average	4.8		4.5		2.8		2.1	

Statistics show that from the second – level to the first – level, the average on-the-spot games a referee took part in each year is 4. 8 games; from the first – level to the national – level, 4. 5 games, there isn't too much difference with the first stage. However, when it comes to the third stage, the national – level referee only took part in 2. 8 games on average each year, and the international – level was the least, 2. 1 games, which were far fewer than those of the first and the second stages. The main reason is that table tennis has been China's national sport, and is quite popular in the public, so there would be lots of local ping – pong games, and the referees of those games are mainly of the second and the first level. As a result, those referees have got more chance to practice, and then they accumulate abundant experience promoting their ruling ability to those of the national – level. Once they became the national – level referee, the ruling object would change; their main task is to referee those national games and few local games, or to be the foreman of the referees. From picture 1, we can see that in the 2002 National Table Tennis Cup-the game of the highest level in China, the Association has designated only 12 national – level referees and 9 international-level referees, all the others being of the first-level referees. This reveals that the referees above the national-level have less chance to referee on-the-spot games, and the higher level the referee is, the more serious the problem is. In order to solve this problem properly, we have to start with the high-level referees. In the first place, raise the

proportion of the referees above the national-level in national games. In the second place, put restrictions on the age of the referees in national games, and give more chance to the young.

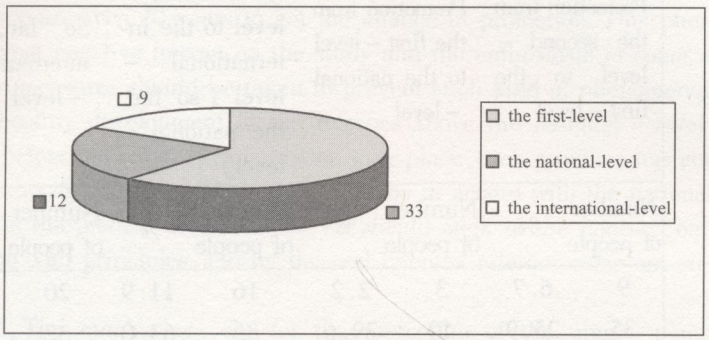

Figure 1. Referees of different levels in the 2002 National Table Tennis Cup

3.3 The indirect experience acquired in the growth of the referee

The indirect experience refers to the instructions a referee acquire from his/her teacher so that one can make fewer mistakes in the growth process, and get twice the result with half the effort. The best indirect experience a referee can acquire can be obtained through the training, which is his the most important part in the growing – up process of a referee. To be a referee, improving his ruling ability through studying the books is obviously not enough, but through standardized and systematic training, for example, the internet tutorship, case study, practice and a variety of efficient training methods, the referee's integrated diathesis such as: in the aspect of theory, experience, and the mastery of the technique and the regulations, can be promoted in an all round way.

3.3.1 How many times spent for training the ping – pong referees participate in China

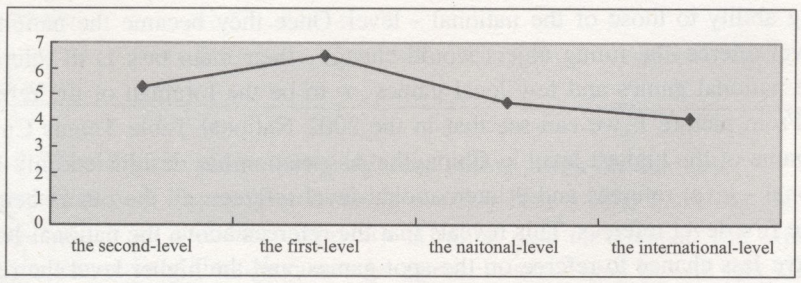

Figure 2. The times spent for training the referees of different levels

The results (Figure 2) show that the training times of the referees of different leves are: from the second – level to the first – level, the average training times is 5.3; from the first – level to the national – level, the average training times increased to 6.3. It proved that the local authorities paid much attention to the training of the referees. But from the national – level to the international – level, the average training times decreased to 4.7, and the international referee had only the least training times 4.1. Compare the number of year of promotion with the referee's training times, in the promotion from the second – level to the first – level, the referee participated training 1.1 times on average each year; from the first – level to the national – level, 1.12 times; from the national – level to the international – level, 0.85 times; after becoming the international – level referee, one had less chance to take part in training. The reason is that the local association is in charge of the training referees below the national – level, thus it's easier to carry out the training. However, as to the training of referee above the national – level, it is the national association in charge of it, and there are a number of difficulties in the aspect of organizing, fund etc. To each promotion, the referee has to try very hard to improve his abilities, and such less training cannot enable the referee to reach the standards of promotion in a short period of time.

3.3.2 The methods and contents of the training of the ping – pong referee in China

At present, the training of our referees is relatively limited, the training courses executed by the authorities or the pre-training before the games are the main forms. Before becoming the national-level referee, most of the training courses confined to the regulations, theory and practices on the spot. Only a small part of referees ever received the training which was chosen by lot, and much less referees received computer training. These lead to the lack of wide eyesight and contemplative faculties, and therefore due to the weak foundation, it makes the training of the referees above the national-level harder to some extent. Recently computer has been applied widely and extensively in the organization and management of large scale ping – pong games, it has greatly enhanced the working efficiency of the organization of the ping – pong games; meanwhile, the listening and speaking ability directly decides the execution quality of ruling in international games. Because of not enough attention and limited training contents it is hard to improve the referee's integrated diathesis and to reach the promotion standards.

Moreover, the pre – training before the games is the main form of the training of the referees above the national – level, and the training courses executed by the authorities usually act as a supplement. The training contents include: regulation, practice on the spot and lot arrangement, few referees have ever re-

ceived the systematic training of computer and English. The main reason is that due to the lack of fund, the ping – pong Association of China has held only three training which concerns the computer application since 1996. Last, the communication of the referees is also one of the tasks of the pre – training.

3.4 The expectation effect in the growth of the referee

The expectation effect law is an important discovery in stimulation theory of the modern management. In this theory, the motive of people to do some work or to take action comes from his prejudgment (including motive, interest and success etc.) for his conduct motive, conduct result and working effect. From the point of psychologist, motive is a subjective drive to stimulate people to do something, and it is a state of mind to start and maintain its conduct. A referee's ruling work is stimulated and kept going under the motive, and that the motive is directly linked to the inner drive of doing his ruling work, thus this is the inner motivation of being an outstanding referee and it's extremely important to the referee's growth. A correct motive can unite one's work and his contributions to career together, and it can have a positive impact on life. In addition, interest is also an important factor which influences people's consciousness and enthusiasm.

All the referees in China are amateurs. They do the ruling work in their spare time, and the burdensome study of theory and ruling work were very hard to deal with if without an obvious motive and strong interest. The results (Table 4) indicate that the referee above the national – level has an obvious positive motive and a strong interest in being a referee, and this is the motive which simulates and supports most of the ping – pong referees all the time, and it is one of the reasons why they achieve success.

Table 4. Different motives of being a ping – pong referee above the national – level

Options	Number of people	percentage
Interest	91	67.4
Devote to the table tennis, strengthen the referee team	68	50.4
Master a skill, more opportunity to find a part time job	34	25.2
For a practical and material aim	18	13.3
other	3	2.2

4 Conclusions

The growing process of the ping – pong referees above the national – level basically follow the law of best age, The law of accumulation effect, the indirect experience law, the expectation effect law. But there are still a lot of problems, such as: the referee above the national – level lack the chance to referee on the spot, there isn't enough attention on the training of the referee, and the training contents and results cannot satisfy the demand of international games etc. In 2008, the Olympic Games will be held in Beijing. This is a huge opportunity to us, and we should take advantage of this opportunity as a turning point, try our best to promote the general level of our referee team.

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21 Developing trend of table tennis tactics from the different places of top paddlers in world competitions

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1 Introduction

In the past one year or more, a group of young paddlers, such as Boll, Zhuang Zhiyuang, Wang Hao, have scored great successes, thus they are praised as the new generation in the world of Table Tennis, although their places are not desirable after the 47th World Table Tennis Championships organized by ITTF, since their places in world are still before ten. Especially due to the new play and tactic style, they attract great attention from more and more people.

When asked by journalists, the present major coach of male team Liu Guoliang has stated: "The three players are qualified to be the representatives of the new generation, since they all become famous since last year and are all in the state of progress, meanwhile, they play quickly and violently, which seems unreasonable in some people's views. How to understand the word "unreasonable"? Liu Guoliang's explanation is that their ways of playing, compared with the traditional ones, are more violent and quicker. Moreover, they can play both backhand and forehand, thus the attack power is relatively great.

Boll, regarded as the prime opponent, is only 21 years old. He prefers left – hand grip and plays very quickly and violently but steadily. Thus paddlers are filled with fear when competing with him. At present, due to his stable achievement, Boll is number one in the men's singles of ITTF, and his turning – point of his success appeared in Men's World Cup held in Jinan. In that competition, he defeated Wang Liqing and Kong Linghui serially and won finally. Yin Xiao, the coach leader of national team of Table Tennis, has showed his view about Boll: "Boll is an all-round left-handed shakehand player, with strong nerves. He is capable of having an intensive rally both forehand and backhand." Zhuang Zhiyuan was born in Taipei and his parents and brother are all paddlers. He started to play table tennis from eight and was sent to national youth team for training in 1993, and then he went to Germany in 1999. His characteristics of play are right-hand grip, quick attack and curve stroke. It is equal to say that his play is the combination of Asian quick attack and European spin. Especially, many opponents feel inadaptable to the speed of his ball. In the

match of ITTF in 2002, he was the winner of men's singles, besides Boll of Germany and Wang Hao of China, he becomes another new star in the Table Tennis World. Wang Hao's quick progress is also a great harvest for Chinese team in 2002. He, born in 1983, defeated Saive and Samsonov in the final match held in Egypt and became the winner of men's singles. And then he got the same honor in the Open Competition in Netherlands. In the Profession Tour Finals in 2002, he won the third place. At the beginning of this year, Wang Hao won the men's singles in Croatia Open Competition and men's team in the Asian Table Tennis Championships, and he is in the eighth place in world competitions. Even Liu Guoliang, the pioneer of backhand looping in China, showed his admiration for Wang Hao who applies the similar play, thus he said: "His play is more dangerous than mine, since I need block shots for transition, and he attacks directly."

Although these young paddlers share the similar shortcomings, that is, lacks of big competition experiences, immaturity and unsteadibility in performances. However, just as Liu Guoliang said: "Boll, Zhuang Zhiyuan and Wang Hao have been the most offensive paddlers among the male paddlers of the world at present time and they will be more powerful in the future."

We will focus on studying the three paddlers'places in world competitions on the basis of place information published on the first issue of 2000 to the eighth issue of 2003 published by ITTF. According to the different places of paddlers in world competitions, we systematically collected, contrasted, compared and analyzed the various factors that influence paddlers performances and from which we predicted the developmental trend of Table Tennis tactics.

2 Methods

2.1 Participants

Boll, Zhuang Zhiyuan and Wang Hao were the subject of the study.

2.2 Research methods

2.2.1 Symbolic statistics method

By collecting and arranging all the statistics about places of the world paddlers published by ITTF monthly before and after 11 – point scoring system applied, we study the developing trend of ping – pong tactics.

2.2.2 Reference datum method

We referred to the related data in order to make knowledge of and summary about top paddlers'strategic and tactic figures

2.2.3 Introduction and conclusion

Analyzing related information and data and predicating the developing trend of Table Tennis tactics.

3 Results and Discussion

3.1 Paddlers'places in world competitions published monthly by ITTF before 11 – point scoring system

Table 1. Paddlers'places in the world competitions published by ITTF before 11 – point scoring system

	Rank in 2000(1st issue – 12th issue)												Rank in 2001(1st issue – 9th issue)								
Name	1	2.	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9
Boll	39	37	35	34	35	39	39	35	30	32	34	33	33	29	32	27	27	18	18	18	18
Zhuang	44	38	37	39	44	38	36	38	38	37	38	38	38	39	33	34	34	34	21	22	20
Wang																					41

Note: The place in world competitions that published monthly by ITTF is the latest. Only the top 50 paddlers are counted.

Analysis from table one (1) Boll: There was a little change for him during the year 2000. His place rose from the 39th to the 33rd, getting six ranks forward, however, during the nine months of 2001, his place gets fifteen ranks forward, which manifests that along with the improvement of his skill, Boll is doing better and better. (2) Zhuang Zhiyuan: His extent of progress is almost the same with Boll, and yet his play belongs to quick attack which needs a adaptation period in skills, so his extent of progress is relatively slow. (3) Wang Hao: There is only one piece if information about his place in world competitions from the year 2000 to September 2001 because he didn't take part in any kind of international competitions before the time, so his place in world competitions is relatively low.

3.2 Paddlers'places in world competitions published monthly by ITTF after 11 – point scoring system

Analysis from table 2 (1) Boll: His place is rising very quickly after 11 – point scoring system was applied, especially after entering the year 2002, he keeps in a high rank and his extent of progress is also very great. Since the second issue of 2001 was published, he got the fifth place and was keeping before the six place for about 19 months—seven times in the first place; twice in the second place; five times in the third place; one time in the fourth place; three times in the fifth place; one time in the sixth place. All the information indicates that Boll has comprehensive skills without obvious shortcomings, thus he

can keep a fine competitive state for a long time, and now he is in his peak time. Just as the chief coach of national team Cai Zhenhua said that Boll and Zhuang Zhiyuan will be the main opponents of Chinese team in the next three or five years, since they are both familiar with the strategic characteristic of Chinese paddlers and the experience of competing with Chinese paddlers (2) Zhuang Zhiyuan: in terms of the extent of progress, his progress is not as great as Boll, however, in terms of place, he gives people a kind of feeling, that is, he is progressing step by step, steadily and surely. Since the tenth issue of 2001 was published, he kept to or before the seventh place for eleven months—one time in the sixth place; six times in the fifth place; one time in the sixth place; three time in the seventh place. So his marks are relatively high (3) Wang Hao: since there so many excellent paddlers in China, meanwhile, Wang Hao is very young thus the chance for him to take part in international competitions is relatively slim, which in turn results in his lower place in world competitions. But along with the increasing opportunity of participating competitions since the year 2001, he was in the 43rd place and in the next issue he ascended to the 20th place and even to the 10th place in the twelfth issue of 2001. Then from the first to the eighth issue of 2003 he was keeping to places before eight (4) from three paddlers' places in world competitions, we can see that firstly, since the last issue of 2002 they all got to the places before ten and keep the good state ever since; secondly, according to the sixth issue of 2003, all their places went downward, especially Boll and Zhuang Zhiyuan, they both went down for two ranks, just because of their undesirable performances in the 47th World Table Tennis Championships. However, they went back to the first place and the fifth place respectively, according to the lists of place in world competitions in the seventh and eighth issue of 2003 published by ITTF. On the basis of judgment made by experts we could concluded that their rise symbolizes the beginning of the new era of Table Tennis World.

Table 2. Paddlers'places in the world competitions published by ITTF after 11 – point scoring system

	Rank in 2001 (1st – 12th issue)			Rank in 2002 (1st issue – 12th issue)												Rank in 2003 (1st issue – 8th issue)							
Name	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8
Boll	14	15	14	10	5	6	3	3	4	5	5	3	3	2	1	1	1	1	1	1	3	2	1
Zhuang	21	22	22	23	25	13	14	14	17	16	16	10	7	7	5	5	4	5	5	5	7	6	5
Wang	42	43	20	20	20	20	16	18	18	18	12	12	10	8	8	7	7	7	8	8	8		

Note: The places in world competitions are the latest. Only the top 50 paddlers are counted.

3.3 Sharing the similar characteristics in tactics and statistics

By consulting their places in world competitions and analyzing related tactic in-

formation and view tapes, we can say that although the three paddlers use playing styles, they share the similar characteristics in tactics and statistics.

3.3.1 Compared with the old paddlers, the young top paddlers play quicker and more violently

In terms of tactics style, the significant characteristics are reflected in the following aspects: firstly, standing closer to the table and returning fast; secondly, skills of flicks and loops are more skillful, so there is no need of pushing as transition when receiving and serving a ball, that is, by using backhand flicks and forehand sweeping, sidespin becomes topspin directly; thirdly, the long period confrontation which is characterized by the changes between attack and defense has been reflected fully. In matches, powerful back – stretch and back – stroke curve have been widely applied and the idea of winning by power is embodied strongly.

3.3.2 The tactics means and tempo are relatively unitary

Compared with the old 'unreasonable playing style'which also reflects the skill style – powerful playing, intensive rally, but its tactics means and tempo are relatively unitary. After in the state of powerful playing, there is no corresponding skills to defend the space, thus it is hard for paddlers to avoid being passive, whereas, the young top paddlers not only have comprehensive skills but also make prominent the outburst of the forearm and wrist, so they also take the initiative in controlling the situation.

3.3.3 Backhand skills are better

Compared with the previous paddlers, they possess more advantages and are more active: Boll's backhand is half – high curve stroke; Zhuang Zhiyuan's backhand can be regarded as a unique skill and has intensive power; Wang Hao improves the skill of backhand looping to a new stage. The enrichment and improvement of backhand skill provides necessary technical supports for implementing active strategic principles.

3.3.4 Having obvious advantage in the speed of forehand

The young top paddlers, playing styles——Boll' forehand quick-stretch, Zhuang Zhiyuan's back stroke and Wang Hao's fast speed——are all quicker and more powerful. This kind of play reflects the active consciousness in the modern Table Tennis World. Superficially speaking, they quicken the speed of their forehand, and yet the real reason is that they have been able to control spins better or to say, they quicken the speed to a higher stage on the basis of present spins.

4 Conclusions

The developing trend of table tennis tactics: the young top paddlers'skill style stands for the developing trend of table tennis tactics, leading the developmental direction of table tennis tactics. Following this direction, we predicate the development of table tennis technology in the near future and what the young top paddlers will bring to the Table Tennis World.

(1) Table tennis is developing towards the skills of closer to the table; with quick speed and violence just such skills have been the development ever since 1990s. Under the impact of the new paddlers, nevertheless, such skills as standing closer to the table, taking quick speed and fighting more violently will be the important technical features in future ping-pong activities.

(2) Based on spinning, rivalry centering on speed will be the key contradiction in table tennis skills for a long period in the future. In the future competitions with spinning and speed, since speed plays a more important role, it will be more dominant and stand out in all.

(3) The manipulation and counter – manipulation of the first three strokes becomes more violent. With the increase of top young paddlers'capacity in performance with forehand and backhand attacks, contest for serving or returning the ball becomes more intensely.

(4) Short – stretch curve stroke may take the place of long – stretch one as a common skill. In order to meet the need of speed and quick attack and defense, the action of stretch – curve stroke will be improved, making prominent the outburst of the forearm and wrist, and the joint speed between strokes.

(5) The traditional balance skill will have technical differentiation. Impacted by the playing of the best young paddlers, traditional balance skill will be divided into: some players will adopt the skill of first three active strokes and powerful ability of deadlocking in their own tactics, approaching the playing of the best young paddlers; others may, by means of technical defense and tactic forehand breakthrough, counterbalance the best young players, to fight for a place in world table tennis field with their integrative capacity.

22 Differences in tactics in game of top players and others factors of success in top table tennis

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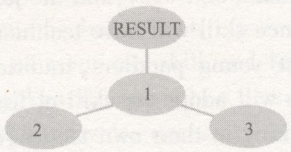
1 Introduction

For top athletes, we can make state that the sentence of Pierre de Coubertin ("it is important to participate") is restated in: "it is important to participate, but it is more important to win". Today, more efficacy and rational (as from aspect of time and energy) training is determinant in achieving of top sport results. Quality of training process also is factor which separate successful and less successfully coaches, it reflect in fact that some players are much more efficient than others. We must use science, to define answer to question: what is the secret of success in sport? With information which we got from science researches, coaches will be able to expand their knowledge, and make training is more qualitative, and athletes will be more successful (of course, if coach have abilities for qualitative programming of training/recovery, as also, to have knowledge of methods and methodology of learning and improvement of elements of game).

Model of successful training process can be shown in figure 1.



Note: (1) Observations and analyses of competitors'activities
(2) Systematic training (basic and specific physical preparation, specific table tennis program based on the individual abilities of player)
(3) Long lasting and rational financial planning of player's development

Figure 1. Model of successful training process

This research is based in the analysis of the game of world's best ranked players, title winners, World champions, European champions and the Olympic game winners.

2 Methods

2.1 The non – experimental systematic observation was used as the dominate research method

Three lists were formed as the instruments from the collecting data:

LIST 1 – For appraisal of frequency, way of realization and efficacy of technical and tactical elements,

LIST 2 – For appraisal of realization of service stroke (and returning of service) and efficacy after service stroke (and after the returning the service),

LIST 3 – For appraisal of movement activities.

2.2 Analyzed activities

Competitors' activities were analyzed in 61 activities (variables), grouping in 3 systems of activities (variables):

(1) System of variables for evaluation of frequency, way of realization and effective of technical and tactical elements (30 variables)

- frequency of technical and tactical elements
- effect of these elements
- stroke placement zone
- stroke realization zone

(2) System of variables for evaluation of realization service stroke (and returning of service) and effective after service stroke (and returning service) (23 variables)

- realization of service stroke (type of service and service placement zone)
- effect of service stroke and activity after the service
- realization (type) of returning service
- effect of returning stroke

(3) System of variables for evaluation of movement activities (8 variables)

- side and deep movements
- change of forehand and backhand position
- Stroke in forehand/backhand position and arm swinging for forehand/backhand strokes

2.3 Participants

On the basis of the analysis of structure of the competition activity (61 activities) of top table tennis players (longitudinal during the period from 1996 – 2004 (all changes of game rules) – 20 world's best ranked players, title winners, World champions, European champions and the Olympic game winners (during the above mentioned period) comparing to less successfully ranked players, as well as by analysis of the game of winners comparing to the defeated

done on the whole sample the elements of the table tennis which influence success in modern table tennis.

2.4 Statistical analyses

For all analyzed activities (variables) following statistical parameters are done:
Descriptive statistics:

- Arithmetic Middle
- Standard Deviation
- Variation (Maximum and Minimum results)
- simple and relative Frequency

Percentage in complete activity and group of activity are done. Discriminative analyses and Multivariate Analysis of Variance (MANOVA) was used (and FOLLOW UP – ANOVA) were used for the defining of existing differences between analyzed groups of (winner/loser – top ranked/lower ranked players).

3 Results

From the results of Multivariate Analysis of Variance for Factors WINNER/LOSER, we can get conclusion that there is a statistical significant difference between the analyzed groups (on p level p = .00 ~ .049). Statistically significant differences are isolated in 14 analyzed activities (variables). Factors contributing the successful result are seen through tactical and technical elements in the following aspects of table tennis.

3.1 Realization of the service

Statistically significant differences are isolated in following activities (variables):

- FLONSE – Forehand long service
- SERLOS – Point lost after service
- SERERR – Service error

Forehand long service – successful players, in their performance, use combination of short and long (nearly exit) service. With this tactics, they are trying to usurp opponents'adaptation to their service. Also, these players have very good continuation of play after nearly exit service – with precise block from backhand or take over with forehand topspin.

Point lost after service – lost points after the service are higher for the defeated players, which points out to inability to achieve the initiative in game, and efficient realization in game.

Service error – defeated players have higher number of service errors during the match. Service error could be caused by low concentration in game (e. g. when the player is in a situation when he cannot realize his game conception,

and is not capable of adaptation to situation and opponent), and since the player is in a results inferior position, trying to change the manner and type of service, not well practiced to be applied in the game.

There is necessary for description and others service activities:

Ace service – points won directly by service are much higher for the winner than for the defeated player. This point to more efficient and qualitative services of the winner during the match, and the low efficiency of returning strokes of the defeated player, and insecure play full of risqué.

Point won with action after service (more than one stroke) – the winning players have higher percent and number of won points in the action after the service which means that they manage to achieve the initiative after the service and to realize it successfully.

3.2 Service return and following game

Statistically significant differences are isolated in following activities (variables):

- FSPINR – Forehand topspin return service
- FBCSPR – Forehand backspin stroke return service
- RSEACE – Returning service ace stroke (as a ace and winning stroke)
- RSEWPO – Point won by the returning service (in action after returning)
- RSERRO – Returning service error

3.2.1 Forehand topspin return service

While the winning players return the serve more skillfully (with pimple strokes), and apply different types of service along with their results superiority (long services), the defeated players base their play on short services.

3.2.2 Forehand backspin stroke return service

Forehand backspin stroke return service is much higher for the winners than for the defeated players. We can conclude that the winning players return service without problems and with firm strokes that secure good placing of the ball and continuation of the point. Especially if we bear in mind that defeated players use short forehand service which is mostly returned by forehand pimple stroke.

3.2.3 Returning service ace stroke (as an ace and winning stroke)

During the game the winning players have more points won by direct returning of the service than the defeated. The winners in matches return services securely, precisely, and efficiently, and the defeated players have less successful services, trying to achieve initiative they make more errors after the opponent has returned their service.

3.2.4 Point won by the returning service (in action after returning)

The winners win more points after the returned service than the defeated players. The winners in matches return services securely, precisely, and efficiently, and have good conception of the game after returning the opponents'service. Also, when they return service, precisely placing the ball and varying the type of stroke they achieve the initiative in the game and win.

3.2.5 Returning service error

The winners make fewer errors when they return service than the defeated. They return the opponent's service successfully.

3.3 The characteristics of offensive and defensive actions (block, pimple, balloon defense)

Statistically significant differences are isolated in following activities (variables):

- FHSPBS – Forehand top spin on backspin
- FHBCSP – Forehand backspin (pimple) stroke
- BHSPBS – Backhand top spin on backspin
- WINSTR – Winning stroke (opponent had contact with ball)
- ERRORS – Error stroke

When we perceived use of all technical and tactical elements, and finish analyzes, we make following conclusions about forehand and backhand game of winner players:

3.3.1 Forehand play

- in play of winners forehand strokes are dominated
- mostly during playing short – short, and return of short service, they use forehand backspin (pimple) stroke
- Offensive strokes are more safety, precise and with change of rotation and intensity. Mostly they achieves their points with precise strokes placed in outside zones, and not with high intensity balls (as a wining strokes) forehand topspin they are playing from zone – near the table
- rarely, they are playing with a lot of risqué in their play, and they are not insist so much to take initiative in game with first (offensive) stroke, especially if ball is placed in their outside backhand.
- rarely, they use forehand block, mostly ball placed in outside or middle forehand zones they take over with forehand topspin
- they use, mostly, placement of strokes through parallels
- generally, forehand strokes of winners, are safe in performance and more effective instead of other players

3.3.2 Backhand play

- in winners concept of play backhand play is inferior instead of forehand play
- backhand topspin is mostly used in offensive stroke, but instead of inferior players, winners perform this stroke near to table, and rarely continues their attack with backhand (attack continue with forehand strokes)
- Mostly used stroke is block. Block is safe, and they are also winning significant number of points, mostly with precise placement
- winners don't play (almost never), short or return short service with backhand backspin stroke
- Generally, all backhand strokes are safety and precise instead of other players.

3.4 Characteristics of moving activities

Winners have higher quantity of movement activities. Specifically, they have better movement forward – backward, which is used for playing short strokes and getting back to basic position for attack. Also, quantity of side movements is higher, which point to better footwork, and adequate position for stroke performance, and ability for playing more forehand in play.

3.5 Model of winners play

Winners play can be defined as safety play without errors, in which player impose his concept of play. Safety of strokes and precise placement contribute to efficacy. Play after service and performance of service (change – short/nearly exit/long service) is more efficacies, and adaptation at opponents'service is better.

4 Discussion and Conclusion

To make some adequate conclusions, we'll see some fact with factors of success through changes of rule in table tennis.

38 mm ball play – Statistically significant differences are isolated in 12 activities (variables). 6 activities associate with service and return of service (ace service and successful realization service, variation of long and short service, return of service without errors, precise return with forehand backspin and direct points with service return), and 6 activities associate with performance of technical and tactical elements (without errors, safety play, forehand play).

40 mm ball play – season 2000/2001 – Instead of previous period, factors of succes stayd in same relation, but number of points won directly with service, directly with return of service and return service erorr, decreased. Number of ace strokes, also decreased.

11 – 2 system of play – season 2001/2002 – Statistically significant differ-

ences are isolated in 5 activities (variables). 4 activities associate with service and return of service (successful realization service, points won after return of service without errors, precise return with forehand backspin and direct points with service return), and 1 activities associate with performance of technical and tactical elements (winning points with "Winning stroke" (opponent had contact with ball – combination of precision and rotation).

New service rule – season 2002/2003 – Factors of succes in play stayed in same relations.

Influence of Factors of succes in modern table tennis we can show in figure 2.

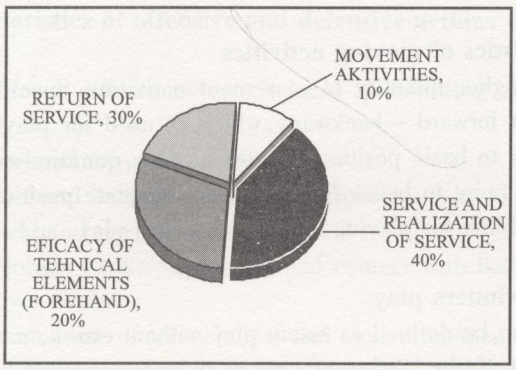


Figure 2. Influence of Factors of succes in modern table tennis

Generally, higher influences in success in table tennis have activities associate with service performance and realization after service. There is good ability for adaptation to opponents service, quality of performed strokes (variation of intensity, rotation and precision during play) and at the end good footwork.

These elements must be fundamental parts of training and objects of development. Also, these elements can be very objective argument for observation of player's development and his efficacy in competition.

23 Backhand game in top table tennis

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1 Introduction

Backhand game has an important part in the modern conception of the game. Backhand strokes make about 45% of all strokes made during one table tennis match (excluding the serve).

In the late nineties till the year 2000 and the change in the ball size, the relation between forehand and backhand strokes decreased considerably comparing to the early nineties, mainly as a result of stronger strokes and faster ball. After the initiation of the bigger ball, it was expected that the relation would be in favor of forehand strokes, but that did not happen. The relation has probably remained the same as a result of better technical training of players and unchanged individual game concepts.

For further improving and development of backhand technical and tactical elements in practice, there are necessary analyses of competitors' activities, and especially of these activities performed in top table tennis. Results of this research give opportunity for quality programming of training process.

2 Methods

Within the range of this research the system of activities for appraisal of backhand activities realization are applied (21).

- System of activities for appraisal of frequency, way of realization and effective of backhand activities

1) BHCONT – Backhand counter stroke (with small rotation, smash, . . .)
2) BHBLOC – Backhand block
3) BHFLIC – Backhand flick stroke
4) BHSPIN – Backhand topspin
5) BHSPBS – Backhand topspin on backspin (first attack)
6) BHBCSP – Backhand backspin stroke
7) BHOTHE – Backhand others strokes (defense strokes far away from table, backspin defense from table)

- Effect of backhand strokes

8) ACESTR – Ace stroke (opponent had been in play out situation)
9) WINSTR – Winning stroke (opponent had contact with ball)

10) NORSTR – Normal stroke (opponent return stroke in game)
11) ERRORS – Error stroke

- Stroke placement zone

12) OUTBPS – Outside backhand zone placement stroke
13) MIDBPS – Middle backhand zone placement stroke
14) MIDFPS – Middle forehand zone placement stroke
15) OUTFPS – Outside forehand zone placement stroke

- Stroke realization zone

16) OUTBHS – Outside backhand zone stroke
17) MIDBHS – Middle backhand zone stroke
18) MIDFHS – Middle forehand zone stroke
19) OUTFHS – Outside forehand zone stroke
20) NEARTS – Stroke made in zone near the table (until 1.5 meter zone)
21) FARFTS – Stroke made in zone far from table (from 1.5 –4 meter zone)

2.1 Participants

Backhand game is examined on the basis of all defined technical elements of the backhand game: counter, block, flick, top spin and pimple through the analysis of the structure of the players'activity at the sample of 200 testees (mostly leading World players – rank in the first 100 at ITTF Rank list) in period from 1996 – 2004.

2.2 Statistical analyses

For all analyzed activities following statistical parameters are done:

Descriptive statistics:

- Arithmetic Middle
- Standard Deviation
- Variation (Maximum and Minimum results)
- Simple and relative Frequency

Percentage in complete activity and group of activity are done. Discriminative analyses and Multivariate Analysis of Variance (MANOVA) was used (and FOLLOW UP – ANOVA) were used for the defining of existing differences between analyzed groups of players (group of players with 38 mm ball – 40 mm ball – system of play until 11 points – new service rule play) and other groups (winner/loser – top ranked/lower ranked players).

3 Results

The most frequently used strokes were analyzed (represent almost 35% of all backhand elements): block and counter, backhand topspin (and backhand topspin on backspin – first attack) – in relation to the manner of performance and their efficiency, as well as their influence on the final result.

Table 1. Frequency of backhand activity

STROKES	TOTAL STROKES	BACKHAND STROKES
Backhand counter stroke	9.85%	23.36%
Backhand block	10.85%	25.72%
Backhand flick stroke	2.15%	5.10%
Backhand topspin	5.95%	14.12%
Backhand topspin ("first attack")	6.59%	15.62%
Backhand backspin stroke	6.32%	14.98%
Backhand others strokes	0.47%	1.10%

Table 2. The efficacy of Backhand strokes can be seen from these data

Efficacy of strokes	%	
Ace stroke	6.21	BHSPBS, BHBLOC, BHCONT, BHSPIN
Winning stroke	21.26	BHSPBS, BHBLOC, BHCONT, BHSPIN
Normal stroke	43.75	BHCONT, BHBLOC, BHBCSP, BHSPBS, BHSPIN, BHFLIC
Error stroke	28.48	BHBLOC, BHCONT, BHSPIN, BHSPBS, BHBCSP

Stroke realization zone			Stroke placement zone		
OUTBHS	–	65.04%	OUTFPS	–	39.13%
MIDBHS	–	27.62%	MIDFPS	–	11.39%
MIDFHS	–	6.20%	MIDBPS	–	6.20%
OUTFHS	–	0.89%	OUTBPS	–	16.94%
NEARTS	–	88.63%			
FARFTS	–	11.37%			

3.1 The use of backhand strokes as the Factor of successful result

Analyzing structure of competitors'activities, statistically differences are found in use of Backhand topspin on backspin – "first attack" between winner/loser players. Loser players use more "first attack" backhand stroke in their play (to increase aggressive play and to take initiative in play) to compensate their inferiority in result. Also, winners have better and more precise placement of their strokes in outside backhand zone. Use of backhand topspin – first attack, also is a result of inferiority footwork. Also, this element is shown as an important Factor of quality of player – as a characteristic of low quality players.

3.2 The concepts of most used backhand strokes

BACKHAND BLOCK – is mostly used backhand stroke. In one set approximately 5.5 block strokes are performed (in game till 11 points). This is a passive stroke, but with precise placement player gets advantage in initiative and also, good chance for direct point.

3.2.1 Analyses in compliance with the changes of the game:

38mm ball play – stroke is usually performed from outside backhand zone (about 80%). Placements of strokes are usually in outside backhand (twice more than outside forehand). Efficacy of strokes is based on winning stroke (about 14%), rarely as ace stroke (about 2.5%), but with high percentage of error (about 36%).

40mm ball play – season 2000/2001 – stroke is performed nearly the same way as in period before, there is increasing of use of the middle backhand (as a result of less precision in play, and higher use of backhand play). Placements of performed strokes are mostly in outside backhand zone, but placement from outside forehand zone increased (for almost 8%). Efficacy of strokes decreased.

11 – 2 system of play – season 2001/2002 – stroke is performed mostly the same, with tendencies of increasing performing strokes from middle backhand zone. Placement of performed strokes is precise to the outside zones (with domination of outside backhand). Efficacy of strokes, in stead of previously period, increased, especially as an ace stroke, but in the other way error stroke increase till high 41%.

BACKHAND COUNTER STROKE – In one set approximately 4.95 counter strokes are performed (in game till 11 points). Mostly, passive stroke, used to stay in game, safer than offensive stroke, but inaf, for pushing opponents to make mistake or to leave initiative in game.

3.2.2 Analyses in compliance with the changes of the game

38mm ball play – stroke is usually performed from outside backhand zone (about 83%). Placements of strokes are usually in outside backhand – about 47% (twice more than outside forehand). Efficacy of strokes is based on winning stroke (about 15%), rarely as ace stroke (about 3.6%). Percentage of error is about 27%.

40mm ball play – season 2000/2001 – stroke is performed nearly the same way as in period before, there is increasing of use of the middle backhand. Placement of performed strokes is mostly in outside backhand zone, but placement from middle backhand zone increased (about 5%). Efficacy of strokes decreased.

11 – 2 system of play – season 2001/2002 – stroke is performed mostly the

same, with tendencies of increasing performing strokes from middle backhand zone (about 2% in stead of previous period). Placement of performed strokes is precise to the outside zone (with domination of outside backhand), and increasing of placement in middle backhand zone. Efficacy of strokes, in stead of previously period, decreased, but safety of stroke increased – error stroke decrease till about 20%.

BACKHAND TOPSPIN – "FIRST ATTACK" – In one set approximately 3.33 topspin strokes are performed (in game till 11 points). Most effective stroke – "winning stroke", but with high percentage of error.

3.2.3 Analyses in compliance with the changes of the game:

38 mm ball play – stroke is usually performed from outside backhand zone (about 85%). Placements of strokes are usually in outside backhand – about 44% (than in outside forehand). Efficacy of strokes is based on winning stroke (about 23%), rarely as ace stroke (about 5.94%). Percentage of error is about 20%.

40 mm ball play – season 2000/2001 – stroke is performed mostly from outside backhand, but there is increasing of use of the middle backhand (till 45%). Placement of performed strokes is mostly in outside backhand zone, but placement from middle backhand zone increased (about 5%). Efficacy of strokes increased, and as an ace stroke and as a winning stroke (about 3%). Error stroke decreased till 16.6%.

11 – 2 system of play – season 2001/2002 – stroke is performed mostly the same, with tendencies of little increasing performing strokes from middle backhand zone (about 2% in stead of previous period). Placement of performed strokes is precise to the outside backhand zone. Efficacy of strokes, in stead of previously period, decreased, also, as a safety of stroke – error stroke increase till about 22%.

BACKHAND TOPSPIN – In one set approximately 3.33 topspin strokes are performed (in game till 11 points). Low effective stroke with higher percentage of error in stead all analyzed strokes. About 30% of all topspin strokes are performed in zone "far from table", in situation when player is already lost his initiative in play.

3.2.4 Analyses in compliance with the changes of the game

38 mm ball play – stroke is usually performed from outside backhand zone (about 85%). Placements of strokes are usually in outside backhand – about 41% (twice more than in outside forehand). Mostly performed from zone near the table. Efficacy of strokes is based on winning stroke (about 23%), rarely as ace stroke (only 2.89%). Percentage of error is about 21%.

40 mm ball play – season 2000/2001 – stroke is performed mostly from

outside backhand, but there is increasing of use of the middle backhand (about 10%). Perform of stroke from zone far from table increased for about 12% (till 30% of all performed strokes). Placement of performed strokes stayed mostly in same proportion as in previous period. Efficacy of ace strokes increased (5.68%), but decrease as a winning stroke (about 7%). Error stroke increased till 36.6%.

11 – 2 system of play – season 2001/2002 – stroke is performed mostly the same, with tendencies of little increasing performing strokes from middle backhand zone (about 12% in stead of previous period). Placement of performed strokes is more precise to the outside backhand zone. Efficacy of strokes, in stead of previously period, decreased (ace stroke), and increase (winning stroke). Safety of stroke increase – error stroke is about 31%.

3.3 The analysis of backhand game in World team championship (final match) (Doha – Qatar) and the semifinal and final matches at The Olympic Games in Athens (Greece)

By analyze of backhand strokes performance in final match at Team WC between China and Germany (3:0) and semifinal and final matches at Olympic Games in Athens (Rye Seung Min (KOR) vs. Waldner J. O. (SWE), Rye Seung Min (KOR) vs. WANG Hao (CHN) following conclusions are done.

(1) in game, backhand strokes are underestimate in stead of forehand elements;

(2) points won with performance of backhand strokes mostly are a winning stroke, with very small percentage of ace stroke (in all analyzed matches, nearly 2%). More points were won with parallel placement strokes (especially with block), in stead of cross playing;

(3) winners in these matches had a higher efficacy of backhand strokes (in way of safety of performance).

3.4 The comparative analysis of the backhand game of the European and Asian players was done (as well as the analysis of the way players hold the rackets: penholder and shakehands)

Basic characteristics of Asian players (and shakehands and penholder) are precision and safety in performance (mostly in outside zones – backhand and forehand). As a consequence of excellent footwork and concept of forehand play, they perform their backhand strokes mostly from outside backhand zone. Points are won as winning stroke", mostly as a first attack (with high rotation).

European players use more variety of placement zones, and use much more backhand strokes in their play. They use and much more perform of backhand strokes from middle backhand zone (some players (with good backhand

strokes) and from middle forehand zone). Mostly are getting points with winning stroke, but in stead of Asian players much more and as ace stroke. In stead Asians they have higher percentage of error stroke.

4 Discussion and Conclusion

Generally, backhand play in modern table tennis have same importance as a forehand play, because it is in nearly equal use. In system of play till 21 points with 38 mm ball that relation (forehand/backhand) was 57: 43, in next period – play till 21 with 40 mm, that relation has been changed to 54: 46. After change to system of play till 11 points, relation is 60: 40, and forehand play dominates.

Backhand play represents mostly passive play, but with safety player stay in game and with precision in placement of strokes he can take initiative in play or eventually achieve direct point.

In modern game which insist from every competitor maximum of his physical abilities, successfully learned technique of backhand strokes give him quality in play, and from aspect of variety of strokes and tactic combination, and from aspect of rationally use of physical energy of player.

24 The use of forehand top spin in modern table tennis

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1 Introduction

Forehand topspin represents most widely used offensive stroke in modern table tennis. This strike makes about 34% of all strokes and about 60% of all forehand strokes.

Forehand topspin is an offensive stroke in which mostly power which is used for stroke is transformed into ball rotation (forward); racket hit a ball tangentionaly over the middle of a ball including the direction of ball movement. Topspin is used in offensive play as a basic stroke, stroke in offensive action and as an ace stroke. There are some varieties of this stroke as:

1) Topspin (basic spin)
2) Side spin
3) Fast Topspin (Hit topspin)
4) Spin from the table
5) Contra spin
6) Fake spin

Forehand topspin stroke on backspin as so called "first attack" and basic topspin were analyzed.

2 Methods

Within the range of this research the system of activities for appraisal of forehand topspin realization are applied (16):

- System of activities for appraisal of frequency, way of realization and effective of backhand activities

1) FHSPIN – Forehand topspin
2) FHSPBS – Forehand topspin on backspin – "first attack"

- Effect of forehand activities

3) ACESTR – Ace stroke (opponent had been in play out situation)
4) WINSTR – Winning stroke (opponent had contact with ball)
5) NORSTR – Normal stroke (opponent return stroke in game)
6) ERRORS – Error stroke

- Stroke placement zone

7) OUTBPS – Outside backhand zone placement stroke
8) MIDBPS – Middle backhand zone placement stroke

9) MIDFPS – Middle forehand zone placement stroke
10) OUTFPS – Outside forehand zone placement stroke
- Stroke realization zone

11) OUTBHS – Outside backhand zone stroke
12) MIDBHS – Middle backhand zone stroke
13) MIDFHS – Middle forehand zone stroke
14) OUTFHS – Outside forehand zone stroke
15) NEARTS – Stroke made in zone near the table (until 1.5 meter zone)
16) FARFTS – Stroke made in zone far from table (from 1.5 ~4 meter zone)

2.1 Participants

The frequency and characteristics of forehand topspin in modern table tennis were based on the analysis of structure of competition activity of table tennis player on the sample of 200 testees (mostly leading World players – rank in the first 100 at ITTF Rank list) during the period from 1996 – 2004.

2.2 Statistical analyses

For all analyzed activities following statistical parameters are done:

Descriptive statistics:

- Arithmetic Middle
- Standard Deviation
- Variation (Maximum and Minimum results)
- Simple and relative Frequency

Percentages in complete activity are done. Discriminative analyses and Multivariate Analysis of Variance (MANOVA) was used (and FOLLOW UP – ANOVA) were used for the defining of existing differences between analyzed groups of players (group of players with 38 mm ball – 40 mm ball – system of play until 11 points – new service rule play) and other groups (winner/loser – top ranked/lower ranked players).

3 Results

3.1 The basic characteristics relating to efficiency and quality of the strokes (proportion of the initial zones of stroke, zone of placing the stroke, efficiency of a stroke performance)

Table 1. The frequency of the forehand topspin strokes

STROKES	TOTAL STROKES	FOREHAND STROKES
Forehand topspin	20.04%	34.65%
Forehand topspin on Backspin – "first attack"	13.29%	22.99%

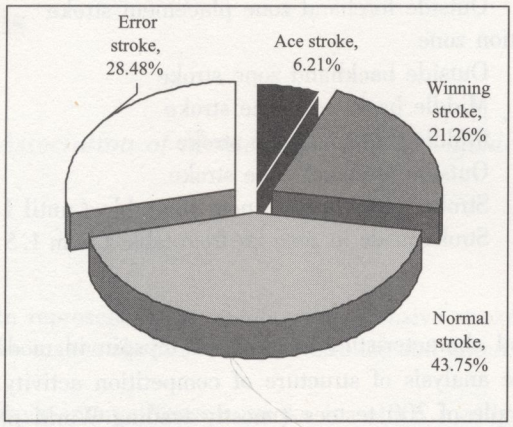

Figure 1. The efficacy of Forehand topspin

The efficacy of Forehand topspin can be seen from figure 1.

In one set approximately 10. 12 Forehand topspin strokes are performed (the game to 11 points won).

Stroke realization zone			Stroke placement zone		
OUTBHS	–	22.90%	OUTFPS	–	25.18%
MIDBHS	–	17.70%	MIDFPS	–	7.13%
MIDFHS	–	13.60%	MIDBPS	–	8.63%
OUTFHS	–	46.44%	OUTBPS	–	31.72%
NEARTS	–	44.12%			
FARFTS	–	35.88%			

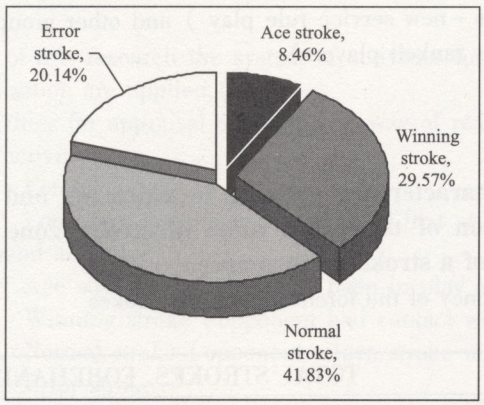

Figure 2. The efficacy of Forehand topspin on backspin – "first attack"

The efficacy of Forehand topspin on backspin – "first attack" can be seen

from Figure 2 .

In one set approximately 6. 71 Forehand top spin on backspin – "first attack" are performed (the game to 11 points won) .

Stroke realization zone			Stroke placement zone		
OUTBHS	–	24. 80%	OUTFPS	–	23. 64%
MIDBHS	–	21. 10%	MIDFPS	–	5. 35%
MIDFHS	–	21. 40%	MIDBPS	–	13. 72%
OUTFHS	–	32. 88%	OUTBPS	–	37. 74%

Generally speaking, these two strokes represent most efficacy strokes in table tennis. As Ace stroke with these strokes in modern table tennis game about 55. 83% of total points are achieved (in stead of all technical elements) . As a winning stroke – stroke in which dominate precision and changing of rotation – with forehand topspin play 43. 29% of points are achieved.

3. 2 The use of forehand topspin stroke as the factor of successful result

By analyses of structure of competitors'activities, statistically differences are found in use of Forehand topspin on backspin – "first attack" between winner/loser players. Loser players use more "first attack" forehand stroke in their play (to increase aggressive play and to take initiative in play) to compensate their inferiority in result.

In play of winners, dominate forehand play and use of forehand topspin strokes.

Winners realize their forehand strokes mostly as a winning stroke (combination of precision and combination of rotation) . Tactically, they made their strokes parallel in stead of place of realization.

3. 3 The concept of performing the forehand spin in compliance with the changes in game rules

Basic characteristics of forehand spin performance and change in conception and efficiency of performance as a result of changed game rules

3. 3. 1 Forehand topspin

38mm ball play – stroke is usually performed from outside forehand and outside backhand zone, not so often from middle zone of table. Placement of strokes is usual in these two zones, little bit more in outside forehand. Parallel strokes are dominated. Efficacy of strokes is based on winning stroke (about 20%) , less as ace stroke (about 5%) , but with high percentage of error (about 30%) .

40mm ball play – season 2000/2001 – stroke is performed nearly the same way as in period before, but we notice increasing of use of the middle backhand zone (as a result of less rotation and slower speed of ball) . Maybe, from the same reasons, placement of performed strokes in outside backhand

zone (about 5%) are much more in stead of previously period of play. Efficacy of strokes increased, and as a winning stroke and as an ace stroke (probably as a consequence of adaptation to new ball). Safety of stroke performance also increased. Error decreased for about 3%.

11 – 2 system of play – season 2001/2002 – stroke is performed mostly from outside forehand and outside backhand zone, but is noticed increasing of use of the middle zone (backhand and forehand). Placement of performed strokes is more precise to the outside zones (forehand and backhand in nearly equal relation). Efficacy of strokes, in stead of previously period, decreased, (as a consequence of better adaptation to new ball, and because of importance of every point in game). Safety of stroke performance also increased (about 8%). Error decreased for about 1%.

3.3.2 Forehand topspin – "First attack"

38 mm ball play – stroke is usually performed from outside forehand and outside backhand zone, and in the same percentage from middle zone of table. Placements of strokes are usually in outside forehand (twice more than outside backhand) and outside backhand. Efficacy of strokes is based on winning stroke (about 28%), less as ace stroke (about 5%, but with relatively high percentage). With less percentage of error (about 21%) in stead of forehand topspin.

40mm ball play – season 2000/2001 – stroke is performed nearly the same way as in period before, but we notice increasing of use of the middle backhand and forehand zone (as a result of less precision in play). Placement of performed strokes in outside backhand zone is increased (almost 4. Efficacy of strokes stayed in same proportion, but safety of stroke performance decreased. Error decreased for about 5%.

11 – 2 system of play – season 2001/2002 – stroke is performed mostly from all zones, even much more from middle zones (backhand and forehand). Placement of performed strokes is precise to the outside zones (forehand and backhand but much more in backhand). Efficacy of strokes, in stead of previously period, stayed in nearly equal proportion.

3.4 Specific features of forehand spin stroke at the World team championship (Doha – Qatar) and the final matches at The Olympic Games in Athens (Greece).

Analyzing performance of forehand topspin strokes (with same methodology) in final match at Team WC between China and Germany (3:0) and semifinal and final matches at Olympic Games in Athens (Rye Seung Min (KOR) vs. Waldner J. O. (SWE), Rye Seung Min (KOR) vs. WANG Hao (CHN) following conclusions are done :

- forehand topspin strokes dominate in stead of other technical elements in game;
- points won with performance of forehand topspin strokes mostly are a winning stroke, less as ace stroke. More points were won with parallel placement strokes, in stead of cross playing;
- winners in these matches had a higher efficacy of forehand topspin strokes;
- in analyzed matches (final and semifinal) percentages of errors in forehand stroke performance were higher than usually (probably as a consequence of importance).

3.5 Differences and specific features of forehand spin stroke of European players compared to the forehand spin stroke of Asian players.

As a basic characteristics of Asian players is precision in performance (mostly in outside zones – backhand and forehand), and winning of points and as ace stroke and "winning stroke". Also, higher performance of safety play in these two elements (with less error stroke) is characteristic of Asian players in stead of Europeans.

European players use more variety of placement zones, and use much more placement of strokes in middle zones. Mostly are getting points with winning stroke. Much more use parallel playing in stead of cross (diagonal playing) than Asian players. In stead Asians they have higher percentage of error stroke.

4 Discussion and Conclusions

There is a great importance of forehand topspin game in modern table tennis. With service together forehand topspin plays (safety and efficacy of these elements) is one of the most influence factors of success in table tennis. Considering this conclusion, there is a necessary to give an attention to these elements at practice and always work in improvement of these.

Changing rules in table tennis had an influence in use of forehand topspin strokes. Today, forehand topspin play is based on safety, precision in placement and variation in stroke intensity and rotation during play.

25 The application of non linear edition system in table tennis match analysis

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1 Introduction

Because of the complexity and opponents'flexible application of ball games, a nonlinear relationship exists between the performance of the competition and athletes'qualities (Hohman, Lames, & Letzelter, 2002). Therefore, it is difficult to predict the athletes'performance in accordance with their qualities. Ball game is one of the events in which tactics are most required (Tian, 1988). The application of tactics, to a large extent, will determine the result of the matches.

Traditional methods of analyzing a table tennis match were based on statistics. Three – phase method has been used to diagnose the Chinese athletes' competitive form and to analyze their technology and tactics (Wu, Zhang, etc., 1996). A more detailed 10 – item analytical method was proposed to analyze table tennis matches by Li & Su (1998). Using performance diagnoses through mathematical model, Zhang & Hohman (2004) analyzed the characteristics of technologies and tactics of world's elite table tennis players.

Analyzing table tennis matches with nonlinear edition system have some advantages, e. g., (1) it provides with players more systematic and detailed information than characters; (2) it is more convenient to manage. The research explored how to use nonlinear edition system to make multi – media material for analyzing high – skill table tennis matches. The application of the system in the preparation phase of significant competitions was discussed.

2 Methods

Firstly, the video tapes of 9 matches, 45 games totally, were randomly selected, including 3 attack vs attack women's singles matches (14 games), 3 attack vs defense women's single matches (14 games) and 3 women's doubles matches (17 games). Then, they were processed, using computers, to multi – media video format. Finally, all the matches were tested by using nonlinear edition software (Windows Movie Maker 2.0, Ulead VideoStudio 7.0). All the work were completed by using the standard computers (Intel (R); Pentium (R) 4;

CPU2.40 GHz;Memory 512 MB;Hard disk 80 GB).

3 Results

3.1 Video format of analyzing technology and tactics

The definition of variant formats of video files and file size were tested, using Window Movie Maker 2.0 and Ulead VideoStudio 7.0. The result indicated that WMV (LAN Video 768 Kbps) is suitable for conducting the technological and tactical analysis in table tennis. Providing needed clarity, its file size is much smaller than that of others (table 1). The average file size of WMV (768 Kbps) format for a women's game was 34,323KB (maximum 52,311KB, minimum 18,395KB).

Table 1. File size of four common video formats for a table tennis game (KB)

Video format	M	Max.	Min.	n
WMV(768 Kbps)	34,323	52,311	18,395	45
WMV(2.1 Mbps)	91,843	139,900	49,202	45
MPEG 2	232,921	361,875	129,231	45
AVI	1,280,390	1,950,728	685,713	45

3.2 Rendering Time of Video File

The rendering time of video file is one of the main factors which affect the editing efficiency. In addition to the configure of a computer and the editing software, the video format is another critical element for the rendering time. In a standard computer the rendering time of a file of WMV (LAN Video 768 Kbps) format was 288 seconds averagely, much smaller than that of other formats. Averagely, it was 306 seconds for an attack vs attack women's singles game, 262 seconds for a women's double game, and 304 seconds for an offensive vs defensive women's singles game. (Table 2)

Table 2. Rendering time of 3 video formats (seconds)

Video format	M	Max.	Min.	n
WMV(768 Kbps)	288	456	155	45
WMV(2.1 Mbps)	519	806	274	45
AVI	500	771	264	45

3.3 Speed of video broadcast

The practice indicated that the speed of video broadcasts is suitable by 50% – 75% of original material for match analyses, among them 50% – 60% of the

speed is proper for women's singles and doubles, and 75% of the speed for matches between offensive and defensive player.

3.4 Structure of Analysis

The video analysis of table tennis matches may be divided into two kinds: multi – media and task – specific video analysis. The former is usually used in preparation training before important competitions, and the latter applies to study the opponent's techniques and tactics during competitions.

The figure 1 is the structure of multi – media analyses of Chinese women national table tennis team during preparation training for 2004 Olympics. It was divided into three parts. The first was title, match video and the description of main characteristics of the opponent, the aim of which were to offer a holistic effect to coaches and players. The second part was the critical content which divided the match into three parts, i. e. attack after service, reception, and rally to analyze. The third was the summary and the suggestions for the players.

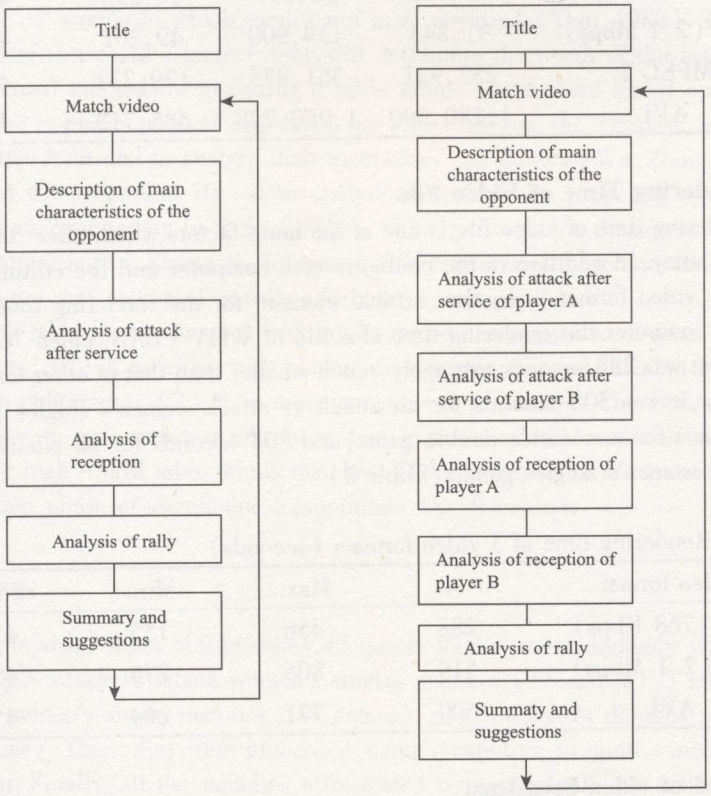

Figure 1. Structure of multi – media analyses

The structure of the doubles match analysis is similar to the above with the exception that the second part was divided into five subparts, i. e. attack after service of player A, attack after service of player B, reception of player A, reception of player B, and rally.

When a match between offensive and defensive players was analyzed, the second part of multi – media analysis was different, to a large extent, from the former two parts. Its main contents included offensive player's attack after service, topspin and smash, topspin, lift and smash, and defensive player's attack and lift.

In accordance with the feature of the preparation during the important competitions, Task – specific video analysis included the opponent's service, reception, and attack after service, scoring and losing feature after service, scoring and losing feature after reception, and critical points, etc. The aim of this arrangement was to provide easy way for the coaches and players to realize opponents'main features in technologies and tactics.

3.5 Application in Training

During the preparation training for 2004 Olympics of Chinese women national table tennis team, 9 seminars of multi – media analyses were conducted. The researchers firstly make the material in accordance with the opponent's playing ways. Before the seminar, the researcher and the coaches sat together to discuss the video displays and data. Finally, the coaches provided the summary and suggestions, guaranteeing the pertinence, practicality, and scientificity.

In addition, in accordance with the coaches'suggestions, the researchers had edited 10 matches to task – specific video data for coaches and players.

4 Conclusions

Nonlinear video edition software can be easily applied in analyzing players'technologies and tactics in table tennis matches on PC. The format of WMV (LAN Video 768 Kbps) is most suitable. And the speed of video broadcasts is practical by 50% ~75% of original material.

26 The design and implement of a software system for analyzing technical – tactics of table tennis match

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1 Introduction

Currently there are few computerized decision support system that allow head coaches to gather match information in real time about players'technical – tactical actions (technical – tactical gestures and technical – tactical conducts). During training and competition, head coaches must take technical and tactical decisions based on his intuition and experience without the support of technical – tactical data. For this reason, it is important to develop computerized decision support system for the analysis and evaluation of quantitative and qualitative elements both in and after the training and competition. In the last decade, some computer programs which have tried to analyze players'actions in collective sports have been marketed, for example Data Training Basketball and Data Volleyball. The first programs provide support for the head coach's work by managing the databases of exercises and making a theoretical analysis of the training programmed by the head coach. The second software system is useful for making statistical studies of the actions performed during match play, but focusing on the indicators that can be easily quantifiable (points, blocks, attack, etc.). However, there are few computerized decision support system that are famous in quantitative process (collecting and analyzing technical – tactical scenario data in more detail), especially for table tennis match.

The Chinese national team has built a database system for analyzing the main opponents in the Olympic Game by storing variety of opponent's information. Nearly 50,000 pieces of records has been entered into database and provided as much supports as possible for the head coaches, players, and researchers. A huge success has been achieved by using that database information system. Chinese players swept up the gold medals in the 27th Olympic Games in Sydney, Australia, after doing the same in Atlanta in 1996. However, this information system only demonstrates ability on information supporting, not on technical and tactical analyzing.

Looking for a method to analyze technique and tactic of table tennis, A. Baca and R. Baron propose a valuable model that orients structure and process of the match. Taking advantage of this model, a temporal evolution of the match may be described. This approach has been successfully applied to table tennis (e. g. Boguschewski et al. ,1994, Tischtennis Lehre, 8 (1), 5 – 8). It has therefore been selected to analyse and improve the behaviour of players of the Austrian national and youth national team.

The paper is structured as follows: After a short introduction about the ideal and rule of system design in Sections 2, the function and the methodology are demonstrated in Section 3, where different approach for technical – tactics analyzing are discussed. In Section 4, a match analysis example is outlined to support above study. Section 5 summarizes and concludes this paper.

2 Technical Tactics Collecting

Two aspects that influence system performance are technical – tactics collective and analysis. In next two parts, a script descriptive language called Table Tennis Descriptive Language (TTDL in short) and technology for analyzing match is demonstrated respectively. The first is for data collecting and the latter is for analysis.

2.1 TTDL syntax and Application

TTDL have tow types of sublanguages, the Action Based Notation (ABN in short) and the Technical – Tactics Based Notation (TTBN in short). Each sublanguage represents a precise syntax with a composition of the 4 phase code. In the following part TTDL syntax and some application will be introduced.

2.1.1 Action Based Notation

Some of characters of code have to follow the program terminology; others may be customized according to the coach or scout – man needs.

Therefore, a code may assume the format in figure 1 and figure 2:

Mode of Skill

Model of Skill represents the way a sport man performs skill. For example, if a right hand person attacks a ball in right side then the mode of skill is Rright.

Skill

The second part of the code is reserved to the definition of the skill. As you may see, it has been used a table tennis jargon. Following enlisted are the table tennis skills allowed by Five Stars and their respective code:

SZ

Starting zone is considered generally the zone of the court where a shot has

been performed, thus identified by a number. Five – Star subdivides the table as 9 zones. 6 zone in table and 3 out as figure 2 – 1 shows.

RZ

The receiving area of the shot is mostly used in the scouting of the attack trajectories and those of the services. It requires great scouting rapidity and, therefore, is not advisable in the learning phase of the program. This aspect of the scouting process can be simple or complex, depending on the capacity of input and above all the trainer's technical requirements.

In according with above syntax Five – Stars

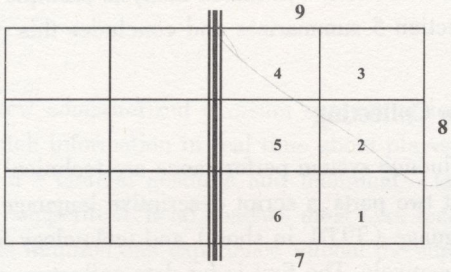

Figure 1. Zone arranged in table

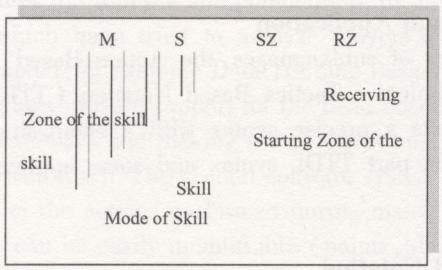

Figure 2. Syntax structure

2.2 Technical – Tactics Based Notation

Liking ABN, the TTBN describes technical – tactics characteristic still with 4 phase code. Some of them follow table tennis terminology, and some may be customized in according with the coach or scout – man needs.

Therefore, a code may assume the format in figure 3.

There are three different kinds of application model, serve – attack, receive – attack and attack – attack. For example, a typical application model of serve – attack is demonstrated as figure 2.4.

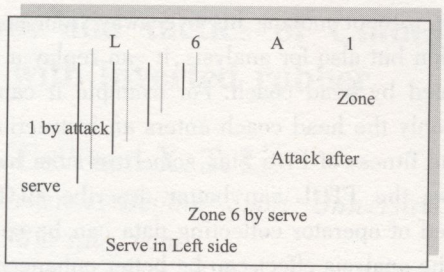

Figure 3. The format of the code

3 Technical – Tactics Analysis

In addition to traditional statistical method such as total, sum, average and max etc, further analysis allows user to know where the skills have been performed and where they have been received or ended. Obviously, to obtain these charts, you have to scout starting and receiving zones also. In order to analyze the performance, two kind of chart are employed, one called point chart and another named line chart.

4 Conclusions

Based on above ideas, a software system called Five Stars for analyzing technical – tactical data of table – tennis competition is designed. The characteristics of this software system are as follows.

Head coaches can use Five Stars to achieve and analyze information both in and after the training and the competitions

To quickly and massively collect technical – tactical data of the match, a coding system called Table Tennis Script Description Language (TTDL in sort) was designed. By using the SDL, the service, receive, and final action of a rally of the match can be described and collected. Not only the action but also the corresponding line of ball flying and the point of ball dropping can be expressed. Base on the collected data, the performance of a player or a pair of players can be analyzed in more details.

Many advanced technical measures of data analysis have been used. In addition to traditional statistical method (total, sum, average and max etc), a new data analysis technology called Data Mining have been used. By comparing the relative actions in each rally, some new technical – tactical patterns can be figured out so that the head coach can make accurate inter – active decision in real time.

Advanced video technique has been used to collect and analyze technical – tactical data. By embedding a video player the operator of Five Stars can quick-

ly input active script without moving his eye away from computer screen. Not only for data collection but also for analysis, it can replay a specific scenario of match that is indicated by head coach. For example it can replay all service actions in a rally if only the head coach enters an instruction.

In order to test the fitness of Five Star, some test suits have been executed. The test result shows the TTDL can better describe all technical – tactical actions, and the speed of operator collecting data can be specialized by two or three practice, and the analysis effect can be better enhanced by visual descriptions (picture and video).

27 Techniques and tactics of Chinese penhold – grip players with inverted rubber

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1 Introduction

As a Chinese traditional playing style, the penhold – grip – attack playing style had given an active impulse on the table tennis development in the world. However, because of lack of innovation and other weakness exposed obviously, the penhold – grip – attack playing style had got into trouble since early 1990s. But, with the growth of Ma Lin and Wang Hao who were penhold – grip players with inverted rubber, the penhold – grip – attack playing style seemed to have a bright future.

There have been many native specialists and scholars who had made some researches and comments on this playing style.

With respect to the development of the penhold – grip players with inverted rubber, Cai Zhen – hua(1999) considered the Chinese model of penhold – grip players with inverted rubber should be dexterous and various. And it requires fast playing, more changes and good placements.

As to the training of this style, Wu Jing – ping(2000) thought that the technical feature of penhold – grip with inverted rubber should be based on the first three balls and mainly depended on forehand attacking, paid attention to attack the topspin and gradually increase the proportion of backhand drive with reversed side in the phase of attack after service.

Many articles mentioned that lack of attack in their backhand has been the obvious weakness for the penhold – grip players. Zhang Xiaopeng (2002) looked back the developing process of the technique of penhold – grip's backhand drive with reversed side and concluded this technique has achieved the initial theoretical assumption.

It could be found from the above references that although many researchers had discussed the penhold – grip playing style, most of their studies only used the qualitative analysis and lacked the applications of quantitative analysis to interpret this playing style. This research used the three – phase method to analyze Ma Lin and Wang Hao's techniques and tactics. The data in each phase with corresponding evaluations were compared, and the advantages and disad-

vantages of Ma Lin and Wang Hao's techniques and tactics were summed up. The purpose of this study was to offer some new references for the coaches and players of penhold – grip with inverted rubber.

2 Methods

More than 15 matches of Ma Lin and Wang Hao were observed through videos. All these matches were selected from important international competitions, such as men World Cup, Pro Tour Final etc., after the new rules had been adopted.

A Three – phase method was used to analyze their techniques and tactics. By calculating the scoring rate and using rate of attack after service, reception and rally, it analyzes a players'technical and tactics characters. The formulas are the following:

$$\text{Scoring rate of a phase} = [\text{scoring points} / (\text{scoring points} + \text{losing points})] \times 100\%$$

$$\text{Using rate of a phase} = [(\text{scoring points} + \text{phase losing points}) / (\text{total scoring points} + \text{total losing points})] \times 100\%$$

Evaluation of the scoring rate and using rate in each phase was conducted for every player. Table 1 was the criteria of the evaluation.

Table 1. Evaluation criteria for three – phase method in singles (%)

	AAS		reception		rally	
	SR	UR	SR	UR	SR	UR
excellent	70		50		55	
good	65	25 – 30	40	15 – 25	50	45 – 55
pass	60		30		45	

(see Wu and Zhang (1996): Design and effect of quantitative methods in table tennis researches.)

Note: AAS: attack after service; SR: scoring rate; UR: using rate

3 Results and Discussion

3.1 Ma Lin's techniques and tactics

3.1.1 Overall analysis of Ma Lin

It was obvious that Ma Lin's AAS was where his superiority was. In this phase his scoring rate was excellent and using rate was high. It was observed that Ma Lin's AAS was very powerful and full of menace to his opponents. His forehand topspin was accurate, powerful, fast, and various in directions. However, Ma Lin was too cautious in some critical situations, which resulted in his attack quality

decreased. It was the main reason of his losing in some matches.

Ma Lin's scoring rate and using rate in reception were excellent and high respectively. It indicated that his application of techniques in this phase was effective. It was found from the video that short push and pivot push were his main methods in receiving a service. His ability of controlling and transiting from 2nd to 4th ball was very strong, which resulted in his pressure reduced. However, Ma Lin's scoring rate was not very consistent. And, his attacking was not enough in receiving short services, the result of which was that it was easy for his opponents to attack initially.

Rally was Ma Lin's weakness and his scoring rate in this phase was fail. His performance in the aspects of transition between 2nd and 4th ball, conjunction between 3rd and 5th ball and between 4th and 6th ball was determination of his scoring rate in rally. High – quality of returning a ball and a big range of movement could help him grip the initial of a rally. However, Ma Lin's using rate in rally was low, which revealed that his performance in first four balls was his most important way to win a game.

Table 2. Ma Lin's overall performance in three phases (%)

	AAS		reception		rally	
	SR	UR	SR	UR	SR	UR
Ma Lin	74	32	52	36	43	32
Evaluation	excellent	high	excellent	high	fail	low

3.1.2 Analysis of Ma Lin in winning and losing games

Ma Lin's scoring rates of phase of AAS in winning games and losing games were 79% and 64% respectively. It was noticed that his scoring rate was still rather high in losing games, which indicated that AAS was his main scoring measure. However, Ma Lin's scoring rate of reception and rally in winning games was much higher than in losing games. It suggested that his performance in reception, transition from 2nd to 4th ball, and the conjunction between 3rd and 5th, and the conjunction between 4th and 6th played a determining role to his matches. (Figure 1 and Figure 2)

It was found that although his using rate of phase of AAS in winning games (34%) was higher than in losing games (26%), Ma Lin's using rate in reception and rally was almost equivalent in winning or losing games. It suggested that keeping the superiority was the most important for Ma Lin's winning.

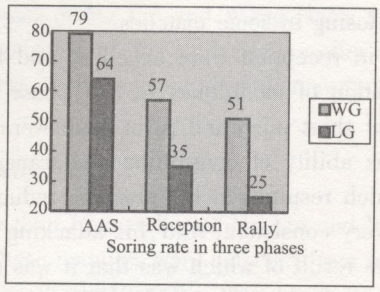

Figure 1. Malin's scoring rate of three phases in winning and losing games

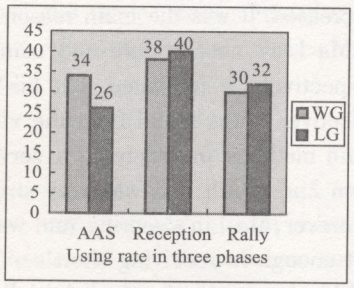

Figure 2. Malin's using rate of three phases in winning and losing games

Notes: WG: winning games; LG: losing games

3.2 Wang Hao's techniques and tactics

3.2.1 Overall analysis of Wang Hao

Wang Hao's scoring rates in all phases were above 50%, which showed that his strength in each phase was rather high. It was observed that Wang Hao's attacking consciousness in AAS was strong. His forehand swing movement was not big but very smooth and flow. However, his attacking power was a little small. Besides, Wang's backhand drive rate with the reversed side was relatively high and effective.

Wang Hao's scoring rate in reception was as high as 51%, and his using rate was 33%. It revealed that his application of techniques in this phase was successful. The main reason of this was that he could launch attack from both sides of his racket in the transition from 2nd to 4th ball. The balance of forehand and backhand made a lot pressure on his opponents. It was suggested that increasing the ability of pushing short ball with big angle when receiving a service and increasing the attacking rate against short balls would help him in future.

Wang Hao's scoring rate in rally which is the weakness of most penholders was excellent. It was observed that his superiority in first four balls and backhand drive with reversed side helped form this base. The application of backhand drive with reversed side has changed the situation in which penholders, when standing close to the table, could only block the balls coming to their backhand. Therefore, Wang Hao's attacking space in rally increased at a large extent. However, Wang Hao's striking power of both forehand and backhand was still not big enough, and his consciousness of using forehand topspin to start attacks from left side of the table was needed to improve. (see table 3)

Table 3. Wang Hao's overall performance in three phases (%)

	AAS		reception		rally	
	SR	UR	SR	UR	SR	UR
Wang Hao	72	33	51	35	51	33
Evaluation	excellent	high	excellent	high	excellent	low

3.2.2 Analysis of Wang Hao in winning and losing games

Wang Hao's performance of all phases in winning games was much better than in losing games. His accuracy of attack after service was quite high, control of reception was fine, and transition misplay from 2nd to 4th ball was low. Since the high quality of first four balls, his rally was developed towards to his side. However, in losing games Wang Hao's performance was not good, including his AAS. It indicated that his application of techniques was not very consistent.

With respect to the using rates, Wang Hao's performance in reception was much different from others. His using rate of reception in winning games was higher a little than in losing games. It was observed Wang Hao's application of techniques of attacking short balls was successful. On the other hand, in the phase of AAS his misplay of first three balls in losing games was relatively high. And, in winning games, because of high accuracy and low power of AAS, his entered the rally without scoring a point within first four balls, which led to a low using rate (Figure 4).

Therefore, increasing the quality of first – four – ball techniques, especially further improving the accuracy of AAS and the ability of driving short balls in services, would play a critical role for Wang Hao's play in the future.

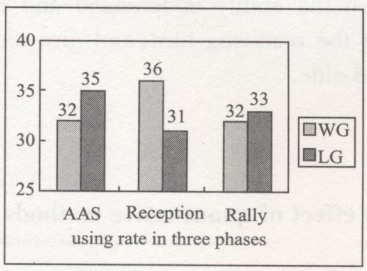

Figure 3. Wanghao's scoring rate of three phases in winning and losing

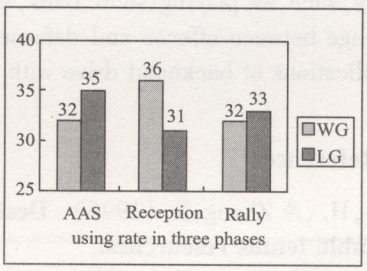

Figure 4. Wanghao's using rate of three phases in winning and losing

3.2.3 Developing tendency of the playing style of pen – hold grip with inverted rubber

The playing way of pen – hold grip with inverted rubber, whose representatives were Ma Lin and Wang Hao, has got the good performance in recent years.

From the view of the techniques and tactics, attack after service was their main advantage. In addition, their ability of forehand continuous attack, drive and countertopspin far from the table was rather strong, which embodied the advantage of playing way with inverted rubber. Therefore, this kind of players has to strengthen the forehand power. Besides, the players'method of receiving a short service is mainly control rather than attack. In this situation, the transition from 2nd to 4th ball was vital for them. In the phase of rally, the use of backhand drive with reversed side compensated for the weakness of backhand of this playing style to some extent. Wang Hao even had the upper hand over the shakehand players on this ground. Therefore, on the basis of strengthening the forehand continuous attack and footstep, improving the backhand drive with reversed side is a effective direction for the players of this playing way.

4 Conclusions

(1) Ma Lin's superiority is attack after service, meanwhile rally is his weakness. To Ma Lin's, the exchange of offense and defense from 2nd to 4th ball , the transition between techniques are the key factors to win a match.

(2) Wang Hao's techniques are comprehensive. His backhand drive with reversed side makes him balanced between his forehand and backhand. it is important for Wang Hao to win a match that he should improve and refine the techniques of the first four balls, especially increasing the accuracy of attacking and enhance the ability of attacking the short balls.

(3) Players who were penhold – grip with inverted rubber should show powerful forehand in the first three balls, make the most of the advantages of grip style, such as playing short balls, strengthen the ability of forehand and exchange between offense and defense during the receiving turn, and give more applications of backhand drive with reversed side.

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28 Anxiety and performance in young table tennis players

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1 Introduction

It has been recognized for many years that psychological factors play an important role in competition. In this way, the relationship between anxiety and athletic performance is widely studied. One of the explanations for this relationship is the multidimensional theory (Liebert and Morris, 1967). This theory suggests that anxiety consists of two subcomponents: cognitive and somatic, and they should influence performance differently. The cognitive anxiety is defined as the mental component of anxiety and in sport it is commonly manifested by negative expectations of performing a task and thus negative self – evaluation. According to Martens *et al.* (1990) there is a negative linear relationship between cognitive anxiety and performance.

The somatic anxiety refers to the physiological elements of the anxiety (Martens *et al.* 1990). It is reflected in such responses as rapid heart rate, shortness of breath, clammy hands, butterflies in the stomach, and tense muscles. Martens *et al.* (1990) suggest that somatic anxiety has an inverted – U shaped relationship with performance, in a curvilinear fashion, with lower and higher levels of somatic anxiety being detrimental to performance.

Although the authors did not propose the self – confidence as a subcomponent of anxiety, they included it in their studies of the relationship between anxiety and performance, referring to the self perceptions of confidence. Martens *et al.* (1990) proposed a linear relationship for self – confidence.

Craft *et al.* (2003) did a meta – analysis considering the multidimensional approach to the study of anxiety – performance relationship and its most employed instrument: the Competitive State Anxiety Inventory – CSAI – 2. The authors suggest that the findings of the studies of anxiety have been inconsistent. In addition, LeUnes and Nation (2002) suggest that the multidimensional

relationship between state anxiety and sport performance is complex and need further investigation.

In addition, previous research has argued that the relationship between anxiety and performance also depends on the characteristics of the task. For example, Oxendine (1970) considered that there are ideal levels for the optimal functioning for best performance and have accounted for variations in motor requirements, e. g. tasks requiring fine muscle coordination, precise motor control, steadiness and concentration are performed best at low levels of anxiety or physiological arousal. These results were confirmed by studies of Weinberg and Genuchi (1980) with golf players and Hall and Purvis (1980) with bowlers when the athletes had their best performance with low levels of anxiety.

On the other hand, gross motor activities involving strength and physical effort should be facilitated by higher levels of anxiety, such as in the study of Parfitt *et al.* (1995) with the Sargent jump task in basketball and volleyball players. For this particular task, the increase of somatic anxiety affected the height of jumping positively as well as by Wilson and Raglin (1997) with track and field athletes who were benefited by high levels of anxiety.

Related to table tennis, Ripoll and Fleurance (1988) described a task which involved complex, precise perceptual and motor skills. In addition, Ripoll and Latiri (1997) suggested that besides spatial precision, table tennis requires temporal precision. Thus, it is possible to suggest that it demands both high physical effort (velocity) and precision (accuracy).

Therefore, the purpose of this study was to investigate the relationship between pre – competitive state anxiety and performance in young table tennis players.

2 Methods

2.1 Participants

Thirty – six young table tennis players (18 females and 18 males), all members of the São Paulo Table Tennis Federation (Brazil), volunteered to participate (age: $M = 12.28$, $SD = 0.74$). All participants in the study were currently competing at regional level. Subjects were assured confidentiality regarding the data collected and their personal identity.

2.2 Instrument

All players completed an inventory about their personal states of anxiety prior to one São Paulo State Federation Tournament. A short description of the instrument follows.

The Children's form of the Competitive State Anxiety Inventory – 2C (CSAI – 2C; Stadulis *et al.* 2002) was employed to measure the intensity of pre – game

cognitive anxiety, somatic anxiety and also self – confidence, with five items in each subscale. The response scale asked the participant to rate the intensity with which each symptom was being experienced on a continuum from 1 (*not at all*) to 4 (*very much so*). On each scale, anxiety level is expressed by a numerical grading system from 5 to 20.

2.3 Procedure

Participants, their parents, and coaches were contacted and informed of the nature of the study in a practice day in their respective clubs, and invited to take part in the investigation. A suitable time and venue for the collection of the data was then arranged. All participants were asked to complete CSAI – 2C on the competition day, within thirty minutes before their first game at São Paulo State Federation Ranking Championship. All questionnaires were administered by the leading researchers.

3 Results

The participants of the study were divided into two groups, considering their results in their first game: 18 athletes – 'winners', 18 athletes – 'losers'. Each group was made out of 9 boys and 9 girls. To compare anxiety levels between the two groups, the Mann – Whitney test was used.

Regarding cognitive state anxiety, Mann – Whitney test indicated that there were no differences between 'winners' and 'losers' in pre – game ($Z = -0.239$, $p = .815$). It means that cognitive state anxiety was not a predictor of performance for these table tennis players.

In the same way, Mann – Whitney test indicated that there were no differences between 'winners' and 'losers' players in somatic state anxiety in pre – game situation ($Z = -0.720$, $p = .481$), as well as in self – confidence levels ($Z = -0.032$, $p = .988$).

4 Conclusions

The multidimensional theory hypothesis that low levels of cognitive anxiety, moderate somatic anxiety and high self confidence were necessary for optimal performance. The lack of supporting evidence for this theory could be explained by the following reasons.

Firstly, considering the task, table tennis could be considered as a hybrid task. Even though it demands spatial and temporal precision, it needs power and velocity to perform well. Thus, athletes with high or low levels of anxiety might get optimal performance, as long as they could control it properly.

Secondly, because table tennis allows athletes to use their own styles of pla-

ying with their physical and mental capabilities, there is no relationship among anxiety components and performance. Thus, athletes with different levels of anxiety may perform well if they adapt their personal characteristics to their styles of playing. For example, one athlete with a high level of anxiety could get a great performance playing faster than another one with a lower anxiety level. Therefore, maybe there are no optimal levels of anxiety for table tennis in general but for each athlete in particular.

Finally, it was noted in this study that there were no ideal levels of anxiety for the table tennis task, as in the study of Morgan *et al.* (1987) which did not find any correlation between personality traits or states and performance. We agree with the authors suggesting that it is important to establish the individual zone of optimal functioning (Hanin, 2000; Kamata *et al.*, 2002) before employing psychological interventions. In addition to that, it is essential to identify when this optimal zone should be reached during the tournament (important moments). Maybe in short duration activities this zone could be arranged in pre-game situation, but in long duration activities (all day long or some days), perhaps the most important moment could be only in the final phase. Therefore, it is crucial for athletes to learn to identify their individual zones of optimal functioning related to anxiety levels and develop coping strategies for these situations by themselves, because many times the coach or the psychologist cannot intervene on specific sport settings.

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29 Cues and anticipation: the cognitive skill of table tennis experts in reception

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1 Introduction

The quest to identify key factors underlying the acquisition of expert performance has stimulated much discussion in recent years. A popular standpoint advocated by optometrists is that successful athletes are endowed with superior visual systems, supporting a "hardware" account of expert performance. It has been argued that athletes need above – average levels of visual function in order to meet the demands of their sport and fulfil their role efficiently. However, support for the presumption that athletes possess superior vision is equivocal at best (Williams, Davids, & Williams, 1999). In previous studies using adult populations, the true variance explained by variables related to visual function has demonstrated only a negligible contribution (3% ~5%) to skilled behaviour (Abernethy, Neal, & Koning, 1994; Helsen & Starkes, 1999). Attempts to characterize expertise from this perspective appear to provide only limited insight into the factors underlying the development of visual – perceptual skill (Ward & Williams, 2003).

Chase and Simon (1973) originally proposed that expert performance could be explained on the basis of superior domain – specific knowledge. Rather than possessing a greater general capacity, skilled chess players used more elaborate knowledge to create meaningful "chunks," enabling a faster and more accurate response. It is suggested that expert athletes are not endowed with superior visual function, and that perceptual and cognitive factors are better discriminators of skilled performance in sports especially those fast ball events. When compared with their less – skilled counterparts, experts are better at anticipating opponents' intentions based on partial information or advance cues (Abernethy, & Russel, 1987; Williams & Burwitz, 1993), and can more consistently pick up the minimal essential information needed for successful anticipation (Ward, Williams, & Bennett, 2002). Experts typically exhibit more effective visual search strateges (Helsen & Starkes, 1999; Williams & Davids, 1998; Williams, Davids, Burwitz, & Williams, 1994) and are faster and more accurate at recognizing and recalling typical patterns of play form memory (Starkes, 1987; Williams & Davids, 1995; Williams, Davids,

Burwitz, & Williams, 1993).

In many fast ball sports the ability to accurately anticipate forthcoming events is a critical feature to performance and has long been identified as an essential cognitive attribute of the expert performer. Systematically examining this aspect of skilled performance, however, presents a difficult problem to the sport scientist. Anticipation should ideally be studied in the field in order to maximize ecological validity with respect to the maintenance of contextually – relevant stimuli and with respect to the maintenance of appropriate temporal constraints on the perceptual and decision – making processes. Field studies however pose problems with respect to the replicability of identical display conditions for different participants and with respect to direct controlled access to the variables of manipulative interest.

For this reason most applied studies of anticipation to date have taken place within the laboratory and have taken the approach of attempting to simulate the perceptual display of the field setting through the use of film. Such film is typically taken from a player's perspective and is selectively edited to present variable amounts of display information. The subject's task is normally to predict the subsequent event outcome (e. g. , the direction or landing position of a struck ball) from the limited information provided. To date, some evidence of superior anticipatory skills for expert fast ball sport players, such as badminton (Abernethy, 1988), soccer (Ward & Williams, 2003), baseball (Han Chen, 2000), handball (Wang Bin, 2002), has emerged from this method.

However, relatively few studies have examined how anticipation, as a kind of cognitive skills, influences the expertise in table tennis. The aim of this study was to examine whether anticipation performance in reception was an effective discriminator between experienced and less experienced players; and, which kind of anticipation is more important in table tennis reception, placement or spin. According to the previous studies in other sports, the hypotheses of the research were that experienced players would have the superiority of placement anticipation over the less experienced counterparts in early occlusion time when they received the services. In addition, given that spin – anticipation has an important role in reception, the difference between the two groups in spin anticipation should be larger than that in placement anticipation.

2 Methods

2.1 Participants

20 experienced (M = 20. 30 years, SD = 2. 11) and 20 less experienced male players (M = 21. 35years, SD = 1. 14) were selected as participants. Experi-

enced players were selected from the college of sports of Beijing Sport University (BSU) who were professional players before attending the university, while less experienced players were selected from the college of physical education of BSU who were amateur players and never have attended the professional competition.

2.2 Apparatus

Software, "Test System of Anticipation in Table Tennis Reception" which is designed and developed by the researchers self, was used to examine the anticipation ability of the participants when receiving a service. A particular keyboard, which was refitted, was applied as well. Participants were presented with 64 table tennis service trials which were divided into two parts. The first part was to examine the accuracy of placement – anticipation in reception and the second part was to examine the accuracy of spin – anticipation. Services in the film were conducted by two players from national team. All trials began with the server prior to the commencement of the service and finish with the display occluded either 160 ms before the point of racquet – ball contact (t1), 80 ms before racquet – ball contact (t2), at the point of racquet – ball contact (t3), or 80 ms after racquet – ball contact (t4). Participants on each occasion were required to predict the ball's landing position (placement) on the table or its spins on the basis of the information provided and then press the corresponding key. The response must be completed as quickly and accurate as possible within 3 seconds.

2.3 Procedure

Participants sat 50cm from the screen of a laptop computer. The test procedure was then explained and the participants were required to imagine themselves as a receiver who was to receive the service of the player on the screen. Before the formal test of each part, which included 32 trials, participants received 4 practice trials to ensure their familiarity with the testing procedure. In particular, it was stressed that they should anticipate the placement and spin as quickly and accurately as possible. No further instructions were given as responding strategy can be modified by experimental instructions. Participants viewed each pattern of play as it developed and responded by pressing one of the four keys which corresponded with four equivalent areas on the table, or four kinds of spin, backspin, non – spin, side – backspin, and side – topspin. Immediately following initiation of their response, the film was occluded to prevent them gaining feedback on task performance and next trial would appear 3 seconds later.

2.4 Data Analyses

Separate two – way ANOVAs were used to analyze two kinds of anticipation –

placement – anticipation and spin – anticipation. The between – subjects factor was skill level (experienced and less experienced) and the within – subjects factor was occlusion time. The independent variable was error rate of the anticipation performance.

3 Results

3.1 Placement – anticipation

There was no significant main effect for skill level, ($F(1,38) = 1.495, p = 0.229$). However, significant main effect was found in occlusion time, ($F(3, 114) = 31.781, p < 0.005$). In addition, the skill level by time occlusion interaction was not significant, ($F(3,114) = 1.771, p = 0.157$). That is, the experienced players did not show better placement – anticipation performance than their less experienced counterparts. The results of all placement – anticipation performance were listed in Table 1.

Table 1. Error rate for experienced and less experienced players on placement – anticipation (%)

Group	n	Occlusion time							
		T1		T2		T3		T4	
		M	SD	M	SD	M	SD	M	SD
Experienced	20	69.4	.111	75.0	.107	59.4	.167	38.1	.160
Less experienced	20	68.1	.103	73.8	.185	63.8	.190	50.0	.190

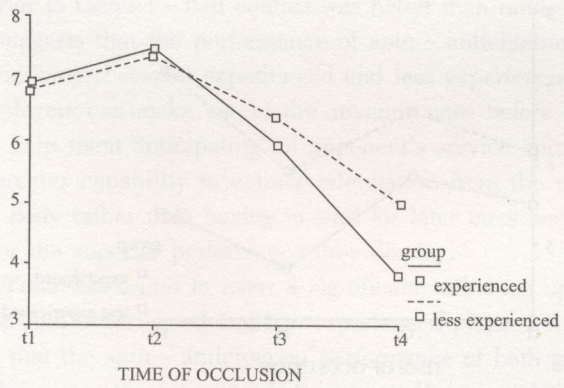

Figure 1. Tendency of error change in placement anticipation

However, although the results demonstrated that the main effect of occlusion time was significant, the one – sample t – test indicated that at t1 and t2, the performance of both experienced and less experienced players in place-

ment anticipation was not different from random guess. After the racquet – ball contact, their error rate of placement – anticipation was reduced significantly with the time developing. The changing tendency of placement – anticipation performance with the occlusion time was showed in Figure 1. It indicates that players' placement – anticipation accuracy became better when the time developing.

3.2 Spin – anticipation

A significant main effect was observed for skill level, ($F(1,38) = 1776.158, p < 0.005$). Experienced players showed superiority over less experienced players in anticipating the spin of services. In addition, It was found that the main effect of occlusion time was significant, ($F(3,114) = 3.525, p = 0.017$). However, the skill level by occlusion time interaction was not significant, ($F(3,114) = 1.003, p = 0.394$). Table 2 showed the results of performance of spin – anticipation in both groups.

Table 2. Error for experienced and less experienced players on spin – anticipation (%)

Group	n	Occlusion time							
		T1		T2		T3		T4	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Experienced	20	55.0	.148	58.7	.158	46.9	.156	54.4	.136
Less experienced	20	61.9	.131	66.9	.227	59.4	.134	72.5	.205

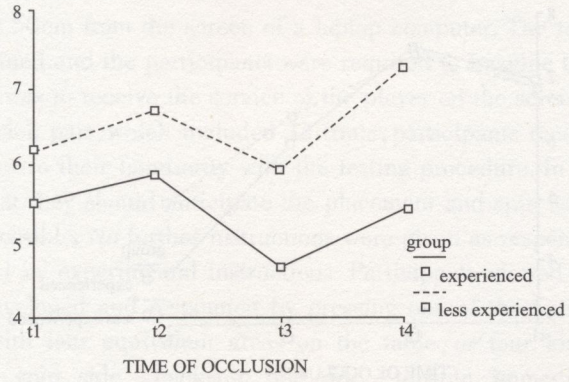

Figure 2. Tendency of error change in spin – anticipatin

Besides, the one sample t – test reveal that experienced players' performance of spin – anticipation was significantly better than the random probability in all four occlusion times. On the other hand, less experienced player's

performance was not better than random probability at t2 and t4. The figure 2 showed the changing tendency of participants' performance of spin – anticipation with occlusion time. It was found that, unlike in placement – anticipation, participants' performance at t4 was worse than that of t3.

4 Discussion

This research examined the feature of anticipation in table tennis reception using a time occlusion paradigm. The further aim was to determine which variable better discriminate between spin – and placement – anticipation.

In placement anticipation test, the results did not support the hypothesis 1 in present study. Experienced players did not exhibit better performance than less experienced players in using early advance information. Moreover, both groups' players did not show performance better than random probability at time t1 and t2, i. e., before the point of racquet – ball contact. The results were different from those of most other studies (Abernethy, & Russel, 1987; Abernethy, 1988; Williams & Burwitz, 1993; Ward & Williams, 2003). It seemed that, unlike other fast ball sports, placement anticipation is not so important in table tennis that it can discriminate players of different skill level. However, the performance of the players of both groups was improved with the time developing. It suggested that the amount of critical task – related cues for anticipating the placement of a service increased with the time developed.

On the contrary, it was found that experienced players showed superiority over less experienced players in spin anticipation test. And experienced group's performance prior to racquet – ball contact was better than random probability. These results suggests that the performance of spin – anticipation in reception is a good discriminator between experienced and less experienced players, and high – skilled players can make use of the advance cues before the racquet – ball contact to help them anticipating an opponent's service spin. As a consequence, their greater capability to extract information from the early action of the opponent's body rather than having to wait for later cues may, to some extent, account for the superior performance they display.

In addition, Time was found to exert a significant influence upon prediction performance for both experienced and less experienced players. It was indicated in the figure 2 that the spin – anticipation performance of both group's players were best at t3, i. e., at the racquet – ball contact. However, their performance worsened with the time proceeded. It suggested that with respect to the spin – anticipation in reception, the most task – related information appear at racquet – ball contact, and after this the amount of cues will not increase with the time developing. Therefore, if a player does not pay enough attention to, or carry enough cues, at the point, his probability to successfully receiving a service will

be small.

5 Conclusion

It was concluded that for table tennis players, the advance information is important in anticipating spins in reception, although most players think that just the racket – ball contact point can tell them the nature of opponents'services. In addition, the experienced players were more effective than less experienced players at using critical cues available for anticipating the spin, rather than for anticipating placements in reception. Finally, experienced players possess a comprehensive knowledge of the relationship between the spin – and time information of opponents, and can pick up on their intended actions to a greater extent when compared to less experienced players.

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30 The relationship among sport competition anxiety, trait mental toughness, and athletic psychological skills in pre – elite table tennis players in Taiwan

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1 Introduction

Table tennis is an open – skilled and individual sport. The feature of open – skilled sport implies constantly changing stimuli. Table tennis players have to quickly adapt to changing environment and react properly. The feature of individual sport suggests table tennis players can only rely on themselves during competition. In addition, success of table tennis competition require consistent in performance. These features in table tennis competition place heavy demand on the psychological quality of a table tennis player. Thus it is important for table tennis players to possess good mental quality.

It is well known that there is a strong association between psychological skill and sport performance (May, Veach, Reed, & Griffey, 1985; Morgan & Pollock, 1977; Ogilvie, 1968). Athletes with good psychological skills are muck likely to succeed in competition. Both athletes and coaches are striving for better development of psychological skills to reach peak performance. Several psychological constructs such as competitive trait anxiety, mental toughness, and motivation, peaking under pressure, coping with adversity, concentration, confidence and coachability have been proposed critical for athletic excellence.

Competitive trait anxiety is defined as a tendency to perceive competitive situations as threatening and to respond to these situations with state anxiety (Martens, Vealey, & Burton, 1990). There has been a broad spectrum of studies show that anxiety can have a detrimental influence on performance (Hanin, 1980, 1997; Gould & Tuffey, 1996; Jones, 1995). In addition, several studies reported the competitive trait anxiety is related to sport – specific personality dispositions (Willis, 1982; Gill, Dzewltowske & Deeter, 1988; Vealey, 1986; Ablrecht & Feltz, 1987).

The mental toughness is another factor that is important in achieving success. For example, Loehr (1982, 1986) emphasized that athletes and coaches

felt that at least fifty percent of success is due to psychological factors that reflect mental toughness. However, sport psychologists have generally failed to clarify the definition and the attributes of mental toughness. Nevertheless, a recent effort by Huang (2004) defined mental toughness as "individual performs undefeated mental property while facing adversity in competition (sport) situation". In his construction, trait mental toughness for sport is defined as a degree of disposition on toughness an individual possess. This disposition of undefeated mental property usually will be expressed when facing adversity in competition situation. Trait mental toughness consists of three factors that include positive effort, anti – pressure, and endurance as measured by Trait Mental Toughness Inventory for Sports (TMTIS).

Research concerning sport – specific psychological skills was advanced by the development of the Athletic Coping Skills Inventory (ACSI – 28) by Smith, Schutz, Smoll, and Ptacek (1995). In Taiwan, Chiou and Chi (2001) developed the Athletic Psychological Skills Inventory (APSI) based on ACSI – 28 and other related inventories. There are five factors in APSI. Motivation refers to behaviour that is confident and positively motivated; consistently gives 100% during practice and competition and works hard to improve her skills. Peaking under pressure and coping with adversity describes the behaviour that is challenged rather than threatened by pressure situation and performs well under pressure; a clutch performer remains positive and enthusiastic even when things are going badly; remains calm and controlled; can quickly bound back from mistakes and setbacks. Concentration refers to behaviour that is not easily distracted; able to focus on the task at hand in both practice and competition situations, even when adverse or unexpected situations occur. Confidence refers to behaviour that is confident and positively motivated; consistently gives 100% during practice and competition and works hard to improve her skills. Coachability describes behaviour that is open to and learns from instruction; accepts constructive criticism without taking it personally and becoming upset. The APSI has been shown as a valid and reliable instrument to assess athletes'psychological skills in Taiwan (Chiou & Chi, 2001).

Studies have shown how psychological factors influenced an athlete's performance (Corbin, Setwart & Blair, 1981; Feltz & Landers, 1983; Kerr, 1987; Lirgg, 1991; Moritz & Feltz, 2000). Hayashi (1998) suggested gymnasts with higher anxiety and low abilities to cope with adversity are more likely to discontinue gymnastics training. Vealey (1986) found competitive trait anxiety was negatively related the disposition of trait sport confidence. From an interaction perspective, sporting environment plays an important role on moderating the relationship between psychological factors and sport performance. There are few studies that have focused on how the aforementioned

psychological factors relate to each other in table tennis players. As such, the purpose of this study was to examine the relationship among several psychological constructs that are thought important to the success of table tennis players. Understanding the relation can apply sport – specific and general psychological theories and research to sport settings in an attempt to increase the psychological well – being, health, and performance of athletic participants.

2 Methods

2.1 Participants

Seventy – five pre – elite table tennis players from senior high schools and colleges in northern Taiwan participated in the present study. Fifty – five males and twenty females were asked to complete a series of three questionnaires.

2.2 Instruments

Sport Competition Anxiety Test For Adult (SCAT – A), The test was developed to measure competition trait anxiety (Martens, 1977). It consists of 15, three point Likert – type questions with answers ranging from hardly ever to often. The scores range from 10 to 30 representing low to high competitive anxiety, respectively. Test – retest reliability and validity have been confirmed (Martens, 1977). The Chinese version of SCAT – A was adopted by Lu (1990).

Trait Mental Toughness Inventory for Sport (TMTIS). Huang (2004) developed the TMTIS which is a 32 – item inventory scored on 5 – point Likert scales. Exploratory factor analysis indicated that there are three factors in TMTIS: Positive Effort (16 items), Anti – pressure (11 items), and Endurance (5 items). The Cronbach coefficients ranged from .84 to .93 for these three subscales, demonstrating a high degree of internal consistency. The confirmatory factory analysis confirmed the factor validity of TMTIS.

Athletic Psychological Skills Inventory (*APSI*), Chiou and Chi (2001) developed the APSI which contains 31 items with five subscales: Motivation (9 items), Peaking under pressure and Coping with adversity (9 items), Concentration (4 items), Confidence (4 items), Coachability (5 items). It is also scored on 5 – point Likert scales. The results of EFA revealed acceptable reliability and construct validity. The Cronbach coefficients were moderately acceptable with values from .75 to .88. The results of confirmatory factory analysis also confirmed the factor validity of APSI.

3 Results

Table 1 summarizes the mean and standard deviation of SCAT, TMTIS, and APSI.

Table 1. Mean and Standard deviation of the SCAT, TMTIS, and APSI.

	Mean	SD
SCAT	21.61	3.57
TMTIS	116.21	19.86
Positive effort	60.69	10.49
Anti – pressure	37.45	7.91
Endurance	18.07	3.89
APSI	106.28	17.02
Motivation	30.99	7.07
Peaking under pressure and coping with adversity	31.35	6.53
Concentration	12.17	2.54
Confidence	12.89	2.89
Coachability	18.88	3.31

The correlation among SCAT, TMTIS, and APSI are presented in Table Ⅱ. The result of Pearson correlation analysis indicated that TMTIS is highly correlated to APSI (r = . 895) while SCAT – A is not related to the other two scales. Further examination revealed that all but one of the subscales of APSI and TMTIS were positively correlated to each other. The concentration subscale of APSI was negatively correlated to the SCAT – A.

Table 2. Correlation among the SCAT, TMTIS, and APSI.

	1	2	3	4	5	6	7	8	9	10	11
1	1.00										
2	-.112	1.00									
3	.009	.942**	1.00								
4	-.226	.913**	.767**	1.00							
5	-.139	.710**	.551**	.561**	1.00						
6	-.170	.895**	.885**	.790**	.579**	1.00					
7	-.040	.789**	.813**	.658**	,495**	.890**	1.00				
8	-.163	.831**	.742**	.799**	.620**	.902**	.776**	1.00			
9	-.325**	.079	.124	.034	-.001	.175	-.108	-.006	1.00		
10	-.155	.750**	.713**	.770**	.341**	.784**	.634**	.687**	.085	1.00	
11	-.081	.564**	.632**	.381**	.402**	.646**	.440**	.412**	.301**	.387**	1.00

Note: SCAT = 1, TMTIS = 2, Positive effort = 3, Anti - pressure = 4, Endurance = 5, APSI = 6, Motivation = 7, Peaking under pressure and coping with adversity = 8, Concentration. = 9, Confidence = 10, Coachability = 11.
** $p < 0.01$.

4 Discussion and Conclusion

The purpose of this study is to examine the relationship among competition trait anxiety, mental toughness, and psychological skills. First, competition trait anxiety is negatively correlated with only concentration of APSI ($r = -.325$, $p < 0.01$). In general, those individuals with high competitive trait anxiety are more likely to respond with high state anxiety in sport competition, and this response tendency makes these individuals more vulnerable to the debilitating effect of state anxiety. Weinberg(1979) suggested that the relationship between attentional focus and anxiety may have accounted for the performance differ-

ences. According to the choking process from Nideffer (1993), sensing of pressure affects level of attention. Thus, the negative relationship between competition trait anxiety and concentration is consistent with the prediction of choking process. Interestingly, the results indicated that the competition trait anxiety is not related to other subscales of APSI and TMTIS. This finding would suggest that higher trait anxiety doesn't always come with lower mental toughness and lower psychological skills except concentration. Such finding would require replication since this is the first of it's kind in the sport of table tennis.

There are moderate to high correlations among the three factors of positive effort, anti – pressure, and endurance in TMTIS ($r = .551 \sim .767$). The moderate degree of correlation suggests that these three factors are related to each other but still possess distinct quality. The correlation coefficients are higher than Huang's (2004) study ($r = .21 \sim .50$). There are two possible explanations for these findings. One possibility is that the subjects in the current study couldn't differentiate among items of these three subscales. A second possibility is that the components that measured by each subscale are similar and closed to mental toughness.

The correlation coefficient of TMTIS and APSI is .895. All the subscales of TMTIS and APSI except concentration are significant correlated to each other. This result suggest more than 80% of the variance is shared by these two measures. The characteristics of mentally tough performers include: high levels of optimism, confidence, self – belief, and self – esteem (Bull, Albinson, & Shambrook, 1996; Favret & Benzel, 1997; Goldberg, 1998; Gould, Hodge, Peterson, & Petlichkoff, 1987); focus and concentration (Goldberg, 1998; Tunney, 1987; Graham & Yocom, 1990); and willpower, control, motivation, and courage (Bull et al., 1996; Favret, & Benzel, 1997; Gould et al., 1987). Virtually, any desirable positive psychological characteristic associated with sporting success has been labelled as mental toughness at one time or another (Jones, Hanton, & Connaughton, 2002). Moreover, The psychological skill is the attribution of success athletes. It seems reasonable to conclude that the trait mental toughness for sport (positive effort, anti – pressure, and endurance) are related to most of psychological skills (motivation, peaking under pressure and coping with adversity, confidence, and coachability). A better understanding of athlete's trait mental toughness can provide us with intervention strategy to enhance psychological skills. In conclusion, competition trait anxiety is mostly not related to psychological skills and mental toughness. The only exception is the negative correlation between competition trait anxiety and the concentration factor of the psychological skill inventory. The high correlation coefficient between mental toughness and psychological skills suggest a great proportion of overlapping between these two factors. Future study might try to integrate these two constructs since there are more

similarity than distinction between these two.

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31 A Comparison of self – esteem and self – concept between table tennis student athletes and student athletes in individual and team sports in Ahwaz, Iran, 2003

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1 Introduction

Self – esteem and self – concept are two concepts highly interesting to researchers . Today, measurement and improvement of self – esteem, self – concept and personal and social skills are considered to be the first and the most important steps in the treatment of several personality disorders like shyness, seclusion, obstinacy, aggression, indolence and sluggishness.

Self – esteem is the degree of confirmation, approval and recognition that one feels towards one's self. Donnelly (2001) defines self – esteem as how much we believe ourselves to be competent, successful, significant and worthy, or having like for oneself. Kalahan et. al hold that self – esteem and self – concept are two different concepts and suggest separate definitions for them. They assume self – concept to be one's perception of one's self, behavior, and the attitude towards the quality of other people's ideas, while, self – esteem involves a person's satisfaction of his or herself. Cooper Smith (1967) maintains that self – concept includes a set of qualities and characteristics that an individual attributes to him or herself, but self – esteem is the value that the information within the self – concept has for the individual.

Today, sports psychologists study the effects of exercising on different psychological variables; also they study the effects of these variables on athletic performance. Self – esteem and self – concept, both, have significant roles in human's life. Self – esteem has a lot to do with the motivation of individual's joining and participation in sport activity. Self – esteem is not a public feeling but a personal specific characteristic which has relationships to behavioral fields and various situations. For example, a teenager boy student might enjoy a high level of Self – esteem and self – confidence in physical, athletic or social arenas, but he/she is not very successful in his/her lessons, with not very considerable academic achievements. People can even have different self – esteem levels in different fields.

The researches done so far show that sports participants enjoy higher self – esteem levels than other people. On the contrary, in another study that was conducted on student athletes and non – athletes, no significant difference was found between the self – esteem levels of both groups. No significant difference was found between the self – esteem of team sports athletes and individual sports athletes. Also, no significant difference was found between the academic achievements of student athletes and non – athletes.

Physical strength, physical fitness and beauty can reinforce self – concept. Physical exercise increases hope of life and inspires a sense of liveliness vigorousness, delight and satisfaction of one's self. Aarnio (2002), Alfermann (2000) and Nigg(2001), conclude that taking part and doing well in sports and physical exercises can help build a self – confidence, internal power, and positive self – concept. Positive self – concept protects the individual against stress and the depression that originates from stress, while a weak self – concept increases the chance of depression. An interesting point found in the society studies was that being superior in sport activity is more important to children than superiority in academic achievement What's more, children – both boys and girls – with the least amount of sports skills are found to be the most lonely and isolated ones.

Self – esteem and self – concept have been widely studied, and most of researchers have found that these two are influenced by physical activities. For instance Gruber (1986), reviewing the literature and meta – analysis of 27 articles, came to know that physical activities influence both self – esteem and self – concept. Furthermore, in another meta – analysis of 73 other articles, it was found that sport participation enhances the level of self – concept. Bizman and Union (2002) studied the effects of losing and winning of basketball teams on their fans'self – concept and emotional responses. They concluded that whenever the favored team wins the game, the level of self – concept and positive emotional responses in the fans increases and the negative emotions drop off. Roote (2002) conducted a study titled "Sex differences in body image of adolescents and significance for self – esteem". 326 boys and girls , aged 13 to 16, formed his statistical sample . The results showed that there is a relationship between body image and sex; added to that, the relationship between females'body image and their self – esteem is more different than males'. Parrot (2001) studied the relationship between the self – esteems, age and sport participation. His findings showed no significant difference between the self – esteem levels of old non – athletes and young non – athletes. No significant difference was found between the self – esteem levels of old athletes and young athletes. Old athletes enjoyed higher levels of self – esteem than old non – athletes. Young athletes showed lower levels of self – esteem than old athletes; in addition, athletes with higher self – esteem levels enjoyed higher physical fit-

ness. In Doushafer's (2000) research a model was suggested in which pre – university girl students taking part in sports and physical activities reinforce their positive body image and improve their physical fitness. So, university girl students could be expected to have higher self – esteem levels. Doushafer managed to prepare a report of 220 university girl students', with the average age of 19.65, participation in sport activity in the past; meanwhile, he measured their body image, awareness of their athletic efficiency, self – esteem and other psychological variables. The results showed that sport participation increases self – worth and has a positive effect on moral and emotional status. People with higher self – esteem levels are generally happy and highly energetic, whereas low self – esteem level has decreasing effects on the behavior. Developing physical efficiencies can build appropriate body image. As long as any of these psychological benefits is missing, sport participation has little effects or it can even damage self – esteem. Therefore, it is necessary for those physical education experts who intend to motivate and encourage students to take part in athletic activities to be acquainted enough with the concepts of self – esteem and self – concept. Based on the researches done, it could be conclude that enough attention should be paid to self – esteem and self – concept – as two undeniable factors – in athletic activities.

The purpose of this study was to compare the self – esteem and self – concept between table tennis of high school boy student athletes and student athletes in individual and team sports in Ahwaz, Iran. The proposed hypotheses, that follows, were tested at the $p < 0.05$.

(1) There is a difference between self – esteem of boy table tennis athletes and other sports.

(2) There is a difference between self – concept of boy table tennis athletes and other sports

(3) There is a difference between sub – scales of self – concept of boy table tennis athletes and other sports.

2 Methods

The method of this study was descriptive and was in the form of field study using questionnaire.

All high school boy students of Ahwaz during 2002 – 2003 educational year formed the population of this study.

140 athlete students of team sports (football and volleyball) and individual sports (ping – pong and track and field) of high schools of Ahwaz, that were chosen randomly formed the statistical sample of this study.

2.1 Instruments

Shirazis' self – esteem questionnaire (1996) and Rojers' self – concept questionnaire (1961) were used to collect information. Shirazis'self – esteem questionnaire validity was confirmed by Cooper Smiths' self – esteem questionnaire (1967). Validity coefficient was r = 0.65 (N = 100). Shirazis' self – esteem questionnaire reliability was calculated using test – retest method after three weeks (n = 100), Cronbach's Alfa questionnaire and split – half; their coefficients were accordingly 0.85, 0.89, 0.86, (p = 0.001). All the coefficients were meaningful. The validity of Rojers'self – concept questionnaire (1961) was confirmed using Becks'self – concept questionnaire (1979). The reliability of Rojers'self – concept questionnaire (1961) was calculated using test – retest method after three weeks (n = 100), Cronbach's Alfa questionnaire, and split – half; their coefficients were accordingly 0.83, 0.74, 0.65. All of reliability and validity coefficients were calculated at the p > 0.05 and were all meaningful.

2.2 Gathering Information

Firstly, the boy student athletes in table tennis and other sports were chosen randomly and then the questionnaires were distributed among them. They were informed about the purpose of the study and were instructed how to fill out the questionnaire. They were assured that their personal information remain confidential. The questionnaires were then collected.

3 Results

The findings of the study are presented in two separate sections: descriptive findings and findings related to the testing of hypotheses.

Table 1 shows the descriptive statistics of self – esteem, and self – concept scores of table tennis student athletes and other athletes.

Table1. Descriptive statistics

Sports		Individual sports				Team sports			
		Table tennis		Track and field		Football		Volleyball	
Statistic / variable		mean	SD	mean	SD	mean	SD	mean	SD
Self – esteem		98.85	7.95	100.19	14.16	98.74	11.04	100.29	8.89
Self – concept		13.65	6.20	8.5	6.24	11.19	7.47	9.29	6.59
Sub – scale	Self – real	116.57	8.51	122.72	12.84	124.85	12.24	121.73	9.61
	Self – ideal	123.83	16.07	125.27	14.01	129	16.61	122.67	15.43

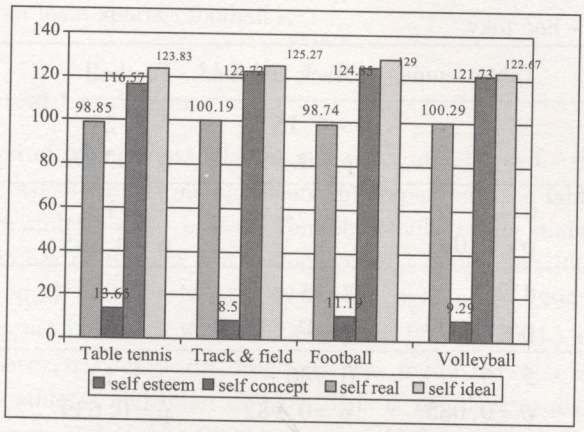

Figure 1. Descriptive statistics

Table 2. The results of ANOVA of self – esteem

Source of variation	SS	df	Ms	F	P
Between groups	73.26	3	24.42	0.20	0.89
Within groups	16189.67	136	110.46		
total	16262.93	139			

Table 3. The results of ANOVA of Self – concept

Source of variation	SS	df	Ms	F	P
Between groups	596.53	3	198.84	1.27	0.288
Within groups	21324.68	136	156.80		
total	21921.22	139			

Table 4. The results of ANOVA of self – real

Source of variation	SS	df	Ms	F	P
Between groups	1300.24	3	434.41	3.60	0.15
Within groups	16328.69	136	120.46		
total	17682.93	139			

Table 5. Post – hoc toky

Sports	Table tennis	Track and field	Football	Volleyball
Table tennis		-6.15 p = 0.085	-8.28 p = 0.009	-5.16 p = 0.085
Track and field	6.15 p = 0.085		-2.13 p = 0.845	0.986 p = 0.982
Football	8.28 p = 0.009	2.13 p = 0.845		3.12 p = 0.639
Volleyball	5.16 p = 0.085	0.986 – p = 0.982	-3.12 p = 0.639	

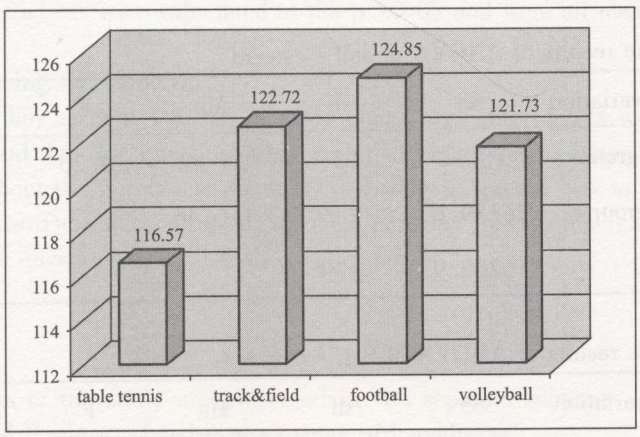

Figure 2. Mean of self real

Table 6. The results of ANOVA of Self – ideal

Source of variation	SS	df	Ms	F	P
Between groups	787.93	3	262.64	1.08	0.358
Within groups	32909.63	136	241.98		
total	3369.57	139			

The results showed that there was no significant difference between table tennis athletes and other athletes self – esteem. No significant difference was found between self – concept of table tennis athletes and other athletes. There was no significant difference between self – real of table tennis athletes and other athletes. There was a significant difference between self – ideal of table tennis athletes and other athletes. Self – ideal of table tennis student athletes

were lower than team sports (football).

4 Discussion and Conclusion

The comparison of table tennis athletes and other athletes self – esteem in this study showed that there was no significant difference between table tennis athletes and other athletes self – esteem. Thus the results of the study is in accord with the researches of Bizman and Union (2002), Doushafer (2000), Gruber (1986), Pin et. al (2002) Neisi (1997), Foroughi pour (1994), and Takli (1994), but is not in accord with the findings of Parrott (2001) and Yaghouti (2000). Moreover, no significant difference was found between self – concept of table tennis athletes and other athletes. This is not then in accord with the findings of Bizman and Union (2002), Aarnio (2002), Alferman (2000), Nigg (2001), and Park (2003), but does accord with the studies of Gruber (1985).

This is then in accord with the finding of Cooper Smith (1969), PourShafei (1990) and Neisi (1997), but does not accord with findings of Foroughi pour (1994). Therefore, it could be concluded that self – esteem and self – concept are very important factor in the improvement of sports, and physical and sport activities is an influential factor in the improvement of self – esteem and self – concept. Thus, it is recommended that educational districts should prepare suitable conditions that encourage the students to take part in sport activities.

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32 The study of college table tennis athletes' competitive burnout and coping strategies of competitive stress

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1 Introduction

To cope with competitive stress or to adjust emotion is important for athletes. Smith (1986) considered that burnout and stress has closed relationship. Raglin and Morgan (1989) presented that 47% of athletes had the experience of competitive burnout. Athletes express that the reasons of burnout includes exacting training, exhaustion, analeptic time is not enough and no response ability. Since colleges are the foundation training center of great athletes. To understand the psychological experience and make the strategies will be good and important issues for physical education development.

From the research by Gould et al. (1996, 1997) it is found that the interaction of personal factor and environment will cause burnout. Others factors, such as train from early age, overtraining and cognitive appraisal are all causing burnout in sport. Furthermore, losing interest and the stress from coach, parents or teammates are the main factors (Cohn, 1990; Silva, 1990; Weinberg & Gould, 1995).

From the viewpoint of sport age, the athletes' results in the phase of college should be the best. From the viewpoint of sport technique, the players should be mature in the physical vigor and psychology. From above mentioned, we can know the college phase is the best status for athlete. But many great players fade out or give up training. Maybe stress is the main issue.

Huang (2000) and Anshel (1996) believed that the researchers should understand different sports type, competitive level, sex, age and culture will influence the coping strategies to stress. Some scholars (Liao, 2003; Shane, 2000; Vealey, 1988) indicate age, sex, sports type will effect athletes' confidence. Shia & Lu (2002) discussed the burnout of college tennis players by sex, training time and age. They found that age, training time will influence mood and staleness.

From above description, the purposes of this study were: 1. to compare the differences of competitive burnout and coping strategies of college table ten-

nis athletes with different demographic variables, and 2. to explore the relationship of college table tennis athletes' competitive burnout and coping strategies.

Definition of Terms

1 Negative self concept of sport ability: The frustration of participating in sports activities.

2 Devaluation by coach and teammates: The negative feedback or evaluation from coach and teammates.

3 Psychological with drawls: The experience and sense shrink from sports.

4 Perception of personal sport performance: The expected sports achievements and satisfaction from coach.

5 Emotional and physical exhaustion: The emotion and exhaustion cause by sports participating.

6 Problem-focus coping: Athlete strives to handle, improve or lighten the influence from pressure, it includes: (1) Actively coping: it means that athlete overcome barriers or solve problems actively when face the pressure. (2) Enhancing effort and determination: it means that athlete put in more efforts for solving problems actively when face the pressure. (3) Separation and not be affected: it means that to avoid distracted from other matters or to be absorbed in handling pressure than coping at the suitable occasion.

7 Emotion-focus coping: Athletes endeavor to adjust the negative emotion result from sports includes: (1) Seeking social support: Athletes will seek another support to strengthen their resources and adjust their emotion condition for solving problems when they face the pressure. (2) Venting emotion: When the athletes meet pressure, they will express personal the experience and emotion of their pressure. (3) The thought of full anticipation: The illusion or the expected situation when athletes have the pressure. (4) Emphasizing straightforwardness: The positive attitude to face the pressure and to obtain the experience and learning from this pressure.

8 Avoid coping: The athletes select to avoid or evade problem when the pressure is arriving.

2 Methods

2.1 participants

The subjects in this research consisted of two major groups from universities in Taiwan, the groups included collegiate from Physical Education departments of universities. The players range from novice to intermediate and from advanced to elite athletes. Therefore, there were 63 males and 51 females ($N = 114$) in this study. Table 1 shows the number of males and females per competitive level. The pretest of this inventory is answered by coaches and

athletes. By the pretest, we can confirm the contents validity. When execute the inventory test, authors try to explain answer rule before test for controlling the consistence.

Table 1. Sample distribution

Background	Classification	N	Percentage
Sex	Male	63	55.3%
	Female	51	44.7%
Competition level	National level	20	17.5%
	National game	94	82.5%
Days of practice per week	Less than 3 days	14	12.3%
	4 – 5 days	76	66.7%
	6 – 7 days	24	21.0%

2.2 Instrumention

Emotional and physical exhaustion. Attitudes to each of the service attributes used in the inventory were assessed using a seven-point Likert scale anchored by the level of never "1 = never" to "7 = always". The accumulated explanation of this inventory is 66.73% . The consistency of each factor is presented by Cronbach α, the values period is from 0.6820 to 0.9203.

The inventory for coping competitive stress strategies is based on Huang (2000). It includes 51 criteria such as problem-focus coping, emotion-focus coping and avoid coping. The inventory were assessed uses a five-point Likert scale anchored by the level of never "0 = never" to "4 = always". The consistency of each factor is presented by Cronbach α is between 0.8002 and 0.9004. The total explanation is 59.36% .

3 Results and Discussion

The purposes of this study were: 1. to compare the differences of competitive burnout and coping strategies of college table tennis athletes with different demographic variables, and 2. to explore the relationship of college table tennis athletes' competitive burnout and coping strategies.

3.1 The difference between male and female athletes' burnout and coping strategies of competitive stress

Table 2 shows the difference between male and female athletes' burnout and coping strategies of stress. From the results, we can understand "devaluation by coach and teammates" has significant variation. The result is agree with

scholars Gill (2000) and Shia & Lu (2002). The male believe their ability is better than female, but the evaluation estimated by coaches and teammates is negative. It shows that the difference of coping stress strategies between male and female athletes. From the results, we can know there is no significant difference.

Table 2. The difference between male and female athletes for competitive burnout and coping strategies of competitive stress

Variable	Sex	Quality	Mean	SD	t-value	p-value
Emotional and physical exhaustion	Male	63	24.49	6.96	−0.17	.866
	Female	51	26.71	6.35		
Perception of personal sport performance	Male	63	36.33	8.32	1.77	.080
	Female	51	33.80	6.59		
Psychological withdrawal	Male	63	14.11	3.41	0.65	.515
	Female	51	13.71	3.15		
Devaluation by coach and teammates	Male	63	13.78	5.24	3.36 *	.001
	Female	51	10.49	5.14		
Negative self concept of sport ability	Male	63	10.27	3.56	−0.34	.732
	Female	51	10.49	3.21		
Avoid coping	Male	61	19.37	3.99	1.49	.139
	Female	53	18.12	4.95		
Problem-focus coping	Male	61	64.59	14.28	0.92	.361
	Female	53	62.20	13.31		
Emotion-focus coping	Male	61	54.75	11.04	−0.36	.718
	Female	53	54.02	10.13		

* $p < 0.05$

3.2 The analysis of burnout an different strategies to against stress with different level

It is shown as Table 3. From the results we know the variation of "Psychological withdrawal", "Avoid coping", "Problem-focus coping" and Emotion-focus coping are significant with different level. And the degree of national level athletes is higher than another level. The reason is national athletes can take action to overcome barriers and solve problems when they face the stress. They can concentrate their attention to handle stress. And they will look for some other one to relax their mood. The results are the same with the researches by Madden, Kirkby, & McDonald, 1989; Gould, Eklund, & Jack-

son, 1993.

Table 3. The competitive burnout and coping strategies of competitive stress comparison by athletes' level

Variable	Level	N	Mean	SD	t-value	p-value
Emotional and physical exhaustion	National level	20	27.65	9.06	0.78	.435
	National game	94	26.36	6.08		
Perception of personal sport performance	National level	20	38.00	10.62	1.81	.072
	National game	94	34.61	6.81		
Psychological withdrawal	National level	20	15.70	3.15	2.73 *	.007
	National game	94	13.55	3.20		
Devaluation by coach and teammates	National level	20	13.05	6.56	0.67	.503
	National game	94	12.15	5.18		
Negative self concept of sport ability	National level	20	9.55	4.08	-1.19	.237
	National game	94	10.54	3.23		
Avoid coping	National level	20	20.95	4.95	2.41 *	.017
	National game	94	18.35	4.25		
Problem-focus coping	National level	20	71.15	13.61	2.80 *	.006
	National game	94	61.89	13.41		
Emotion-focus coping	National level	20	59.75	11.75	2.53 *	.013
	National game	94	53.29	10.05		

* $p < 0.05$

From Table 4, we can obtain the variation analysis result of "Devaluation by

coach and teammates" is significant. It means that the more training time, the more Emotional and physical exhaustion. Furthermore, due to athletes often practice together with coaches and teammates, the negative evaluation of athletes is occurring easily. It shows that whether the different training time will influence the strategies of coping stress. The results shows that the emotion expressiveness of athletes training 6 ~ 7 days per week are better than 4 ~ 5days per week.

Table 4. The competitive burnout and coping strategies of competitive stress comparison by training time

Variable	Days	N	Mean	F	post hoc
Emotional and physical exhaustion	Less than 3 days	14	25.21		
	4 ~ 5 days	76	26.11	2.00	
	6 ~ 7 days	24	28.92		
Perception of personal sport performance	Less than 3 days	14	35.50		
	4 ~ 5 days	76	35.14	0.01	
	6 ~ 7 days	24	35.21		
Psychological withdrawal	Less than 3 days	14	14.79		
	4 ~ 5 days	76	13.78	0.55	
	6 ~ 7 days	24	13.92		
Devaluation by coach and teammates	Less than 3 days	14	10.57		
	4 ~ 5 days	76	11.80	4.02*	6 ~ 7 > 4 ~ 5
	6 ~ 7 days	24	14.92		
Negative self concept of sport ability	Less than 3 days	14	10.43		
	4 ~ 5 days	76	10.29	0.07	
	6 ~ 7 days	24	10.58		
Avoid coping Problem-focus coping	Less than 3 days	14	17.57		
	4 ~ 5 days	76	18.41	3.34	
	6 ~ 7 days	24	20.79		
Emotion-focus coping	Less than 3 days	14	67.50		
	4 ~ 5 days	76	61.41	2.73	
	6 ~ 7 days	24	67.88		
Avoid coping	Less than 3 days	14	58.71		
	4 ~ 5 days	76	52.18	5.48*	6 ~ 7 > 4 ~ 5
	6 ~ 7 days	24	59.00		

* $p < 0.05$

3.3 The correlation between table tennis athletes' coping strategies of stress and competitive burnout

From Table 5, we can know the relation between "Emotional and physical exhaustion" and "Avoid coping", "Devaluation by coach and teammates" and "Avoid coping" is significant positive. It means that table tennis athletes have the idea to evade problems or stress when they "Emotional and physical exhaustion" and "Devaluation by coach and teammates". The relation between "Perception of personal sport performance" and "Problem-focus coping", "Psychological withdrawal" and "Problem-focus coping" is significant positive. It means that the athletes with higher "Perception of personal sport performance" will seek the solution to solve problem or stress. The relation between "Perception of personal sport performance" and "Emotion-focus coping" is significant positive. It means that the athletes with higher sports sense will seek some others persons' support to solve problems.

Table 5. The correlation matrix between coping strategies of stress and competitive burnout

variable	Emotional and physical exhaustion	Perception of personal sport performance	Psychological withdrawal	Devaluation by coach and teammates	Negative self concept of sport ability
Avoid coping	0.19*	0.12	0.15	0.23*	0.12
Problem-focus coping	−0.10	0.59*	0.48*	−0.06	−0.18
Emotion-focus coping	0.05	0.47*	0.47	0.02	−0.06

* $p < 0.05$

4 Conclusions and Suggestion

4.1 Conclusions

The purposes of this study were: 1. to compare the differences of competitive burnout and coping strategies of college table tennis athletes with different demographic variables, and 2. to explore the relationship of college table tennis athletes' competitive burnout and coping strategies. The findings were as followings.

(1) Male athletes had higher scores of "devaluation by coach and teammates" than those of female athletes.

(2) National level athletes had higher scores of "psychological withdraw-

al", "avoid coping", "problem-focused" and "emotion-focused" than those of national-game level athletes.

(3) The athletes who practiced 6 ~ 7 days a week had higher scores of "devaluation by coach and teammates" and "emotion-focused" than those of the athletes who practiced 4 ~ 5 days a week.

(4) There was not any difference of competitive burnout and coping strategies of competitive stress between the athletes with different sport years.

(5) There were positive correlations between "problem-focused", and "emotion-focused" with "the perception of personal sport performance", and "psychological withdrawal". There was negative correlation between "problem-focused" with "total competitive burnout". There were positive correlation between "avoid coping" and "emotional and physical exhaustion" with "devaluation by coach and teammates".

4.2 Suggestion

4.2.1 The coaches should counsel athletes based on background for reducing their sports burnout

The results of this research presents the degree of athletics burnout occurring by male athletes which is higher than female athletes. Because of the stronger competitiveness the more competitive pressure brings. Therefore, the competitive burnout for sportsmen will occur. Coaches should offer male athletes counseling duly for avoiding pressure when training. Secondly, the athletes have more time to train will respond high score in criteria Emotional and physical exhaustion and Devaluation by coach and teammates. It means heavy training will make athletes feel exhausted and attract coaches or teammates negative evaluation. Therefore, to arrange training suitably will enhance the performance of athletes. Otherwise, heavy training will make athletes feel exhausted.

4.2.2 The coaches should counsel athletes to adjust themselves pressure

For achieve nice results of race will cause pressure. The pressure is not only from themselves, but also from coaches, teammates or parents. In the violent competition environment, athletes must handle pressure flexible. Don't keep the defeat in mind in order to avoid competitive burnout.

4.2.3 The researcher can expand the level of athletes in the future

It means to compare the difference of athletes' competitive burnout with different education phase. It is helpful for the coaches to know the psychological condition of young athletes. If the coach can know the competitive burnout of teenagers player, he/she can adopt some suitable strategies to help the athletes. Additionally, this article only discusses competitive burnout, the strate-

gies of coping competitive stress with sex, athletes' level and training time. In the future, we can study the effects of participating motivation and organizational factors on athletes' coping strategies of stress and competitive burnout.

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33 Effect of task modifications on the forehand drive of skilled table tennis players

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1 Introduction

In open skills, like those performed in table tennis, it is essential to overcome changing environmental conditions in order to succeed. Highly skilled players are able to face most of the changing conditions related to ball variations such as spin, velocity, and location of the ball. It makes the study of how skilled players adapt their behavior to varying conditions an important subject of investigation. In table tennis, they may do that by changing stroke techniques – from forehand spin to backhand block for example. However, a second possibility to handle changing conditions, the focus of the present study, is to perform the most efficient or preferred technique over and over again. When one observes a specific stroke it is possible to realize that skilled players seem to consistently repeat a movement pattern. Nevertheless, we know that it is unlikely to execute the same movement twice (Bernstein, 1967). Therefore, in the study of how skilled players adapt their behavior to different conditions two characteristics of the movement should be considered: consistency and variability (Bartlett, 1932; Manoel and Connolly, 1995).

Two major approaches to study skilled motor behavior may be recognized. One is comparing experts and novice subjects in order to understand what could explain differences in performance, for example cues sources for act-

ing. Another is analyzing, via kinematics, skilled subjects performing movements in their specific dominium of expertise.

In relation to the first possibility, some studies have revealed that skilled subjects, in racket sports, rely on the same sources of information than novices. Therefore, the differences in performance may be attributed to a better use of information than to the use of different sources of information to act (Abernethy and Russell, 1987; Abernethy, 1990ab). In addition, the studies comparing expert – novice differences have showed that both skilled and unskilled subjects cannot track fastballs during their entire trajectory before hitting it. Thus, we might deduce that rapid movements executed in open skills are probably pre – programmed (Ripoll and Fleurance, 1988; Davids et al., 1989; Ripoll, 1989; Rodrigues et al., 2002). Furthermore, rapid movements (about 200 msec) like those executed in racket sports are more likely to be performed in an open loop fashion. These evidences lead us to consider the concept of motor programs controlling movements in open skills, like those performed in table tennis. Nevertheless, the notion of such a motor program must account for the variability and consistency in highly skilled motor behavior.

Regarding to kinematics analysis of motor expertise, some studies with open skills have showed that skilled performers rely on the production of very consistent movement times. Possibly, they do so to make the task easier to control (Wollstein and Abernethy, 1988). However, in some studies, researchers did not introduce modifications on the task employed to examine the ability to deal with near real playing conditions (Hubbard and Seng, 1954; Tyldedsley and Whiting, 1975; Bootsma and Van Wieringen, 1990). Then, we may infer that those studies were not concerned with motor adaptation, but with motor control by highly skilled subjects in stable environmental conditions. On the other hand, taking one step further to understand adaptation in dynamic conditions, some researchers conducted studies in which velocity changes were introduced, but without considering outcome performance (Franks et al., 1985; Wollstein and Abernethy, 1988; Burgess – Limerick et al., 1991).

So, in spite of clarifying important aspects of skilled motor behavior, most of the mentioned studies seem to have left some gaps to understand adaptation in skilled motor behavior in open skills. Most important, in relation to their background, these studies sought only for consistent aspects of skilled motor behavior, what can be considered a partial understanding of the phenomenon. In other words, most of these studies did not consider variability like a complementary attribute of skilled motor behavior (Manoel and Con-

nolly, 1995; Newell and Corcos, 1993). This makes one believe that variability is merely noise in the system, which should be eliminated in highly skilled performance (Schmidt et al., 1979). Though, it is worth to note that Burgess – Limerick et al. (1991) found that highly skilled hockey players were more variable than their novices' counterparts in the relative backswing duration.

One possible way of investigating consistency and variability in skilled motor behavior according to the idea of motor program, independently of the adopted approach, is the observation of relative and absolute measures of the movement (Schmidt, 1985; Tani, 1995; Kelso, 1997). However, like Riley and Turvey (2002) have pointed out, programs are deterministic and modifications of program concepts have considered variability like noise. Adopting an alternative approach to variability, we will discuss the results considering consistency and variability as complementary aspects of behavior.

The aim of this study was to investigate the ability of highly skilled subjects in overcoming different modifications of the task (Franks et al., 1985; Wollstein and Abernethy, 1988; Burgess – Limerick et al., 1991) while keeping their performance. More specifically, our focus was to investigate how skilled table tennis players respond to task modifications. Implications for the conception of motor program are discussed as well as the role of variability in skilled motor behavior.

2 Methods

2.1 Participants

Subjects were seven highly skilled table tennis players, all of them right handed who had previously been members of the Brazilian national team in the last 2 years (6 male and 1 female). All the participants were still active, and played table tennis at least 3 times a week when the data were collected. The mean age of the subjects was 27.85 years (± 5.36) and the mean experience time was 19.14 years (± 5.24).

2.2 Task

The task was to hit a ball to one target using the table tennis forehand drive. As the robot launched a ball in the pre – programmed condition, the subject tried to drive it into the center of the secondary target as accurately as possible. The target, located at the opposite side of the table, had five point gradations (40, 30, 20, 10, and 0).

2.3 Procedure

Subjects were required to hit the target as accurate as possible, without concerning about the speed or strength to contact the ball. The conditions presented to the subjects were the followings: 1) two bounces (one before and another after the net) with topspin, 2) two bounces with sidespin, 3) one bounce (after the net) with topspin, and 4) one bounce with sidespin. As a result of the changes in effect (topspin and sidespin), and in bounce (straight or bounced), there were changes in ball's speed. In conditions 1 and 2, the arrival speed of the ball (before the stroke) was approximately 4.5 m/s, while in conditions 3 and 4, approximately, 8.8 m/s. The rating of ball throwing was 60 balls per minute.

Description of the phases

At first a complete stroke was divided into two phases: backswing and forward swing. The beginning and end of the backswing was determined at the moment the mark on the racket tip was at minimal speed displacement relative to the direction of the oncoming ball. The forward swing started immediately after the backswing, and continued until the moment of minimal striking velocity, when the racket moved in the opposite direction of the oncoming ball.

In order to analyze the movement in detail the forward swing phase was also divided into two phases: contact and follow – through phases. The contact had its beginning immediately after the backswing and finished at the moment of contact with the ball; consequently, the follow – through started after the contact of the ball with the bat and finished prior to the beginning of the next backswing phase.

3 Results

A one – way analysis of variance with repeated measures was conducted for each variable (temporal and spatial). Statistical significance was set at a $P < 0.05$ for all tests. Significant main effects were followed up with pairwise comparisons using the Tukey (HSD) post hoc test.

Table 1. Mean and standard deviations of all dependent variables (mean *sd*).

Variables	Conditions				
	1	2	3	4	Post hoc test ($p < 0.05$)
Score	30.57 ±1.06	30.00 ±3.50	24.71 ±3.86	23.21 ±5.32	1 &2≠3 &4
Rel. time back (%)	55.28 ±2.66	55.66 ±3.31	56.26 ±7.14	55.35 ±5.90	None
Rel. time forward (%)	44.80 ±2.70	44.35 ±3.31	43.74 ±7.14	44.65 ±5.90	None
Rel. time contact (%)	17.32 ±2.84	17.54 ±2.52	12.40 ±3.39	11.74 ±2.43	1 &2≠3 &4
Rel. time follow (%)	27.40 ±3.19	26.81 ±2.57	31.34 ±6.86	32.90 ±5.59	1 &2≠4
Abs. time back (ms)	543.59 ±30.71	545.97 ±49.19	551.27 ±77.68	540.67 ±69.30	None
Abs. time forward (ms)	440.23 ±28.59	433.98 ±29.35	427.43 ±66.38	434.87 ±54.93	None
Abs. time contact (ms)	170.49 ±24.04	171.03 ±18.18	120.99 ±31.65	114.02 ±20.88	1 &2≠3 &4
Abs. time follow (ms)	269.74 ±36.37	262.95 ±31.39	306.44 ±66.13	320.85 ±55.42	1≠4; 2≠3 &4
Rel. disp. back (%)	43.96 ±6.45	46.17 ±3.33	41.52 ±9.56	42.12 ±10.15	None
Rel. disp. forward (%)	56.04 ±6.45	53.83 ±3.33	58.48 ±9.56	57.84 ±10.14	None
Rel. disp. contact (%)	23.85 ±7.36	21.76 ±7.27	18.77 ±9.12	16.41 ±9.24	1≠3 &4; 2≠4
Rel. disp. follow (%)	32.19 ±7.61	32.07 ±6.46	39.71 ±7.88	41.43 ±7.27	1 &2≠3 &4
Abs. disp. Back (cm)	91.02 ±29.62	92.96 ±20.97	69.44 ±28.27	65.76 ±23.79	1 &2≠3 &4
Abs. disp. forward (cm)	112.06 ±22.17	108.23 ±23.29	94.31 ±26.12	89.38 ±30.02	1≠3 &4; 2≠4
Abs. disp. contact (cm)	47.96 ±15.25	44.34 ±16.76	31.19 ±15.79	25.89 ±15.45	1 &2≠3 &4
Abs. disp. follow (cm)	64.10 ±16.01	63.89 ±15.37	63.12 ±16.20	63.49 ±19.83	None
Var. abs. time back (sd)	22.87 ±7.70	17.50 ±5.53	21.83 ±11.57	24.56 ±3.93	None
Var. abs. time forward (sd)	17.91 ±4.09	16.07 ±3.75	20.68 ±10.11	23.48 ±5.11	2≠4
Var. abs. time contact (sd)	11.27 ±2.29	11.70 ±2.09	13.59 ±3.24	13.53 ±2.03	1 &2≠3 &4
Var. abs. time follow (sd)	13.50 ±4.33	12.25 ±5.54	18.63 ±13.59	20.91 ±6.66	None

Note: *rel.* = relative; *abs.* = absolute; *disp.* = displacement; *back* = backswing phase; *forward* = forward swing phase; *contact* = contact phase; *follow* = follow – through phase; *var.* = variability.

4 Discussion and Conclusion

To investigate how highly skilled table tennis players adapt to different modifications of the task, we introduced four different task constraints commonly found in table tennis matches. Compared with the performance of table tennis players in other studies (Bootsma and Van Wieringen, 1990; Rodrigues et al., 2002) our subjects showed good performance to hit the target in all conditions.

Firstly, introduction of sidespin on the ball (condition 2 and 4) did not require any modification in terms of temporal or spatial movement organiza-

tion. However, the sidespin effect made conditions 2 and 4 more difficult to accomplish.

In analyzing backswing and forward swing phases of the forehand drive, we found that there were no changes in the movement pattern. However, a more detailed analysis of the forehand drive showed that the contact and follow – through phases were modified, probably, in order to deal with task modifications. Besides, these modifications helped to hold the forward swing phase invariant. Perhaps, keeping the backswing and forward swing phases temporally preprogrammed may decrease attentional burden for the subjects, what may reduce problems to control temporal features of highly skilled motor behavior. Furthermore, it could allow the subjects to pay attention on more relevant aspects in real game conditions, e. g. opponent's motion, ball trajectory. These findings are similar to those reported by Tyldesley and Whiting (1975), Wollstein and Abernethy (1988) concerning the operational timing hypothesis. However, the locus of invariance is different from that proposed by Tyldesley and Whiting (1975), since that the contact phase was modified in some conditions, while the backswing and forward swing showed to be invariant.

In relation to displacement, the subjects kept relative displacement in the same way they kept the relative time. However, absolute displacement was modified for almost all phases, exception done to the follow – through phase. Since that the follow – through phase was kept invariant in absolute terms, it seems reasonable to think that absolute displacement was not rescaled. Thus, displacement does not seem to be high level represented or motor program stored for the task analyzed here.

In short, the importance of temporal aspects for highly skilled motor behavior seems to reveal that absolute time is high level represented. Such observation is convergent with that proposed by Teulings and Schomaker (1993) and Teulings (1996), where they mention that in tasks with high temporal demand, timing may be what constitutes the high – level movement information. On the other hand, the contact phase allows adaptation and, when necessary, seems to be easily modified.

We believe that the action program model put forward by Manoel et al. (2002) could help to explain our results. According to Manoel et al. (2002) action programs are hierarchically organized at two complementary levels: a macroscopic level, and a microscopic level. The macroscopic level would be responsible for invariance at more global analyses of the movement. Our results indicate that this macroscopic level was reflected in the relative and absolute time of backswing and forward swing phases of the movement. On the other hand, at the microscopic level we could find more variance for the phases. However, this higher variance at the microscopic level is not under subjects control but constrained by the invariance at the macroscopic level (Ma-

noel and Connolly, 1995). It means that in spite of selecting a macroscopic structure responsible for invariance, the subjects had opportunity to use flexible components or phases of the movement at the microscopic level within imposed boundaries by the macroscopic level. In terms of our results, this microscopic level seems to be reflected in the flexible use of time (relative and absolute) in the contact and follow – through phases, which were affected by modifications on the task. This possibility makes tenable store more global components of the skill at a high – level representation or at the macroscopic level. Selection at the macroscopic level would be done in a hierarchical fashion to form a movement pattern more complex, while letting room for variability that may be useful to deal with task constraints. This notion of action program outlined by Manoel and Connolly (1995) and Manoel et al. (2002) seems to be cohesive to the notion of motor control organized as a hierarchy of levels presented by Tresilian (1999) for reaching and grasping movements, where computational burden and variability problems are accommodated.

In addition to that, we might imagine that there is a hierarchy of preferred modifications of movement pattern. This way, the subjects would rather change displacement instead of time, contact and follow – through phases instead of forward swing phase, and so on. It means that the subjects try to keep important characteristics of the movement pattern unless they cannot achieve their goals without modifying these characteristics.

It is interesting to point out that the contact phase, perhaps the most important phase for adaptation, the mean standard deviation was significantly higher in conditions 3 and 4 than in conditions 1 and 2. This augmented variability can be understood as functional variability that confers flexibility to movement pattern in order to overcome task requirements (Manoel and Connolly, 1995; Bootsma and Van Wieringen, 1990; Burgess – Limerick et al., 1991; Davids et al., 2003). Nevertheless, it is possible to argue that this increased variability is noise related (Schmidt et al., 1979). For example, Newell (1980) showed that ballistic movements are temporally less precise when performed with slower velocities. On the other hand, spatial accuracy tends to decrease with higher speeds, exception done to movements performed with near maximum force (Schmidt and Sherwood, 1982). So, if temporal precision was more important than spatial accuracy, they should increase velocity at ball/bat contact. Our findings suggest that temporal features are highly important to accomplish the task, but, even so, they chose to decrease bat speed to intercept faster balls. Then, we fell attempted to say that they chose to produce inherently more variable movement patterns, and this predicted additional variability may provide flexibility to deal with task requirements (Manoel and Connolly, 1995). This increased variability indicates abundance of systems resources, and together with contact phase modification it allows adapta-

tion to different constraints in real games.

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34 Significance and strategy of building psychological contract of an athlete team at university

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1 Introduction

Stephen Robins (1994) believed that, a team referred to an official community composed of interoperated individuals to achieve a certain goals. This definition emphasizes the difference between a team and a community. All teams are communities, but only official community can be a team. Then, after making close study on differentiating a team and an ordinary community, he had the following four conclusions. First, a community emphasized information sharing, while a team focused on team achievements. Second, the function of a community is neutral (sometimes is negative even), but that of team's is usually positive. Third, a community needs individual responsibility, however, a team's responsibility is possibly individual's, or sometimes belongs to the whole team. Fourth, a community's skills are stochastic or different, but those of a team are mutually supplemented.

Social approval and society display are the two main factors that decide whether teamwork would succeed or not. Social approval means that people are used to thinking in the way of "others – we" idea pattern to view the world. People always prefer to define themselves to some kind of circle, distinguishing from "others" and being proud of them by making some real achievements to their circle. The above is the mechanism of society approval. On the other hand, society display refers that all team members share the same belief and criteria, and adjust each one's hobby and behavior to reach rationalization. Generally speaking, change from traditional hierarchical system structure to organizational structure based on teamwork, is a process from quantitative to qualitative.

As for a university ping – pong team, trust and promise should be paid highly attention. Nevertheless, what drives trust and promise? Why some teams' performance is always not very well and the players usually think lowly of themselves? That's because they seldom understand that trust is the link between coaches and athletes, worse more, they don't know that psychological contract underlying trust is a constraining power.

2 Intention and significance

Based on administration related theory, this article analyzes the significance and function of team management from the view of psychological contract and brings forward some corresponding suggestions.

As a certain group, college ping – pong team has some special implications. First, the team needs to attract, keep and improve the relationship with its players. Second, the team should be built up, developed and maintained in a dynamic period. Third, the team works in a process from making to keeping and realizing a promise. Then, the importance of building up lasting relationship between coaches and players must be consolidated in those implications, which has changed and extended the single view used before.

Psychological contract is the harmonic psychological link between coaches and players, which plays an important role in the teamwork. Building up psychological contract is significant in inspiring the players, keeping group's potential, and realizing the final goal of the team.

Although there is little about psychological contract and its administrative function nowadays, it is a brand – new idea and a valuable try to apply the psychological contract theory to the sports team management and conduct deeper research into the essence of the relationship.

3 Significance and function of psychological contract in sport team

Psychological contract is a concept proposed by Levinson in 1960's. It is kind of mutual expectation between the organization and its staff. According to different levels of a college sport team in a certain period of time, together with development requested by athlete psychology level, the psychological contract can be adjusted to develop this relationship, in order to avoid bad results arising from the imperfect system. Simultaneously, the psychological contract is a mutual expectation between a trainer and an athlete.

University student athletes own their specialties such as individuality, diversification, and innovation spirit. They have relatively high sport technical skills, professionalism, and a strong desire for achievement. They are willing to challenge themselves, pursue for realization of their self – value and a lifelong sustainable development. So that's why they not only maintain a higher athletics technical level, but also pay greater attention to social acknowledgement and approval.

1. In order to manage student athletes, university sport teams formulate rules and regulations such as the team gauge, the attendance – checking system, and bonus. But due to great changes of environment and objective reality

situation, these systems can not cover all kinds of relations including athletes, trainers and the universities. However, the psychological contract is able to adjust and develop these relations, according to different levels of a university sport team during a certain period of time, avoid bad results created by the imperfect systems.

2. Psychological contract is a mutual expectation between a sport team's trainers and athletes. University student athletes unceasingly use psychological expectation to check whether their own words and actions are consistent with their team's development, to enhance their loyalty to the whole team. As for a trainer, building up psychological contract may reduce the management cost while increase the efficiency by effective interaction. Thus, this kind of invisible contract can arouse athletes' enthusiasm, develops their potential, and realize the sport team's innovation.

3. Psychological contracts may fill athletes with psychological expectation and actual goal. For example, if the trainer pledged to give athletes higher bonus, opportunity to enter graduate study and richer life, athletes would regard them as return of their hard work, which would stimulate their enthusiasm.

4. Psychological contracts may lead athletes to believe in team's development. The more psychological contracts between athletes and the team, athletes would have the higher degree of satisfaction, confidence and the enthusiasm.

Obviously, psychological contract is a harmonious psychological link between trainer and athletes, which contributes a lot to a team's success. Building up psychological contract have great significance in arousing athletes' enthusiasm, maintaining athletes' and the team's potential, and realizing the team's ultimate objective .

4 How to build psychological contract

4.1 Set value target and keep coherent expectation

As to athletes, there are two demands which must be in accordance with valuable aim. On one hand, it should suit their value. On the other hand, it should be challenging. Whether a team's goal is significant or not depends on the degree to which the goal fit to the common value of the team members. According to university student athletes' characteristics, it's hard to manage them by means of pushing or controlling. Experienced trainers understand that they must focus on the objective of team, and let athletes understand their contribution to the team.

4.2 Lay stress on policy and set the form of contract

To set up the atmosphere of trust, care and support of each other, there are

four things must be dealt with: tolerating the personality, leading by caring effectively, forming the interior agreement to ensure them support to each other and making sure enough information – sharing. How the trainer trusts his athletes decides his management style. The best formation of dynamic team's is a trusty spirit which is made of the different values and different expectation.

4.3 Improve self quality and perform pragmatically and honestly

The coach is responsible for taking the dominant action in performing the contract in the administration of the sports team. He must direct work systematically to approach a certain goal, form a capable directing system, and make his creativeness realized and tasks fulfilled in the limited training time by the athletes.

Managing a university sport team, the trainer is in charge of various aspects such as athlete's training, competition, study, life. He should set his own plan and leadership as the team's guiding principle, and to lead athletes to be willing to fulfill responsibility, high efficiency.

5 Conclusion

In conclusion, psychological contract is a brand – new topic in the field of physical education management. Thus, we need to conduct deeper research into the essence and working process of psychological contract, if we expect better performance of it.

35 Trait analysis of top ranking table tennis players

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1 Introduction

Success of athletes depends on hard training. What's more important is that the player can focus on self – education by self – discipline during the growing process. Learning the successful experience of world champion players and self – education are the common emphases and measures for coaches and players in the training process, and also it is the shortcut and direction for training excellent athletes.

If the table tennis players want to obtain the world championship or improve their sports achievements, they must go through tough training every day. The players must surpass themselves in capability, psychology, and mind every day. The bitterness, tiredness, injury, sickness, and pain can only be tasted by the players themselves. Therefore, in order to conquer the pains of training, besides encouragement by other people, high – level players must have the ability of self – education, and surpass themselves against rivals in hard training and competition.

The world champions of table tennis all have their ways to success. We can take their common characteristics of successful experiences as the reference for coaches to educate their players and the self – education reference for players. This can shorten the exploration process and speed up the process to excellence.

2 Methods

This essay takes 20 Table Tennis World champions as the main research objectives, with induction as the research method.

3 Results

The most important thing for a successful player is the cultivation of self – education. If a player worships the world champion and learns the common

characteristics, with verve above the world champion, then he/she can become the future world champion one day.

3.1 The successful experience of the world champions

3.1.1 Waldner

Waldner found that the Sweden mode had one advantage: players must be responsible for their own games and training. Therefore, he was conscious of developing a style suitable for himself. He said that a good athlete must have a good serve, and learn how to deal with various plays under different circumstances.

He realized that in the game, he must solve the problem by himself to win. His characteristics were that he was good with the first three bouts, with comprehensive skills, and at observing and judging the rivals' intention. He had the concept of changing tactics.

3.1.2 Gatineau

He believed that extra speed and abnormal psychological characteristics were two valuable factors to success. If one player had advantages, he must bring the advantages to the utmost, and exceed the extent normal people accept. He also paid attention to the pace movement and hand skills, and also studied the psychological status of his rivals. The world – class matches were psychological battles. The key to his success was genius with diligence. He was modest, polite, and respectful to his rivals. He would shake hands with them just after the match. He never neglected any loser, and never despised any rivals.

3.1.3 Liu Nan – Kui

Liu Nan – kui was modest and adaptive, good at imitating with painstaking training. He combined the Japanese forehand attack, pace, and fast attack with the serve of Mainland China. On one hand, he mastered excellent skills. On the other hand, he improved his physique and psychological energy, formed his unique technological features, and succeeded. During the three years from 1985 to 1988, he changed from an excellent young player to a world champion. He had seven secrets:

Alternatively use high and low tosses to sever with increased spin and changeable and skillful techniques and tactics

Increase bursts on hitting the ball, with higher swing

Fast – changing gravity by pace movements

Change the middle table attack to close table high – point attack

Understand the rival's play, techniques, and personality

Train well and have hard fortitude

A complete set of changeful back hand skills

3.1.4 Hasegawa

In order to overcome stress before the game, first, I did many physical exercises after technique training, especially jogging. This was to gain strong will, duration, and attention in the game.

Second, on the night before the game, in addition to examining rubber and racket, I would analyze and research the rival's advantages and disadvantages and the plays that I will use. Then I would welcome the game with confidence. On that day, during the time before the game, I would think the tactics over again and again.

3.1.5 YitenFenshion

In training or competition, in order to overcome the bad competition state, first I must have an iron mind. I will observe and explore the rival, wait, and find chances. I must compete with the most skillful technique on the game. Then I can definitely overcome the bad competition state. Second I shall have active emotion full of mettle, and pay attention to related issues on techniques.

3.1.6 Zhuang Zedong

Two factors to win the world champion: innovation is the secret, and vigor is the key. During the training you must pay attention to feelings on every bat. Different forces and different parts of the racket shall be used to hit the ball.

3.1.7 Li Furong

To become an athlete, you must win established sportsmen. Otherwise, you are nothing. The world gives one way to winners: to train again and again. You must have the mind of revenge, the mind of winning, and the sense of honor. Your mind shall be full of game and victory. This is the best personality of a player, liked by coaches and feared by rivals.

To win excellent scores, the function of the coach is limited. More emphasis is put on the player's efforts. The player must have the spirit of never thinking of being defeated, not being scared by defeat, and not admitting defeat.

3.1.8 Guo Yaohua

To be an excellent player, you must cultivate the superiority complex of yourself. This is the different psychological mind brought by comprehensive strength. On whatever stage, fighting and initiative shall be given predominance.

During the game, you shall pay attention to psychological analysis. You shall play a psychological battle. To be a champion, you must be mature in

mind as well as in technology. Before the game, you shall make your mind quiet, gradually adjust your emotion, and bring techniques and skills to full play with an excellent competition state.

3.1.9 Cai Zhenhua

Big games examine the player's six comprehensive capabilities, namely on – spot advantageous state, psychological quality, competition experience, capability to handle emergencies, stable performance, and technique strength.

3.1.10 Jiang Jialiang

Before the game, I carefully prepared to enhance my self – confidence under the guidance of coaches. During the game, I was confident of winning the game, and struggled boldly. My mind was concentrated on concrete tactics, and how to bring my skill to full play.

In order to win a single game, first the athlete must eliminate miscellaneous thoughts on how to win the stronger rivals in the next game before winning the weak rival in this game. Second, the athlete must have a stable psychological state and the capability to correctly judge and analyze the situation.

3.1.11 Hui Chun

You must have a long – range perspective. If you want to make a breakthrough in techniques, you must fight against the rival on skills, on mind struggling, and on courage. You must have a strong aggressive mind.

3.1.12 Kong Linghui

Playing table tennis needs enthusiasm, fortitude, ideal, and mind. Strength + opportunity = success. During the most difficult time, the key thing is self – confidence. During the game, you must find the shortcoming of the rival, and attack it with changeable tactics

My experiences and lessons on playing table tennis were to study others, including foreign players' techniques, and discuss them with the coaches. Then, I made a plan and an objective, and clearly wrote it on a notebook.

3.1.13 Chuang Chih – Yuen

Through the parasitic growth mode, we shaped an athlete combining Asian speed and European back – hand attack technique styles. He had comprehensive skills, balanced attack and defense, aggressive and changeable play, and rich game experience. The main tactic was fast pace attack and changeable play.

3.1.14 ShangchunChiozi

The methods that I use to overcome the bad competition state and eliminate intense emotions are as follows: first, to do down – to – earth training; second, the contents in skill training include stipulated bats exercise, comprehensive exercise, and exercise of full games; third, when I am in a bad competition state, I practice with all kinds of players; fourth, one or two weeks before the game, all I think, say, and do must be related to the game to avoid other things affecting my emotions; fifth, the training plan and contents before the game must be adjusted and changed according to the current real situation; sixth, pay attention to daily dinners and life system.

3.1.15 Zheng Minzhi

A player must undertake anneal physically and psychologically, fighting against the rivals in the competition, against his/her own sickness and injury, against social contagion, and against the difficulties in life. A table tennis player must know friendship, must be agile and honest. During spare time, you shall be good at learning classical literature and heroic things, collecting articles about morals and culture from periodicals and newspapers, and cultivate his/her will. This is because a tough mind and psychology must be fostered voluntarily. People must have some energy, and playing ball must have a fortitude spirit, and conquer every difficulty.

3.1.16 Chi Pao – Hsiang

She put herself to a low position. On the training ground, she arranged a large quantity of training voluntarily with fortitude. She required the coaches to enlarge difficulty, practice mind and physique. She carefully observed the serve, receiving serve of old players. She was modest and adamant.

3.1.17 Chiao Chih – Min

The preparation in the past time shall require me to hold on higher standards, and I shall not let the coach to lower the standard to adapt me. When defeated, on one hand, I must get familiar to the score techniques to make up the shortcomings; on the other hand, I will observe carefully to research the shortcoming of Asian and European players. I will also have a comprehensive picture of each one's skills, tactics, temperament, and personality, so I can be more aggressive in the game.

3.1.18 Ken Li – Chuan

We must continue to bring the spirit of struggle to full play, without being afraid of bitterness and tiredness. Especially, we must pay attention to overcoming the conservative and stable spirit in the game. What I feel most is that

before and during the game, under whatever disadvantageous situation you can always win as long as you trust yourself.

3.1.19 He Zhili

Calm in the game, she was a fierce player with fast speed and tricky points of fall. She made an ambitious goal in 1984: become the national champion in one year, become the Asian Champion in two and three years, and become the world champion in five to six years. In 1989, she won the female singles in the 39th world cup.

3.1.20 Deng Yaping

She said: "I won the awards on behalf of the group; the honor belonged to all of us." She played every ball like a tiger, and was full of the mettle to conquer. With the mind to attack, attack, and attack, she showed her vigor. She is less than 1.50 meters. She won the world champion with excellent physiques, fast paces, a fortitude mind, and painstaking skills.

She desired to get the championship more than anyone else. She seriously spent every minute, and played 40 minutes more than others. She had a saying that no practice in one day would make me know it, no practice in two days would make the coach know it, and no practice in three days would make the audience know it. She required herself to practice 10000 spins every day, and have very good self – discipline.

3.2 The self education of excellent players

In order to train excellent players, besides creating a good environment and emphasizing the coach's leadership role, we must also pay attention to the self – education of players.

3.2.1 The meaning of self – education

Self – education is to increase the self – knowledge and skill with purpose, and to affect the forming of self – moral character. During the process of developing one's own intelligence and physique, we shall fully bring the individual initiative into full play, using certain measures and methods to educate one actively.

The process of self education is as follows: to realize the self – value→self – requirement conciousness appears→self – improvement objective appears→use self – order, self constraint, self – discipline, and self encourage→through concert contents to teach oneself→to realize the goal of self – improvement.

3.2.2 The importance of self – education

The most distinctive characteristic of self – education is to combine the object

and subject of the education together, and bring the initiative, self – consciousness, and enthusiasm into full play. There are self – education issues in everyone's life, self – education is a method, and also a form, the subject consciousness is the theoretical basis of self – education.

Self – education is the motivation for the player to succeed. During the training process, in addition to the tutorship of coaches, the players can clearly understand their shortcomings and advantages through self – education, and on which aspects he shall make efforts.

With the development of science and technology, scientific training, the improvement of the perception of players, especially the perception of self – value, the requirement on the players' self – education will become higher.

3.2.3 The contents of self – education

3.2.3.1 Sports spirits

Patriotism of winning honor for the motherland

Persistent ambition to become a world champion

Strong affection and sense of responsibility

Solidification, the spirit to sacrifice him –/herself for the honor of the group

No arrogance on winning and no dismay on failure, untiring effort for improvement, tenacity, and determination

Diligence, hard work, careful and rigorous, striving to seek truth

High confidence

3.2.3.2 Training of excellent psychological status

Psychological capability is an important factor for competing capability. For excellent players, good psychological quality becomes more and more important. Therefore, the players must understand their own psychological characteristics and master all methods for self – adjustment to make them in a good psychological state.

3.2.3.3 To improve professional theoretical knowledge

In addition to technique improvements, the improvement in theoretical knowledge of the player can better guide himself or herself in training. The main efforts shall be put on the recognition of table tennis development characteristics and situation. Especially, they shall pay attention to the world – class players, and to development in techniques and skills. They shall be good at collecting relevant data from the common games and periodical reports.

3.2.4 Method for self – education

3.2.4.1 To continuously reflect on oneself

The reflection of oneself is to recognize the player himself over again and again. Continuous reflection will continuously understand the advantages and disadvantages of one, and keep a calm and clear mind.

3.2.4.2 To consider thoughtfully

The player must think about more questions, and solve the issues on improving the skills.

3.2.4.3 To write a training diary

The player shall take the training diary as a part of the training. The training diary is the process in which the player reflects and examines the training of the day. By writing a training diary, sometimes the player obtains more than mere the training. Therefore, the training diary is precious first – hand data.

3.2.4.4 To become an observant and conscientious person

As long as a player is observant and conscientious, he can learn a lot from the surrounding environment.

3.2.4.5 Learning through conversation

Young players generally like chatting. During games, the players can get much knowledge from the conversation with players of other teams and coaches. Also, they improve their communication skills at the same time.

4 Conclusions

One high level player must have a higher self – education capability. Many excellent players have proved this. Therefore, in a high competition environment, the self – education of players is more necessary and important

To learn world champions' experience is an important method to become an excellent player. Each world champion has his or her way of success. In summary there are six points:

(1) Be ambitious: swear to become a world champion

(2) Be good at learning: from native and foreign athletes and coaches

(3) Painstaking: to train hard and think hard

(4) Obvious style: the obvious style, and outstanding skill

(5) Solid skills: solid basic skills

(6) Good psychological state fortitude, and treat victory and failure correctly

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36 The research about the relationship between depth of involvement in leisure and leisure benefit of playing table tennis – taking the students who take the class of table tennis in Ta – Hwa institute of technology as an example

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1 Introduction

Table tennis is also known as Ping-Pong, originally from England, and considered by the aristocrats to be one of their favorite sports. In the beginning of the 20th Century, in Japan where the International Contest of Ping-Pong was headed, "Table Tennis" became the official game in Japan where the International Contest of Ping-Pong was headed. Table tennis is a sport that helps you develop mental and physical abilities. Its virtues include: simple and convenient equipments and location, easy to understand the rules, manageable exercise load and low injury rate, a diverse and extraordinary kind of sport. In addition, because table tennis is played indoors, it is not influenced by the weather conditions, which adds convenience to the sport (1986, Hsu Su Yuan). Therefore, the table tennis course is now the most polular one opened in the schools and universities, and there are lots of learners and a great number of students practicing it as a leisure activity. Indeed, the main goal of physical education classes in the universities is to form long – term constant practice of sports and to lead a healthy lifestyle (2004, Liu I Chun). However, according to the Center of Health website: "Among the people older than 15 years old in Taipei, 71% male and 75. 1% female are considered as deficit of active exercise." Lately in 2001, The Health Center interviewed 1099 people of 31 years old and the elders with the topic of "Citizen's frequent exercise research." by phone calls. The results showed 61% of the participants did not have a constant practice of exercise (2002, Lin Chen Chan). Biddle (2001) stated the importance of physical education class in maintaining ones good health. Coakley & White (1992) also thought the physical education environment has a main influence on teenagers to decide whether to participate in the sports or not. Consequently, the implementation of this class in educational institutes plays an important role in the exercising life of each per-

son. And table tennis is the most favorite sport of the college students. Thus, we investigate why table tennis has played an influential role in students' selection. Developing strategies to increase their exercise routine is the base of the investigation. In addition, how to make changes in their sport life and let them receive satisfaction from playing table tennis is one of the topics of this class. Therefore, this issue in leisure domain is considered as leisure benefit (Kao Chu Hsiung, 1995). However, everyone thinks differently. That is why leisure benefit includes three factors such as: balanced life experience (including: stress relieve, enrich life experience, psychological balance), perfect life connotation (including: maintaining energy, developing intelligence, promoting family relationship, improving friendship, concerning environment quality), promoting life quality (including: creating the perfection, be definite of self ability, real practice of ideals). But not just by participating you could get all these benefits, you have to get the benefits from the process of participation, and also make the right investment, like time, spirit, strength. Only by doing these you could get the benefits of leisure. Dimanche, Havitz and Howard (1991) said: participation in leisure activities has its levels and it includes behavior and social participation, based on centrality, importance, pleasure, interest, self expression, and so on. In consequence this research is based on the college students' participation in leisure, other benefit factors, and relations.

Research aim

Discuss college students' preference in table tennis. It is about the three factors and its reasons in participating level for leisure benefits.

Research supposition

Higher participation in table tennis will lead to higher balance life experience.

Higher participation in table tennis will lead to higher perfect life connotation.

Higher participation in table tennis will lead to higher life quality

The relation of the evidence of the leisure benefit between the three factors.

Glossary

Table tennis participation level: individual involvement and persistence arousal level (Sherif 1965). Defining playing table tennis core value, importance, happiness, interest, self expression and attention level (Selin & Howard 1988); operation definition pointing (participation level chart) and more attention into higher scores.

Leisure benefits: during the process of participation, if participants receive the satisfaction or proper adjustments in body conditions; operation definition pointing (participation level chart) and more attention into higher scores.

LISREL: Linear Structural Relations, by statistician Joreskog & Sorbom. According Bock Bargamann (1966) stated the covariance structure analysis. Its virtue on the analysis of causality software program.

2 Methods

Using LISREL (Linear Structural Relations analysis) pattern to show the information. First by Confirmatory factor analysis, in LISREL measurement model (Figure 1), using observed variables to connect to latent variables, and secondly using structural equation model (Figure 2) to confirm the reasons relationships.

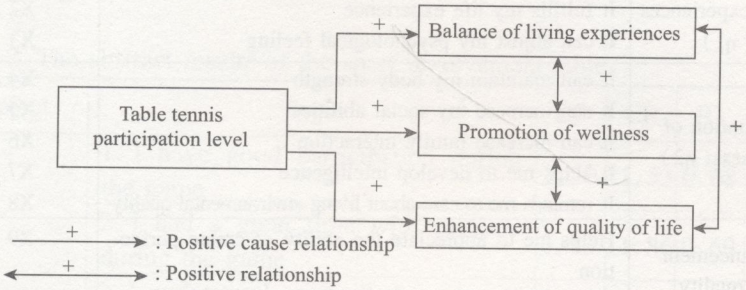

Figure 1. Research model

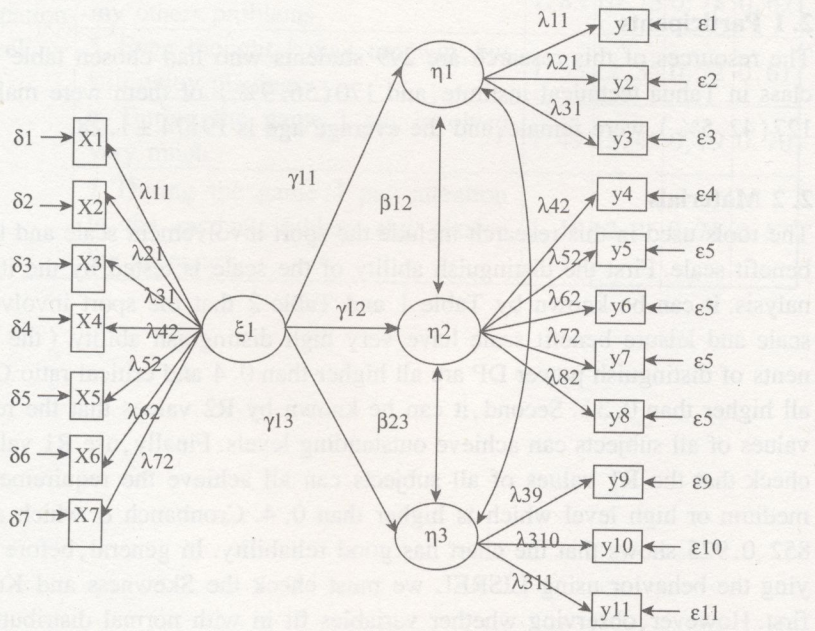

Figure 2. Research measurement model

Table 1. Survey pattern variable explanation

Latent Variable	Variable	Observation
Table tennis participation level(ζ1)	Very good presentation	y1
	Having fun time during participation	y2
	I understand the process and content very well	y3
	I could almost forget other activities during participation	y4
	Even though I could not win, I enjoyed playing	y5
	I could sink into the game	y6
	I pay attention to racquets and other conditions.	y7
Balance of living experiences (η1)	It can unstressed my life while playing	X1
	It fulfills my life experience	X2
	It can adjust my psychological feeling	X3
Promotion of wellness(η2)	It can maintain my body strength	X4
	It can increase my social abilities	X5
	It can increase family interaction	X6
	It helps me to develop intelligence	X7
	It reminds me to care about living environmental quality	X8
Enhancement of quality of life(ξ3)	Helps me to appreciate the ability of create perfection	X9
	Allow high self esteem opportunity	X10
	Practice my ideals.	X11

2.1 Participants

The resources of this research are 299 students who had chosen table tennis class in Tahua technical institute, and 170(56.9%) of them were male and 127(42.5%) were female, and the average age is 19.74 ± 1.28.

2.2 Materials

The tools used in this research include the sport involvement scale and leisure benefit scale. First the distinguish ability of the scale is tested by the item analysis. It can be known by Table 1 and Table 2 that the sport involvement scale and leisure benefit scale have very high distinguish ability (the exponents of distinguish power DP are all higher than 0.4 and critical ratio CR are all higher than 0.3). Second, it can be known by R2 values that the relative values of all subjects can achieve outstanding levels. Finally, use R1 values to check that the R1 values of all subjects can all achieve the requirements of medium or high level which is higher than 0.4. Cronbanch α which are 0.852、0.925 shows that the chart has good reliability. In general, before verifying the behavior using LISREL we must check the Skewness and Kurtosis first. However, observing whether variables fit in with normal distribution or not will affect the results of the estimations and examinations. Hence this re-

search uses PRELIS to calculate the Skewness and Kurtosis of 18 variables. The result is showed as table 3. It can be known that the Skewness and Kurtosis of all observing variables are between −2 and +2 except y4 of which Skewness is higher than 2. According to the research of Mardias (1985), if we want the observing variable to fit in with normal distribution, it will be better that the Skewness of it is between −2 and +2. Hence the distribution of 18 observing variables of this research are all in the acceptable region except y4 of which Skewness is higher than 2. Therefore we will cancel the observing variable y4 in the following analyses. Then we examine validity by Confirmatory factor analysis. We can know that all the indices are in the acceptable region.

Table 2. The abstract results of the sport involvement table

Project	Topic	DP	CR	R1	R2
Table tennis participation level	1. I have good participation during the game	1.40	11.53	0.68	0.54
	2. I had a great time with partners during the game	1.13	11.86	0.69	0.59
	3. I understand most all the rules of the game	1.45	16.02	0.75	0.65
	4. In my participation, I may forget my others problems	1.83	16.73	0.78	0.67
	5. Even thought I may not win, but still enjoy playing	1.33	12.35	0.72	0.61
	6. During the game I am involved very much.	1.49	15.45	0.79	0.70
	7. During the game, I pay attention to the racquet, rubber, and choose the necessary	1.48	12.26	0.71	0.57

Table 3. The abstract results of the leisure benefit table

Project	Topic	DP	CR	R1	R2
Balance of living experiences	It can unstressed my life while playing	1.15	11.62	0.73	0.68
	It fulfills my life experience	1.24	12.94	0.76	0.71
	It can adjust my psychological feeling	1.27	12.70	0.72	0.66
Promotion of wellness	It can maintain my body strength	1.04	10.07	0.66	0.59
	It can increase my social abilities	1.35	13.67	0.74	0.68
	It can increase family interaction	1.48	12.91	0.73	0.65
	It helps me to develop intelligence	1.51	15.23	0.84	0.79
	It reminds me to care about living environmental quality	1.55	14.21	0.80	0.75
Enhancement of quality of life	Helps me to appreciate the ability of create perfection	1.47	14.67	0.78	0.73
	Allow high self esteem opportunity	1.49	14.67	0.80	0.75
	Practice my ideals.	1.57	14.00	0.77	0.71

Table 4. The abstract results of the Skewness and Kurtosis table

Observed variables	X1	X2	X3	X4	X5	X6	X7	y1	y2	y3
Skewness	-0.086	-0.546	0.012	-0.347	-0.733	-0.303	-0.266	-0.469	-0.211	-0.248
Kurtosis	-0.059	1.525	-0.427	-0.193	1.789	0.146	-0.164	0.624	-0.028	0.056
Observed variables	y4	y5	y6	y7	y8	y9	y10	y11		
Skewness	-0.812	0.155	0.147	0.027	0.002	-0.427	-0.147	-0.316		
Kurtosis	2.736	0.497	0.592	1.297	1.771	1.334	0.397	1.293		

Table 5. The abstract results of the table tennis participation level and Leisure Benefit CFA table

Topic	X2	X2/df	GFI	AGFI	NFI	NNFI	RMR
Table tennis participation level scale	47.3	3.38	0.95	0.91	0.96	0.96	0.025
Leisure Benefit scale	167.3	5.22	0.88	0.80	0.96	0.95	0.034

2.3 Information Management

After the Questionnaires process, I analyze the Information By statistic software including SPSS 11.0 and LISREL 8.54 Edition. The research is done to make sure the Relationship of pronominal by way of the items analyzes Prov-

able elements analysis, the credibility form, and the maximum Likelihood of LISREL.

3 Results and Discussion

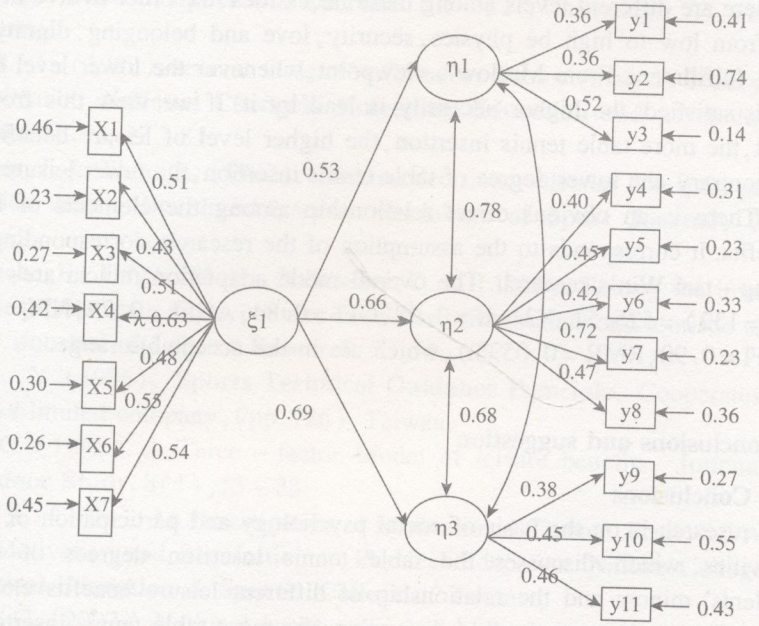

Figure 3. Confirmation result research pattern

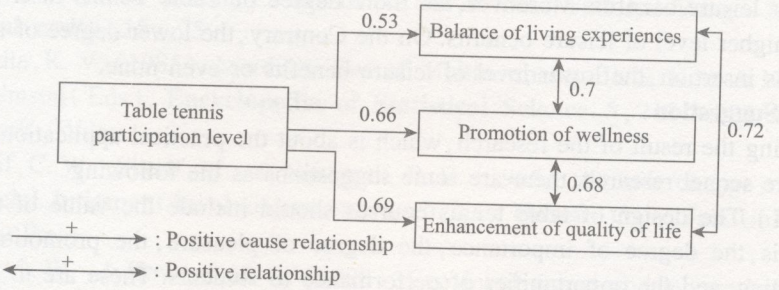

Figure 4. Confirmation result Research model

The results which are proved by LISREL show that the Insertion degree of table tennis has appositive causation with the three benefits of LISREL. Meanwhile, the more Insertion degrees, the bigger effect of improving life quality (Parameter Estimates = 0.69, $p < 0.05$),. And then it's the content of life (Parameter Estimates = 0.66, $p < 0.05$), the minimum is the element of balancing life experiences (Parameter Estimates = 0.53$p < 0.05$). Howev-

er, according to Jun – Shun Kao's three leisure benefits mode, one of the references is the need hierarchy theory which was proposed by Maslow. Based on the need hierarch theory: 1. Motivation is the inner source of human existence and growth, while the inner source is composed of variable necessities. 2. There are different levels among these necessities, the order of five necessities from low to high be physics, security, love and belonging, dignity, and self – fulfillment. From Maslow's viewpoint, whenever the lower level necessity is satisfied, the higher necessity is lead by it. If we view this from the point, the more table tennis insertion, the higher level of leisure benefits. On the contrary, the lower degree of table tennis insertion, the fewer leisure benefits. There is an obvious direct relationship among the elements of leisure benefits. It corresponds to the assumption of the research, corresponding with Ching – tsai Win's research. The overall mode adaptation indicia are: ((X2 (df = 132) = 525.51, X2/ df = 3.98, GFI = 0.84, AGFI = 0.79, NFI = 0.89, NNFI = 0.90, RMR = 0.057)), which are in the acceptable range.

4 Conclusions and suggestion

4.1 Conclusions

The research is on the basis of social psychology and participation of leisure activities, which discusses the table tennis insertion degrees of college students' minors and the relationship of different leisure benefits elements. According to the statistics and discussion, the more table tennis insertion, the more leisure benefits. On the contrary, the less the Table Tennis insertion, the fewer leisure benefits. Moreover, the more degree of Table Tennis insertion, the higher level of leisure benefits. On the Contrary, the lower degree of table tennis insertion, the lower level of leisure benefits or even none.

4.2 Suggestion

Aiming the result of the research, which is about the practical application and future sequel research, there are some suggestions as the following.

(1) The design of table tennis courses should include the value of table tennis, the degree of importance, the degree of pleasure, the promotion of learning, and the opportunities of performance to students. These are to raise the insertion of students.

(2) About the future research, combining with behaviors to discuss the degree of insertion, in order to get and understanding on all aspects. Therefore, I suggest taking the behaviors insertion and social psychology into consideration for discussion. Furthermore, it can add more pronominal, discussing more, such as leisure experiences, leisure abilities, leisure satisfaction and other pronominal to study.

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37 The theoretical study of Chinese and foreign table tennis technique innovation

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1 Introduction

The Chinese table tennis team has mastered the development law of the world table tennis technique – tactics and playing method since half a century ago. We advance along with the technique – tactics innovation in the world. We advance not only in practical innovation but also in theoretical innovation. At present, our country has twenty professional researchers on the table tennis theoretical science. Compared with Japan, Sweden, Germany and England etc, China has more professional researchers. Fifteen sport scientific researchers attended the first science representative congress in Rome in April, 1983. Most of them studied sport physiology, sport biomechanics and sport medicine. Only a Chinese representative studied sport training.

2 Methods

References method, Statistics method, Logistic method and Comparison method were used.

3 Results

Quantity and quality of Chinese researches are as well as, if not better than other countries' for many years. Many research outcomes are first carried out in the world. On the basis of an incomplete statistics, we has published 1245 foreign theses since 1959, 1193 technicality articles in science issues and technicality conferences, three professional articles and five books about the rudiment and middling training method since 1987. We published 1034 technicality articles from 1990 to 2002, which nearly total the articles published by foreign countries in seventy years(Table 1 and 2).

Table 1. Comparison of the total of Chinese and foreign references

Type of references	Year	Total	1990s'
English references	1929—2002	1193	406
Chinese references	1987—2002	1245	1034

Canada Discus Data Bank collected 1440 table tennis references of some countries in1990s' excluding Japan, Korea and North Korea.

Table 2. The quantity of some countries' table tennis theses in 1990s'

Country	Quantity	Percentage	Country	Quantity	Percentage
China	1097	0.76	Scotland	1	0.07
England	194	0.135	Finland	1	0.07
France	85	0.06	Canada	1	0.07
Sweden	15	0.01	Italy	1	0.07
Germany	12	0.8	Portugal	1	0.07
Spain	10	0.7	Turkey	1	0.07
Russia	4	0.3	America	3	0.2
Australia	4	0.3			

Most of table tennis theoretical articles belong to China, England, France, Sweden, Germany and Spain. Only 23% of theses in 1990s' are works of foreign countries. 368 theses among 1140 theses studied the table tennis technique – tactics. Of 270 theses among 368 theses, 18.75% belonged to China. Of 75 theses among 368 theses, 5.2% belonged to such foreign countries as England, France, Sweden, Germany and Spain. The quantity of every one of these countries is 1% of the total. In addition, they studied only the rudiment application of the normal technique – tactics and expounded it. This proves that these countries have no more advanced table tennis researches.

By classifying and analyzing Chinese 1034 technicality articles in 1990s', we clearly know several characteristics of Chinese table tennis theoretical research.

(1) Study table tennis from related subjects

(2) The study scope should be wide and the study emphasis should be obvious . we should choose technique – tactics to break through, which coincides with the need of exercise practice.

(3) We should apply theory to practice and improve the innovative application in order to better sport training level and performance.

(4) 1034 articles including professional articles, training method articles

and equipment are written by 250 researchers. More than half of them are coaches who themselves take part in practice. These scientific outcomes are very practicable.

4 Conclusion

Theoretical researchers of Chinese table tennis choose themes from practice, applying abundant experiences into theory and then applying theory to practice again. They use practice to test theory and make more advanced theory. So, many professional researches have not only a certain theoretical level but also considerable practical value, and answer why innovation can make our technique – tactics training and others retain advanced for a long time from the theoretical level, which is very helpful to further development of table tennis in our country.

38 The analysis of the printed papers of table tennis from 1981 to 2000 in China

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1 Introduction

Sports science is a significant part of sports. It is an important factor to impel the development of sports. With the development of the sports, researches in this field become more and more important, especially for Chinese table tennis team. Comprehensively summarizing the documentation is regarded as a momentous meaning that would definitely instruct the development of table tennis in China in future.

2 Methods

The Printed Papers of Table Tennis from 1981 to 2000 were selected and analyzed.

3 Results and Discussion

2141 papers about the table tennis which came from the total 2,293 papers, were checked out according to "the list of Chinese sports journals". All the papers were classified into three parts, the physical education in school, the competitive sports and the exercise sports. The first one included 72 articles which account for 3% of the 2,293 papers; the second surprisingly had 2,048 that account for 96% of total papers. The last one only contained 21 articles, accounting for 1% of the 2,293 papers. The articles in the field of exercise sports are deficient from the respective researching.

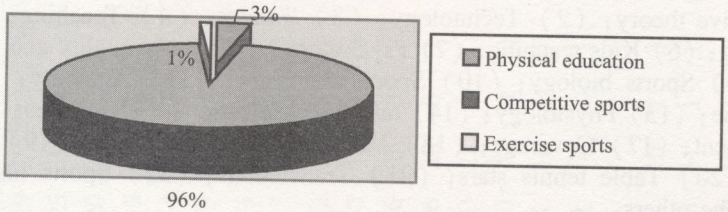

Figure 1. The percentage of each kind of the printed papers of table tennis

The papers that were written by the individual persons accounted for 78.

8% of the 2002 articles which were printed and named. The others 424 accounted for 21.1% . The number of papers which had units was 1004. They were divided into six sections such as training department , sports colleges and other universities etc. in detail, there were 321 papers which accounted for 32% belonging to the training department, 301 which accounted for 30% by sports colleges, 149 which accounted for 15% of research seminars, 120 which accounted for 12% by other colleges of sports, 60 articles which accounted for 6% by others places, the different sports departments have 53 papers which accounted for 5% of the whole document. From the numbers mentioned above it was concluded that the first three places were the main contribution to the whole document. At the same time they should communicate with each other frequently.

Table 1. The catalog of the paper

Author's Unit	Numbers	Percentage
Training Department	321	32%
Sports Colleges	301	30%
Research Seminars	149	15%
The Other Colleges of Sports	120	12%
The Others Places	60	6%
Different Sports departments	53	5%
Total	1004	100%

With respect to the research methods, there were some peculiarities deserving to be cared about. 224 papers, only accounting for 10.5% of the 2141 papers, had the explicit research methods. There were 76% of the printed papers that used more than 2 different methods and the most popular way was to use 2 methods which account for 36% of the whole papers. The papers that used 3 methods equaled to 28% ; papers using 4 methods accounted for 11% , and that using 5 were 1% of 2141. There was only one paper using 6 research methods. In addition to the normal methods such as documents, statistics, testing and investigations, a variety of methods, e. g. , experiments, observations and stimulations, were used to the table tennis researches as well.

The total 2048 articles included 23 distinct species. (1) Respectively comprehensive theory; (2) Technology; (3) Tactics; (4) Teaching; (5) Training; (6) Kids teaching; (7) Psychology; (8) Body quality and training; (9) Sports biology; (10) Sports chemistry; (11) Anatomy; (12) Medicine; (13) Physiology; (14) talent identification; (15) Rules; (16) Equipment; (17) Coverage; (18) Management of the clubs; (19) Coaches; (20) Table tennis stars; (21) Translations; (22) Sports history; (23) The others.

The grouping method of this study is relatively proper. The distribution of 23 kinds of papers from 1981 to 2000 was consistent with the principle of China's competitive sports, i. e. , superior sports develop first.

Table 2. The numbers of the Printed Papers of Table Tennis from 1981 to 2000 in China

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	Total
1981	19	26	2	0	9	4	2	3	0	0	1	0	0	5	7	7	12	1	2	17	2	6	48	173
1982	25	22	2	1	9	4	8	3	4	0	2	0	1	2	1	4	8	1	3	5	5	2	12	124
1983	20	15	2	1	10	4	12	0	2	0	0	0	1	6	11	5	3	1	0	4	1	15	24	137
1984	19	14	2	1	8	1	4	0	5	0	3	0	4	0	4	2	5	0	0	1	3	12	21	109
1985	14	9	5	1	5	3	13	2	4	1	1	0	0	2	3	4	8	1	3	23	4	8	33	147
1986	15	19	4	0	6	1	8	3	4	0	1	1	2	4	6	1	14	1	3	8	4	2	20	127
1987	14	20	3	2	7	2	4	2	8	0	3	0	6	2	5	2	0	0	0	1	2	2	12	97
1988	15	21	1	2	3	11	3	5	2	0	0	1	0	0	9	0	2	3	1	3	2	1	26	111
1989	12	17	1	0	2	2	4	1	2	0	0	0	0	2	7	1	8	0	2	3	3	5	11	83
1990	10	11	1	0	3	5	10	1	0	0	0	0	0	6	5	2	5	1	1	4	4	0	13	82
1991	16	6	0	2	3	3	8	0	3	0	3	2	2	0	5	3	11	0	0	0	0	0	14	81
1992	16	20	0	1	5	5	10	3	1	0	3	1	1	1	5	3	4	0	0	2	0	3	17	101
1993	10	25	1	0	9	5	5	4	3	0	3	0	0	3	12	14	19	3	0	4	1	2	37	160
1994	10	8	0	0	7	3	5	1	2	0	1	0	4	0	7	8	7	5	0	3	0	0	23	94
1995	8	18	1	1	5	2	8	2	1	0	1	0	1	1	5	0	8	1	1	3	0	0	12	79
1996	9	7	2	1	7	5	9	2	2	0	1	3	0	1	8	2	3	2	0	1	0	0	8	73
1997	5	7	2	1	6	7	3	9	0	0	0	1	1	2	2	3	8	0	0	0	0	0	11	68
1998	4	10	2	3	3	4	7	5	2	0	3	1	3	0	6	4	1	4	0	0	0	0	4	66
1999	10	31	1	1	10	9	8	6	2	0	0	1	0	3	5	12	2	5	1	2	12	1	16	138
2000	11	19	4	1	9	5	3	4	4	0	0	1	0	4	5	4	1	3	0	1	2	1	9	91
Total	263	325	36	19	126	85	134	56	54	1	26	12	26	44	118	81	129	32	17	85	45	60	371	2141

4 Conclusions

This paper, according to the book "The list of Chinese sports journals", checked out the total 2,141 articles about the table tennis which are come from the whole 2,293 papers have been printed. They were classified to main three parts, respectively speak, the school parts, the sports parts and the population part. The first one comprises 72 articles which account for 3 % of the 2,293 papers, and the second one surprisingly consists of 2,048 that account for 96 % of total papers. The last one only account for 1 % of the 2,293 papers, which has 21 articles. The population's articles are deficient from the respective researching.

The total 2,048 articles comprise of 23 distinct species that are respectively comprehensive theory, technology, tactics, teaching, training, kids teaching, psychology, body quality and training, sports biology, sports chemistry, anatomy, medicine, physiology, talent identification, rules, equipment, coverage, management of the clubs, coaches, table tennis stars, translations and sports history etc. The main characteristics of these papers from 1981 to 2000 are conspicuous and diverse and parallel with our famous rules that is the preference of the sports.

39 Analysis and countermeasure on the current popularization of table tennis in China

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1 Introduction

While table tennis ambassador of China is making brilliant accomplishment in the international table tennis games, the public table tennis activities are losing its popular position. Shanghai, as the cradle of table tennis, is not able to make an exception. In order to bring out the abundant meanings of table tennis playing and to realize its value, we have undertaken researches and analysis on the above situation in the way of literature research, survey and logical analysis, furthermore, we have put forward some relevant suggestions and advices on how to rebound the table tennis activities in shanghai.

2 Results and Disccussion

2.1 General situation about popularization of table tennis in Shanghai

During a long period, our purpose of extending table tennis activities in schools is based on finding and fostering talented players. Take shanghai as an example, there are only a few schools regarding table tennis as their key sports events. It leads to a distinctive declining in the number of teenager players and various levels of games. For example, in 2004, it was hard to hold table tennis tournament in shanghai, meanwhile, there were only four male students entering the table tennis examination for P. E specialty.

Concerning to entertainments and fitness of adults, although people still be fond of table tennis, it becomes less popular quickly. We have done research on 2003 shanghai Minzhi table tennis match of mid – aged and aged players, statistical data shows (Figure 1): although there were more than 760 players, male participants accounted for 605 and females were only 155. Without reference to gender, 55 to 64 years old group was the largest one and the 65 to 75 years old group ranked the second. Among them, many became to be keen to playing table tennis since 60th last century. All this indicated most table tennis lovers are old aged males.

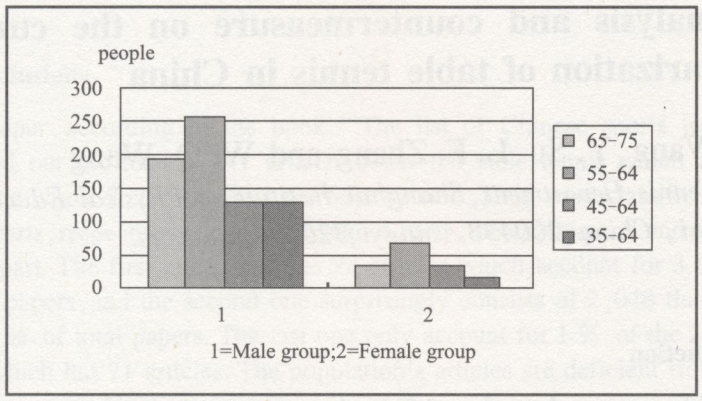

Figure 1. General background of participants of Shanghai Minzhi table tennis match

2.2 Analysis on the causes of table tennis losing its position

With the times and transform of social economic system, prevalence of table tennis in 60th last century has not been hot topic any more. Declining in number of table tennis players, unreasonable proportion in both age and gender has emerged. The major causes are shown as follows.

2.2.1 The important role that table tennis plays in improving fitness has not been understood

Large amount of research data shows that table tennis with the characteristics of changeable, interesting, safe and simple equipments is very helpful to prevention of diseases, improvement of health and development of various sports skills. The followings are its value in improving health.

2.2.1.1 Be helpful to improve heart and lung function

It is measured that the average rhythm of the heart is 150 times per minute. Its load of playing is moderate and it leads to big change of rhythm of the heart. Frequent playing helps to improve resistance ability of heart system, metabolism of Ca (calcium) and P (phosphorus), activeness of cells enzyme and metabolism of body. Especially, it is suitable for mid – and old – aged people to improve health.

2.2.1.2 Be helpful to improve speed of reaction and ability of body coordination

Average speed of the ball is 20 meters per second. It requires hitters make judgments and strategies immediately. Interval of reaction of table tennis players is commonly 0.14 seconds (0.3 seconds for normal people). It shows that table tennis players have strong ability to meet an emergency.

Therefore, frequent playing leads to good connection between muscles and energy so as to improve the nerve center system and dynamic system and to fully develop the speed of reaction and body coordination ability.

2.2.1.3 Be helpful to form strong spirit

Table tennis matches usually last long and they are also competitive and changeable. It requires strong and firm will, furthermore, it requires good mentality and correct judgment.

2.2.1.4 Be helpful to intellectual development

There are various skills in table tennis playing and its process of match is rather complicated. The players have to be able to observe the characteristics of the opponents so as to make strategies. Table tennis match is also a match of intellects. The players often use delusion movements to puzzle or disturb the opponents. Therefore, it helps to develop the ability of analyzing and settling problems, as well as the intellects.

2.2.1.5 Make people open and lively

According to a Japanese survey on characteristics of 3000 table tennis players, the top three characteristics of 1526 male players are strong curiosity, strong wills and active respectively. For female, they are active, strong curiosity, strong wills. The only difference is their sequence. Such characteristics as positive, optimized and strong will are crucial for the competitive modern life.

2.2.1.6 Be helpful to communication between people

Through table tennis playing, people are able to make friend, communication with each other, enhance trust and friendship. Especially for retired people, it offsets the bad effect of less social activities and satisfies their expectation of being given more concern.

2.3 Too specialized implements and rules of game

Since 1991, 44 mm balls emerged in Japan. The balls with soft texture and big volume are popular in amateur players, especially old – aged players, because it is slower and more interesting. In Germany, owing to a serial rule system of amateur table tennis games, table tennis is very popular among the public. Only in Berlin, there are more than 100 table tennis clubs; members of national table tennis clubs reach more than 700 thousand (including amateur players). Germany has become a kingdom of table tennis in the aspect of its popularization.

However, we are lagging behind in developments of equipments and rules that are suitable for public sports exercise. Even in teenagers' table tennis training, a-

dult or professional standards are still followed. Some reforms have been done on the above aspects, but the effects are not satisfied owing to several reasons.

Standard table tennis desk is 274 cm in length, 152.5 cm in width and 76 cm in height. It is designed mainly for the adults. Therefore, top players in China averaged 165 cm in stature, 90 cm higher than the desk. However, average height of teenagers in China is below 139 cm, furthermore, their length of arm is much shorted than that of the adults. They have met many difficulties in playing table tennis; it will affect their interest in playing. Thereby, negative effect of problems in desks can't be ignored.

Moreover, recent table tennis desks are not well designed; as a result, it doesn't help to motivate the interest of playing of teenagers.

2.4 Difficult for the beginners

According to statistics, table tennis ranks the eighth in its difficulty in playing among all sports events. Therefore, many new learners don't persist on learning for long. By contrast, football, basketball and badminton are much easier for the new learners.

With the characteristics of fasting and changeable, table tennis seems to be a two – sided sword, it helps to improve the speed of reaction while increases the degree of difficulty for the new learners. With times of picking balls, the players would lose his interest in playing and the effect of exercise is not able reached. Since the emerging of 40 mm ball, such problem has been solved to some extent, but it still has satisfied the needs of aged players and new learners.

2.5 restriction from external circumstance

In recent years, the development of economy in Shanghai has been keeping in two digits increase. However, there are large difference of revenues of different employments and districts, especially these jobless people and workers from other places in the country. In general speaking, people's purchasing power are not strong enough, as well as the health exercise concept. Most of them are emphasized on medicine consumption and ignoring health investment.

Secondly, owing to heavy burdens and violent competitions, many young people are engaged in their careers. They have been used to staying up all night. Meanwhile, they are responsible to bring up their children and manage house works. Mid – aged females are faced with heavier burdens. To pursue successful career and a perfect home, they have no efforts to spend on health. Overdrawing on health has become a habit.

Thirdly, affecting by the multi – polarization of culture, people have much more choices on entertainments and sports activities. It divided people with different hobbies into smaller groups. Actually, it reduces the participants of table tennis playing.

3 Suggestions and countermeasures

3.1 Persist in basic policy and deepen table tennis reforms

In order to consolidate the advantage of table tennis cradle of shanghai, we have to entirely carry out the policy of "Olympic strategy" and "national sports" and deepen the reforms of table tennis event. New problems under the new historical circumstance can be solved in this way.

The general objective of table tennis reform is to hold more table tennis activities of various kinds, to improve athletics level of table tennis under the condition of attracting more participants from all sides. Therefore, deepening reform requires different emphasis in different domains of table tennis.

In a word, reforms on table tennis training and match should be emphasized on improvement of its attractiveness and degree of professional. Only by attracting more spectators, to form a sophisticated table tennis market would become possible. Concerning to table tennis exercise of adults, requirements on skills should be reduced. As to reform on table tennis education, improvement on attractiveness of table tennis playing can be realized through simplifying rules, reducing requirements and designing equipment suitable for teenagers. By this way, teenagers would become more interested in playing table tennis.

3.2 Perfect the systems of table tennis at school

We suggest set up table tennis lessons for new learners in the middle schools and compulsive or un – compulsive courses in universities. We can improve the popularization of table tennis while fostering talented backup players.

We suggest set up special classes of table tennis in primary schools and kindergartens. We can reduce the height and the size of table tennis desk; it would help to reduce difficulty in training. If we cut the right – angled corner of the desk into rounded corner, it would help to improve the degree of safety.

3.3 Spend more efforts in promoting the abundant meanings and values of table tennis activities

Creating a "happy playing" circumstance and condition, so as to attract more participants, especially young people and females. Moreover, we should try to change the concept of consumption in sports activities, that is, change the concept of "pay for medicine" into "pay for health". Make the public to realize that playing table tennis could be the everlasting good partner of health.

We should provide basic conditions and equipments, so that table tennis would be public sports event in the community. The residents would be able to attend entertainment and sports exercise in the district and they would gain more with little investment.

40 Analysis and research on the benefits of table tennis activities in improving the fitness of teenagers

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1 Introduction

The primary and middle school students are now experiencing more and more pressure from the study. It indicates more and more intensively competitive of the times. High expectation of their parents leads to big burden on the students; as a result, it is severely harmful to the health of mental and physical development of the teenagers.

Result of《Supervision and measurement of health of students in 2000》indicates that fitness of teenager students in our country shows a decreasing trend compared with that of 1985 and 1995, especially in heart and lung function, reaction and eyesight. However, what is the effect of table tennis activities, as a key event in sports education, on the improvement of students' fitness? We have done experiments and researches on this point.

2 Methods

2.1 Participants

120 pupils from Chengxi Middle School and Junmin Primary School in Fujian Province are chosen as objectives of our research. They are divided into two groups and they have been tested for half years. During this period, students of experimental group attended table tennis exercise under the guide of coach 3 times a week and 90 minutes for each time. The comparison group only attended normal P. E lesson and they have not other sports exercise. Table 1 shows the details.

2.2 Methods of research

Tests of heart and lung function, reaction and eyesight have been undertaken, while the statistics software such as SPSS and EXCEL has processed outcomes of these tests. Furthermore, analysis and research have been done with the method of comparison (experimental group VS comparison group).

Table 1. General situation of experiment objectives

Schools	Objectives	Groups	Number	Remarks
Chengxi Middle School	17 ~ 18 aged pupils	Experimental group	30	with more than 4 yrs experience in extracurricular table tennis playing
		comparison group	30	with no hobby in sports
Junmin Primary School	11 ~ 12 aged pupils	Experimental group	30	with more than 4 yrs experience in extracurricular table tennis playing
		comparison group	30	with no hobby in sports

3 Results and Discussion

3.1 Heart function test

The simplified measurement of heart function is a simple method to test the change of heart function when specific load is borne. It is one of the scientific research productions of Sweden Sports Union. The format is: Index = (P1 + P2 + P3 - 200)/10. Smaller index indicates better heart function. Table 2 shows data of testing of heart function. Table 3 is the table of T - test.

Table 2. Comparison of heart test data

	N	P1 average	P2 average	P3 average	Average index
Experimental group (11 ~ 12 aged)	30	74.4	126.13	94.53	10.44
comparison group (11 ~ 12 aged)	30	79.73	135.73	111.33	12.68
Experimental group (17 ~ 18 aged)	30	70.08	104.27	85.20	5.62
comparison group (17 ~ 18 aged)	30	76.00	115.20	94.93	8.59

Note: (P1) pulse when quiet, (P2) pulse after 30 times went down, (P3) pulse after one minute rest.

Table 3. T – test (heart function)

	Variance	Observation value	P(T < = t) one tailed	level of significance
Experimental group (11 ~ 12 aged)	1.22	30 pupils in each group	1.46631E – 10	0.05
comparison group (11 ~ 12 aged)	1.40			
Experimental group (17 ~ 18 aged)	1.39	0 pupils in each group	5.63E – 13	0.05
comparison group (17 ~ 18 aged)	1.80			

It is on the assumption that there are no distinct differences in heart function index between table tennis amateurs and normal students. Under the T – test hypothesis, it indicates: ①P value of children from 11 to 12 group equals 1.46631E – 10($p < 0.05$). So null hypothesis is rejected and alternative hypothesis is accepted. Index of experimental group is less than that of comparison group. ②P value of children from 17 to 18 group equals 5.63E – 13 (also $p < 0.05$). So null hypothesis is rejected and alternative hypothesis is accepted. Index of experimental group is less than that of comparison group. P – value of two age groups are both less than the level of significance.

Teenagers are experiencing a fast growing period. The development of every part of their bodies in not stable yet. Under common circumstance, their multiple organs, especially cardiovascular system grows slower than their outside organs such as skeleton and muscle. So overload exercises should be avoided, otherwise, it will damage the cardiovascular system.

Intensity of table tennis exercise is quite moderate. Continuous bating and moving in table tennis playing will help to improve the function of heart. Long – term exercise will surely improve the function of cardiovascular system. Comparison of test data in this essay also shows: heart function of the experimental group (students with more than 3 years experience in table tennis training) is much better than that of comparison group. It proves playing table tennis frequently exert positive effect on improvement of heart function.

3.2 Eyesight test

These years, short eyesight becomes more common, especially among the teenagers. According to the statistics, short eyesight in middle school students is at the rate of 58% and 80% for college students. Therefore, how to prevent short eyesight has become a hot top.

Data of eyesight test is undertaken in 6 meters standard. Larger value stands for better eyesight. Table 4 shows the experiment data and Table 5

shows T – test.

Table 4. Data comparison (eyesight test)

	Experimental Group (11 ~ 12 aged)	Comparison group (11 ~ 12 aged)	Experimental Group (17 ~ 18 aged)	Comparison Group (17 ~ 18aged)	Remark
average eyesight of two eyes	5.018	4.835	5.027	4.612	Distance (6 meters)

Table 5. T – test (eyesight test)

	Variance	P(T < = t) one tail	Observation value	level of significance	Average
Experimental group (11 ~ 12 aged)	0.010428				5.018333
		4.96E – 08		0.05	
comparison group (11 ~ 12 aged)	0.016405				4.835
			30 pupils in each group		
Experimental group (17 ~ 18 aged)	0.006851				5.026667
		2.09E – 17		0.05	
comparison group (17 ~ 18 aged)	0.022704				4.611667

Our assumption is that there are no distinct differences in eyesight between table tennis amateurs and normal pupils. Under the T – test hypothesis, it indicates: ①P value of children from 11 to 12 group equals 4.96E – 08 (< 0.05). So null hypothesis is rejected and alternative hypothesis is accepted. Index of experimental group is higher than that of comparison group. ②P value of children from 17 to 18 group equals 2.09E – 17 (also < 0.05). So null hypothesis is rejected and alternative hypothesis is accepted. Index of experimental group is higher than that of comparison group. P – value of two age groups are both less than the level of significance.

Physical research proves that using eyes for long time and incorrect reading habits are the major causes of short eyesight. Therefore, controlling of the time of looking at steady objectives is one of the most important measures to prevent short eyesight. When playing table tennis, we focus our eyes on the fast moving ball. The speed and moving direction of the ball varies from time to time. The relative position of our eyes and the balls changes continuously. Thereby, it helps to improve the function of contraction and relaxation of ciliary muscle. The outcomes of our research have proved that frequent table ten-

nis exercise exerts a positive effect on the eyesight of teenagers.

3.3 Reaction of hands test

The index shows how fast the hands react to visual stimulation. It reflects the degree of acuteness of people's optic nerve and nerve center directly. Clock ruler is chosen as implement of measurement. Corresponding value of experiment data can be checked out from Table 8. Table 6 shows the experiment data of reaction speed. Table 7 is the table of T – test.

Table 6. Data comparison

	Experimental Group (11 ~ 12 aged)	Comparison group (11 ~ 12 aged)	Experimental Group (17 ~ 18 aged)	Comparison Group (17 ~ 18aged)	Remark
Averages	16.57	26.45	8.22	15.07	At the same condition

Table 7. T – test (Reaction of hands)

	Variance	P(T < = t) one – tailed	0bservation value	Averages	Level of significance
Experimental group (11 ~ 12 aged)	21.00	2.02E – 12	30 pupils in each group	16.57	0.05
comparison group (11 ~ 12 aged)	17.27			26.44	
Experimental group (17 ~ 18aged)	3.55	5.91E – 15		8.22	0.05
comparison group (17 ~ 18 aged)	8.56			15.07	

Our assumption is that there are no distinct differences in reaction speed between table tennis amateurs and normal pupils. Under the T – test hypothesis, it indicates: ①P value of children from 11 to 12 group equals 2.02E – 12 (<0.05). So null hypothesis is rejected and alternative hypothesis is accepted. Experimental group performed better than the comparison group. ②P value of children from 17 to 18 group equals 5.91E – 15 (also <0.05). So null hypothesis is rejected and alternative hypothesis is accepted. That is to say value of comparison is different from that of experiment group at the level of significance. Index of experimental group is higher than that of comparison group. Experimental group performed better than the comparison group.

The basic manner of activity of our nerve system is reflex. It is categorized into conditioned reflex and un – conditioned reflex. Reflex is defined as the reaction of the nerve system to the internal and external stimulations in the process of adjustment on organs enginery. Our experiment shows that due to high plasticity of children's organs and nerve system, frequent table tennis ex-

ercise with the characteristics of fast and changeable will help to fix relative reflex and improve the ability of reaction.

4 Conclusions and suggestion

4.1 Conclusions

Our research indicates: frequent table tennis exercises help to advance the heart function, eyesight and reaction ability of hands and eyes. Meanwhile, it is proved that table tennis activities play as a key role in carrying out the strategy of national sports.

4.2 Suggestion

Firstly, we hold that in order to prevent table tennis from becoming unpopular among middle school students, it is necessary to understand the effect of table tennis exercise in schools. As an extracurricular activity, it helps to train talents of athletics sports. Being part of P. E lessons, it helps the pupils to learn about knowledge and skill of table tennis. Being an extracurricular activity, table tennis has the characteristics of recreation and fitness. Furthermore, it has prominent effect on reducing both physical and mental burdens on teenagers.

Secondly, it is necessary to enhance the promotion of table tennis exercise, so as to stimulate the interest in attending table tennis activities and provide more opportunities for them to have actual experience in table tennis playing. It is also necessary to provide professional advices on the trainings of table tennis tutors (coaches) and improvements of equipments and facilities.

41 Analysis of the success of the China table tennis team under the national sports system

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1 Introduction

The China Table Tennis Team was founded in 1952, and the period from 1959 – 1969 was the time that the team grew up. During that time period, the Chinese team combined "fast, accurate, furious, and changeful" styles for close and fast attack, and guidance of "stable, low, rotating, and aggressive" styles for undercut to start a new development stage for table tennis.

Table tennis is the national ball sport of China. Fifty years' continuous success had created the world miracle of table tennis sports. It is the paradigm athletics of Chinese national sports system, the model table tennis country in the world, the biggest treasury and most important strategic resource of sports. It is an important measure of development strategy for all table tennis countries to study the national sports system of China table tennis teams.

This dissertation will discuss national sports system, table tennis spirit, and successful experience, and draw precious experience as the reference for all countries to improve the comprehensive strength of table tennis sports.

2 Methods

This dissertation will use research methods such as literature research, deduction, and induction.

3 Results

3.1 The meaning of national sports system

The national sports system originated from the experience of USSR and east European countries. On April 15, 1986, the National Sports Committee issued "The resolution on sports system reform," the Chinese sports have become systemized and formed a set of high level athletics training and operation system. The characteristics of the system was to fully utilize the national capital, and give priority to the development of high level athletics, enhance the complete set of training system of amateur sports school, province professional

team and national team for assembly training, and improve the professional sports team training system and National Game with Chinese characteristics. Based on the principle of "unified thoughts, consolidated organization and consistent training," the system reinforced the leadership, gave prominence to key items, readjusted the pattern, strengthened the competition to realize "training domestically and contesting with foreigners."

3.2 Exploration on table tennis spirit

The whole development process of China table tennis teams originated from the situation and thoughts of the times. With the change of time and space, the experience accumulated by utmost fortitude and efforts has formed a unique spiritual culture. This spiritual culture represented the connotation and extension of Chinese athletic sports, and fully embodied the core meaning, value, and function of athletics.

3.2.1 Chinese Sports Spirits

The core of the China table tennis spirit originated from Chinese sports spirit. The development of the spirit inherited and carried forward the six principles of Chinese sports, including "Motherland paramount, devotion and dedication, scientific factualism, obeying discipline and laws, solidification and friendship, and spirits of struggle."

3.2.2 Table tennis spirits

At the same time of making great achievements, the China table tennis team also gave birth to fruitful harvest. In 1981, Wan Li made a summary for table tennis spirit: "The spirit of competing for the honor of the country, with motherland in hearts and global perspectives; the spirit of persistently sedulous training, continuous research and innovation, the collective spirit of being one heart and one mind and solidification to fight, spirit of revolutionary optimism and heroism with no arrogance for success and dismay in failure."

3.2.3 Table tennis culture

Fifty years' success of China table tennis was the result that the table tennis cycle profoundly mastered the athletics development rules under the guidance of the Mao Zedong thoughts and Deng Xiaopin theories, trained scientifically, and struggled in solidification. It has accumulated rich experience in leadership decision, team management, thoughts education, competition training, strategy and tactics, technique innovation, personnel training, and information and support. A complete forceful system of inherence and development has been constructed to form a unique table tennis culture. It is a precious spiritual treasury and strategic resource in the sports circle.

3.3 The analysis of successfully experience

Table tennis is one of the advantageous items for Chinese sports and has kept its world advanced level for fifty years. This is a peculiar phenomenon in world sports history. Since founded in 1952, the team has studied the foreign advanced experience during the development process, and combined internal principle through self – exploration. During the whole process, it continuously summarized successful experiences and failure lessons, and continuously innovated and improved knowledge. The research, understanding, and mastery of table tennis theory and practice have become more systemized and complete. The successful experience of achieving excellent performance is worth profound exploration. Here we analyze the successful reasons as follows:

3.3.1 The emphasis of the central government leaders and care of the national people

The three generations of leaderships all paid great attention to table tennis sports. Chairman Mao played table tennis in person. In 1971, the table tennis diplomat promoted the active development of Sino – US relations. Deng Xiaoping has interviewed the national team many times. Jiang Zeming in the spring festival of 1990 went to the table tennis gym to watch the training of the team. In 1995, Jiang Zeming went to the inauguration ceremony of the World Cup Competition in Tianjin to meet the sports committee and table tennis association leaders. The care of leaders and all social circles is indispensable to the achievements of the China table tennis team, which is the fruit of several generations' efforts of the table tennis circles.

3.3.2 The leaders paid attention to dialectic

The leaders paid attention to the thoughts education of the table tennis team. They guided the athletes and coaches on how to view the issues from two different perspectives, how to handle the relationship of "defy strategically, and focus tactically" to the rival, and how to use dialectic to solve issues such as training and competition, attacking and defense, speed and spin, advantages and disadvantages, keeping ahead and lagging behind, part and whole, thoughts and technology, and object and subject. That epigram with philosophy has greatly inspired the fight of athletes in training and fighting to achieve success. Therefore, learning dialectic has become a fashion in the China table tennis team, and a precious heritage to conquer rivals.

3.3.3 The national strategy

The unified thoughts, "training domestically and contesting with foreigners" is the consistent strategy of the China table tennis team. For fifty years, coaches of all levels of countries have consistently supported the national team.

They not only assisted the national coaches to solve the difficult training problems, help the thoughts education for the national players, but also trained and delivered all kinds of reservation personnel. In the national strategy, the respect and support between the upper and lower level was mutual. The local team supported the national team, and the national team respected the local team, amateurish sports school, and high and primary table tennis team.

3.3.4 Mastery of the factors to success

One of the main factors for the China table tennis team's achievements, is that the advanced acknowledgement and timely mastery on the characteristics and principles of success of table tennis sports. In the 60's, the Chinese national table tennis team had summarized the five factors for success as fast, spin, accurate, furious, and changeful. The training before the 26th world cup had put forward that based on the comprehensive techniques, the team shall use fast, accurate, furious, and changeful plays to aggressively win the victory. It has mapped the technological style of different tactics. Fast attack shall be fast, accurate, furious, changeful, and spin. Arc attack shall use rotating, fast, accurate, furious, and changeful. Undercut should be spin, stable, low, changeful, attack. Finally, it concluded the four guidance principles: aggressively attack, comprehensive techniques, unique advantages, and changeful tactics.

3.3.5 Establishing the small world of China table tennis circles

Based on full understanding of table tennis factors to success, the Chinese team in 1965 put forward the highly scientific and strong effective technique development policy: "All flowers are in bloom but I am egocentric. Adopting all advantages of different style and walking my own way," and formed the strategic thoughts of "establishing the China table tennis small world." The rivalry of table tennis is the process of adaptation and anti – adaptation. The anti – adaptation can be summarized with egocentricity. Adaptation can be solved by all flowers are in bloom. To further realize the purpose of adaptation, it adopts all advantages of different styles, and summarizes all styles of world table tennis techniques. At the time of extensive adaptation, the unique style of itself shall be formed, i. e. walking on my own way. All those have formed a systematic strategic project.

3.3.6 Trial horse system

During the process of establishing the small world of China table tennis circles, the improvement of the trial horse system and simulation training is a strategic method, which cannot be imitated by other countries or imitation without the same level. After coaches and researchers full analyzed the technique of main competitors and their advantages and disadvantages, a group of

trail horses were formed to simulate the competitors' styles to simulate the competition and training. Through simulated confront, the main athletes were fully convinced to gain the psychological advantages of the competition. In addition, a group of male players were specially formed to train the national female team players with simulation of the competitors' style in the "males help females" training of high quality and strength. In addition, the multiple – ball training method aimed at improving training quality was also an important supplementary method.

3.3.7 Stable and outstanding coach teams

The factors to success of the China table tennis team were to appoint and make outstanding coaches of one generation after another. The male team started from Fu Qifang, Xu Yanshen, Li Furong, and Xu Shaofa to the current Cai Zhenhua. The female team has Liang Zuohui, Sun Meiyin, Rong Guotuan, Zhang Xielin, and Lu Yuanshen. Although they were of different ages with different personalities, they have many common grounds: strong enterprise, full devotion, innovation, and exploration. Especially, the tactics in large competition games, and resourcefulness guidance on the spot helped them to defeat rivals by surprise action, and brought forward one batch of world champions after another

3.3.8 Emphasis on reservation training and echelon formation

Since the 80's a second table tennis team has been formed with fixed team numbers for long time assembly training. Based on necessity, it persisted on diversified play and formed echelons in age structure. Also, the second team and first team can be promoted or demoted. Every year, the team will have several large round robins. On the one hand, the first team member will feel the pressure, and on the other hand, it will motivate the second team players. It will promote the levels of both sides. In addition to the second national team, there are also assembly trainings twice a year in the national scope. For months, the plays in the team are numerous with strong antagonism and high quality. The assembly training will send national coaches to assume the training team leader. The purpose of assembly training is to find and promote competent personnel for the second national team without missing talented players to the largest extent. On the one hand, it promotes the players through game achievement. On the other hand, local coaches can recommend the players. Also, it fully supports the training of young people financially.

3.3.9 Closed training before the large games

Large – scale assembly training and closed training before large games was the important method of the Chinese team to make sufficient preparation for

great achievement. Especially, it was carried out 2 months to 1.5 months before the competition so that the athletes were fully prepared in physical energy, techniques, tactics, psychology, and willpower. The closed training fully utilized the limited time to train pertinent techniques and tactics. Through simulated pertinent training, the principal players will adapt to the plays of main rivals, so that they could make good achievements in games with confidence.

Every time before closed competition, the coaches must assume possible problems in the competition, solve the players' pertinent problem, and create those problems in the training intentionally for the players to solve. Throughout those trainings, the coaches help the athletes' capability to fight in real battle.

Methods include: to carry out adaptation training in the cities with similar temperature and humidity to the competition location, to research principle to succeed and pertinent training, to lay emphasis on environment education, and put the slogans on the closed training gyms.

3.3.10 Emphasis on training plan

The Chinese team paid special attention to techniques and tactics strength. In training, the coaches laid emphasis on "what to practice, how to practice, and how much to practice," which was the core reason that the Chinese team lead the world in technique. Especially, the accurate positioning of "what to practice" is the assumption and key to pertinent training.

To establish and implement a training plan is the basic capability of every coach. To understand and perform the training plan is the basic requirement of every athlete. One scientific training plan can lay the solid foundation for successful training. The plans can be classified into general plans and individual plans.

The contents of the training plan were decided through collective research. The individual plan made by one athlete must be collectively discussed. Especially, the one who defeated the athlete shall participate to pick up the shortcomings so that the athlete can effectively make up the shortcomings and bring the advantages into full play. The general plan is made by the coach group. In general the training plan is classified into basic skills, tactics, and independent fighting capability training.

After training, what the athletes learned in techniques and tactics shall be collected by the team leader on every weekend to hand in to the coach group. The coach group also would have meetings to discuss the training contents and methods so that the training plan is fully implemented.

3.3.11 Summarization after important games

No matter what achievement that the national team had made, it was always required to maintain the clean mind, treat the honor and success correctly, and find shortcomings in victory for improvement methods. This strong consciousness of misery, psychology state, and mind state eliminated the team's arrogance in success and dismay in failure. If victorious, the team shall start from zero, if in failure, it will fight with revenge. The team will forever progress with no satisfaction.

The theory and practice levels of the Chinese coaches were exposed in the summarization report after every large game. It would not only demonstrate the current situation of the world development situation, but also explore the difference and dynamic changes among the teams as the evidence to map out future countermeasures. This method was the concrete method to make the Chinese team standing in table tennis theory and practice summit of the world.

3.3.12 Maintaining excellent tradition

Management, including the management in life, training and competition, were emphasized especially for the top – level players. Hard practice, scientific training principles, and mode of large sports quantity, the spirit of rough training of the red – clothes team, are the largest treasure of the China table tennis team. The internal self – reflection of team, cohesion, and no counting on individual gains and losses for the national interests are all important traditions of the China table tennis team.

3.3.13 Double – track system

The so – called double – track system, an important part of table tennis system reform, required the athletes to register with double identities. They not only represented the provinces or cities to participate in the National Games and National Championship Games, but also participated in Club National Championships and other commercial games. It has gained in three ways: the provinces and cities can get protection by participating in national games, and benefit from the athlete's transfer. The high level athletes have a greater effect by participating in games with larger advertisement effects, which aspires the enterprises more. Athletes have obtained extra game experience and economical benefits from the enterprise. This practice could make the team more stable and retain the players.

The Club National Championships under the double – track system has developed stably since 1995. Currently it has three grades: super championship, Club A, and Club B.

3.3.14 Emphasis on science and research

Scientific research is one of the important measures that help China table tennis to reach the summit. The scientific coaches and researchers on all aspects not only research on new technology and new plays, train new players, but also help coaches and athletes to conquer the rivals together. For example, the improvement and innovation on different rubber characteristics were made for the national team players. The diagnosis, analysis, and technique filing of world major players, the video types of major rivals were established for the national major players to watch and research repeatedly. The pertinent analysis and mastery of the rivals' characteristics made the athletes confident. In addition, the coaches were scientifically conscious, and cooperated with the researchers well. Furthermore, it created the successful model, which combines leader, coaches, athletes, and researchers in training management.

3.3.15 Emphasis on innovation

Innovation is the soul of a nation, and the unexhausted motivation of a country. The table tennis team promotes innovation, and explores new techniques and tactics. According to statistics, during the one hundred years of international table tennis development, altogether there were 37 plays and technique innovations. The Chinese players have innovated 21 of them for the past fifty years, 57% in total. The purpose is that players of all plays can win the world championship, and the competitors were always in the phrase of passive adaptation.

4 Conclusions

The great achievement of the China table tennis team has embodied the unique table tennis spirit and culture with Chinese characteristics under the national sports system

There are 15 factors for the success of China table tennis team, as follows: the emphasis of the central government leaders and care of the national people; the leaders paid attention to dialectic; the national strategy; mastery of the factors to success; establishing the small world of China table tennis circles; trial horse system; stable and outstanding coach team; emphasis on reservation training and echelon formation; closed training before large games; emphasis on training plan; the summarization after important games; maintaining excellent tradition; double – track system; emphasis on science and research; and emphasis on innovation.

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42 The strategic research on the development of athletic table tennis in Taiwan

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1 Introduction

The development of Taiwan table tennis has forested a group of athletes with outstanding performances, such as Wu Wen – Chia, Chiang Peng – Lung, Chuang Chih – Yuen, and Chen Jin. Under the circumstance of changed rules, the planning for the future development is especially important for avoiding transitory success and shortening the exploration process.

According to the actual situation of Taiwan and analysis on the current basis and future development trend, system improvement is the main objective. To promote future comprehensive strength and development level of Taiwan's table tennis sports, we need to fully utilize the typical successful experiences of strong table tennis teams and individuals of European and Asian countries, as well as failure lessons to more systematically and comprehensively research on previous experiences.

This dissertation focuses on strategic research from the previous passively following international competition trend to actively seeking strategic development. It puts forward various long – term reform and development strategies and establishes a strategic model suitable for Taiwan for reference with a view to world development trend of table tennis sports, successful experiences of strong teams, and the issues facing Taiwan.

2 Methods

This dissertation uses research methods such as literature research, expert interviews, deduction, and induction.

3 Results

3.1 The positioning of Taiwan table tennis sports

With the gradual development of Taiwan's table tennis sports and partial re-

sult and experience gained through hard efforts, only by reasonably formulating the development objective and plan, we can follow the development and trend of world development and gradually improve the general strength and make better achievements.

3.1.1 The new situation of world table tennis sports

Currently world table tennis is developing towards comprehensive, fast, and changeable directions. The "world is fighting against China." Male competition has multiple players with furious competition. Female competition is lead by the Asian team, particularly the China team.

After the change of rules, the development of table tennis techniques became more ferocious and faster. Forehand and backhand can both counterattack. The style becomes fast and furious with "no reason."

Therefore, master the principles to success, continuously master the international table tennis team strength trend timely, collect the information of all teams and adjust the training competition, and prepare well, and then we can follow the new trends of world table tennis development.

3.1.2 The current situation analysis of Taiwan competition strength

In the male team, Chiang Peng – Lung, Chuang Chih – Yuen, and Chang Yen – Shu are the three major players of the male team. The future key players to succeed are Wu Zhi Qi, Jiang Hong Jie, and Zhou Dong Yu.

In female team, Huang I – Hua, Pan Li – Chun, Lu Yun – Feng, Su Hsien – Ching, Yu Mei – Ju, and Li I – Chen are the major players. They are all young and have excellent combinations with different plays. The biggest issue is that they lack large game experience.

3.1.3 The objective position of Taiwan's table tennis sports

To closely combine world table tennis development trend and the actual development in Taiwan, we take " Global perspective, relation to reality, preparation for future, enhancing reform, and promotion of progress" as the internal requirement for the table tennis sport development for Taiwan in the future eight years.

3.1.3.1 The strength objective in general

The development objective of Taiwan table tennis sports from 2005 – 2012 shall be "To stably promote the strength in general, to consolidate and promote the leading status in the Asian Olympic Games, Olympic Games, Asia Cup, and World Cup, to further improve the status in world table tennis sports."

3.1.3.2 Strength development objective

We shall take the top four rankings of world teams as the indicator of strength. We shall make a record by winning a gold medal in the Olympic Games, World Cup, and World Male Singles. To further improve the strength in winning a gold medal and medals in seven items for group and single, and the qualification for competition in the Olympic Games, and to win the sports' top eight players.

3.1.3.3 Strategic objective for surpassing

From the current situation, we can clearly set South Korea, Japan, Hong Kong, and China as the most important competitors in the future eight years. Japan, Hong Kong, and South Korea are strong in general. By 2010, Taiwan's teams shall fully overstep them with the purpose of improving and examining our own athletic strength, and ensure the position of the number one group in Asia.

Korea and China are the main objectives for Taiwan to make a record in rankings. To overstep South Korea and China, we shall research on the seven items for group and single, especially in male group and male single as the breakthrough to improve the overall single and group strength as well as group cohesion and moral.

3.1.4 Breakthrough of Taiwan Table Tennis

In the history of Taiwan's table tennis sports, no one has won the championship of the Three World games (World Male Single, World Table Tennis Champion, and Olympic Games). Chuang Chih – Yuen won the championship in the World Professional Table Tennis Tournament in 2002, and has given some hope for Taiwan's table tennis sports in the Three Cup games.

3.1.4.1 The strategic breakthrough

In the three steps development stages of the eight years, we shall find the optimal position for breakthrough in items: we choose male between male and female; we choose single between group and single. Therefore, we will focus on male single and take Chuang Chih – Yuen as the key strategic individual for training.

From the history of world table tennis sports, the first championship won by one country or region was significant to the future development of this sport. The table tennis teams of China, Japan, Sweden, and South Korea are good examples. The strategic objective of Taiwan's table tennis sports shall take Chuang Chih – Yuen as the key development focus, and make efforts to win top three in the World Three Games and win one world champion as the objective.

3.1.4.2 The analysis on subjective and objective conditions

From the subjective and objective conditions, Chuang Chih – Yuen is the strategic key person for Taiwan's table tennis sports. The reasons are: from the situation of world table tennis and the achievement that Taiwan has made, the strength of Taiwan's male athletes are not lagging behind in singles and has already lead the development of world table tennis sports. The achievement of Chuang Chih – Yuen could prove that his play is advanced.

In objective conditions, the development of the world table tennis circle is on the turning stage, from the facts of the 11 points system, uncovered serves and European teams such as Sweden are on the edge of changing personnel. New players are numerous, but not mature in strength. The above subjective and objective conditions provide Chuang Chih – Yuen excellent chances.

In the future two years, Chuang Chih – Yuen shall be the training focus with favorable policy and active training. We shall increase the practice in international games, and promote his stability in large games. In addition, we shall enhance his mind state, and try to win the world championship and open a new age for Taiwan's table tennis sports.

3.1.4.3 Future training modes

There are three strategic development routes for training Taiwan table tennis players with excellent achievements:

1. Parasitical mode (walking out), represented by Chuang Chih – Yuen, with main training location in mainland China and European Clubs
2. Local mode (self – cultivation), represented by Wu Wen – Chia and Chiang Peng – Lung, with major training locating in Taiwan
3. Foreign group (invitation in), represented by Chen Jin and Xu Jing, by introducing excellent athletes from Mainland China

Among the three routes, we shall take the first route as the main method, supplemented by the second route as the major cultivation mode. As the third route is more or less out of luck and difficult to implement, we will not use this method as the important strategic method. We will invite the mainland and European athletes if the conditions are mature.

3.2 The strategy of Taiwan table tennis sports development

3.2.1 Strategic thinking in general

3.2.1.1The mission for development

To establish the development strategy of Taiwan's table tennis sports is a major evidence to formulate the middle and long term development plans. Based on reality and correctly understanding the characteristics of Taiwan, we analyze the current basis and development trends, borrow domestic and foreign successful experiences, research and compare carefully to make the optimal

choice, and develop the table tennis sports of Taiwan characteristics as the mission.

3.2.1.2 Development policy

In general, we focus on enhancing people's physiques. Under the goal of popularization and improvement, the policy shall aim to improve Taiwan's table tennis sports, and increase the table tennis population. We will make pertinent reform and development on important theoretical issues, realistic issues, and strategic issues.

3.2.1.3 The basic spirit of development

The basic spirit of Taiwan's table tennis sports development strategy is to shorten the time and give predominance to breakthrough, make pertinent action research, discover issues, explore rules, and solve problems. We will make strategic adjustments on the seven table tennis items of group and single, with different development focuses to realize strategic objectives.

3.2.1.4 The tasks of development

The tasks of Taiwan's table tennis sports development strategy lays in considering development issues from the long – term, and gradually shortening the distance from the world's strong countries, combining upper and lower level minds, collecting limited human, financial, and material resources to improve training benefits and training efficiency, enhancing scientific, technology, and personnel training, and emphasizing on the innovation, speed, value, balance, and relationship of strategic development to progress in the new century.

3.2.1.5 The general objective of development

Through continuous system improvement, we lay emphasis on developing strategic plans to become the number one group in the world, i. e. the top four teams, and gain the strength to win the gold medal as the general objective of development.

3.2.1.6 Strategic choice

Based on the following strategy, we choose "surpass strategy" as the most suitable strategy to rapidly improve Taiwan's table tennis sports. The major characteristics of surpass strategy are:

(1) Based on development of table tennis sports, we will compete with world leading countries or surpass the world advanced level.

(2) We shall realize the importance of table tennis sports technology, and invest a training and science center to enhance the combination of training and scientific research with obvious effects to realize the goal of the latecom-

ers surpassing the formers.

(3) We will introduce world – advanced techniques and successful play modes to analyze creatively and combine the advanced technology of table tennis for sports training and speed up the improvement of sports technique levels

3.2.1.7 Strategic objective

Based on guidance rule of "Research it before defeating it," the main rivals of Taiwan's table tennis sports are: China, South Korea, Japan, Hong Kong, Germany, France, Sweden, and Belgium.

3.2.1.8 Strategic focus

The development strategy will focus on the training and cultivation of young people with male single as the breakthrough, and consistently walk on the elite road, adopting the three modes including parasitical mode, local mode, and foreign group mode to train high – level athletes.

3.2.1.9 Strategic steps

Three stages for eight years:

The first stage: short term objective: male shall keep Asia's top 4 players and female shall become Asia's top four by 2006

The second stage: by 2008, the male and female shall enter the world top four teams or top four in ranking

The third stage: by 2012, the male and female shall keep the top four stages of the first level group of the world, and win a gold medal.

3.2.1.10 Strategic pattern

Taiwan's table tennis sports shall have the three – level pattern of "upper, middle, and below."

Below: the focus pattern of Taiwan's table tennis sports, the evidence to choose athletes is that if she/he was elected as a young national player or has participated in Taiwan High School Games on table tennis, or the top eight male and female group team, or listed focused counties and cities.

Middle level: The top four players wining young national players will be listed in elite training program, and we shall select two training locations: first is the Taiwan Tainan table tennis training camp, second is the provincial and cities professional team of Mainland China with the purpose to improve techniques and tactics.

Upper level: Top four players of the ROC team shall be listed in "medal special program" and participate in different professional clubs of Europe, Japan, and China to get the chance to compete with the world – class players.

3.2.2 System strategic measures

3.2.2.1 Decision system

3.2.2.1.1 Administration system

We shall promote strategic consciousness, enrich strategic research, improve system, and enhance the general strength of Taiwan's table tennis sports as the paramount objective of development.

We shall organize table tennis associations, employ relevant personnel, formulate development policies; encourage large enterprises to support excellent players and coaches; utilize the media to promote the extent of social focus, and increase the population of table tennis sports; establish supervisory system, and implement the evaluation system to every link of the table tennis association plan practices; actively raise money and perform the "invitation and walking out" policy.

3.2.2.1.2 Information system

We will take information collection as the important measure to master the sports training development trend, understand the conditions and characteristics of rivals, improve pertinence of training, and make achievement in games.

The method to collect information can be various: computers can be used to obtain the literature information in periodicals, dissertations, magazines; continuous interview, visiting, and talks with relevant personnel of table tennis can obtain non – literature information; focusing on development of all countries of the world competition, and timely, extensively, and pertinently collecting the world's top class players' video tapes for analysis, sorting, and providing for the reference of the training of coaches and players, assisting the players to win the game, and bring the role of information collection to the ultimate benefits.

3.2.2.2 Embodiment system

3.2.2.2.1 Training system

It is the predominant job to create a "high strength, high rivalry, high concentration, and high competition" training environment. We will gradually form the environment of focus training for focus personnel and special policy for special personnel, with gold medal strategy and elite policy as the goal.

We shall set the goal of table tennis player of competition style, intellectual type with connotation. Through different stages, we will form policy of selecting, making, and utilizing competent personnel by choosing personnel according to experience, competition results, and science. We will focus on promoting training and trial horse system for players with different technique plays, recommend high potential players to receive training plans overseas to

improve sports achievement and technical skills, and systematically establish the continuous training system of table tennis sports from primary school to university.

3.2.2.2.2 Coach system

We will train the strategic type top coaches as the objective, improve the understanding and mastery of all coaches on table tennis theory and practices, and formulate scientific innovation training plans

We will improve the coach system, establish coach periodicals, train the coaches and players to utilize the computer technology to obtain the information, employ excellent foreign sports coaches to help the sports training, arrange coach forums and seminars of all levels, visit the training of strong teams, or train in different places so as to improve the professional capability of domestic coaches, organize coach groups to watch the world class matches, and understand the world development situation and trend; emphasis on coaches meeting after large games, and transmit the latest information to coaches of all level to understand the technology development.

3.2.2.2.3 Game system

It is the core objective of the game strategy to win excellent achievements. We will improve the competition system, and select excellent personnel through games as the focus players for active training. All levels of inter – school competition shall be hosted to enhance technology communication, and increase the population of table tennis. The annual domestic and overseas game schedule shall be planned. We will establish game system to keep track of international games, and lay emphasis on double games. Through games we will select players to enrich the experience of excellent players in international games.

3.2.2.3 Supporting system

3.2.2.3.1 Tutorship awards system

We will research and formulate reasonable tutorship awards measures by awarding both psychologically and materially for either coaches or players.

We will praise the group and individual who contribute to the development of table tennis sports, establish professional sports coaches in schools, increase the chance of excellent players to enter higher education, encourage players to continue to participate in sports training, and help the players to plan their careers.

3.2.2.3.2 Scientific research system

We will improve science and research system, promote science and technological consciousness, enhance the combination of science and sports to real-

ize the goal of tasks driving science and technology to solve practical problems. We will borrow advanced table tennis research results to improve game achievement. We will use new facilities and equipment products to improve sports effects.

We will improve the quantity and quality of coaches' dissertation, combine the using of relevant sports science and technology, including sports physiology, psychology, physics, biochemistry, nutriology, and medical theories, and injury protection to the training and games to enhance the capability to solve the problems in the games, especially the problems put forward by coaches and players.

3.2.2.3.3 Professionalization development

Professional clubs will be the important topic of Taiwan's table tennis sports development.

The professional club can improve the competition levels of table tennis sports, enhance the training motivation for players of all levels, introduce new concepts and tactics, enhance the competition among teams, and increase sports population by providing channels of releasing pressure and participation.

Taiwan's professional table tennis sports shall be supported by four to eight enterprises through creating table tennis clubs. The Professionalization of Taiwan's table tennis sports is the breakthrough. Borrowing European and Asian clubs' experiences and Taiwan's professional baseball experience, the Professionalization of Taiwan's table tennis will be an important future development direction.

4 Conclusion

(1) Through efforts in all aspects, Taiwan's table tennis sports can become one of the world's strongest teams in ten years.

(2) The objective of Taiwan's table tennis sports is to become the World's number one group, top four strongest teams, and capability of winning a gold medal of Three World Games by three stages in eight years, to borrow the successful experiences of strong table tennis countries, and lay emphasis on developing strategic plans.

(3) The strategic modes of Taiwan's table tennis sports include three modes: one is the parasitical mode, represented by Chuang Chih - Yuen, the second is the local mode (self - cultivation), represented by Wu Wen Jia and Jiang Peng Long; the third is the foreign group mode (invitation in), represented by Chen Jin and Xu Jing by introducing excellent athletes from Mainland China and Europe

(4) Based on objective and subjective factors and consideration of the cur-

rent environment, the current strategic breakthrough shall choose male between male and female, and choose single between group and items, and choose single between single and double. It shall fully implement in male single with Chuang Chih – Yuen as the main strategic person.

(5) Taiwan's table tennis shall implement the surpass strategy through three divided systems: decision system, embodiment system, support system, and eight strategic measures: administration system, information system, training system, coach system, game system, tutorship awards system, scientific research system, professionalization development, and construct the table tennis sports with Taiwanese characteristics.

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43 Survey of table tennis optional course and teaching staff situations in colleges and universities in China

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1 Introduction

As a national ball game, ping – pong is one of the most popular bodybuilding sports in China. With the deepening of PE's reform in higher learning institutes, it has spread with its popularity in colleges and universities for its characteristics of fit – keeping, interesting and entertaining. The paper discusses the survey on the ping – pong optional course and Teaching Staff Situations in Colleges and Universities, which aims at finding out the present situation of ping – pong optional course, and giving some suggestions.

2 Methods

(1) Questionnaires: to design a questionnaire to consult PE teachers or those who in charge of PE department in 37 colleges and universities in china.

(2) Interview: to interview PE major teachers in PE colleges and some PE teachers in other universities.

(3) Mathematic statistics: to take mathematic statistics for the survey

3 Present situation of ping – pong optional course in colleges and universities

3.1 The situation of ping – pong course and teaching condition

According to the investigation in 37 colleges & universities, 31 of them have ping – pong course, which accounts for 83. 78% . The universities that give the course have facilities in different locations, such as sports stadium, ping – pong room or large classroom for ping – pong; while some schools don't provide ping – pong course, because they attach less importance to ping – pong,

or due to poor teaching condition such as lack of space or teaching staffs. In general the ratio of universities that provide ping – pong course is comparatively high in mid and eastern region while low in western region of China.

3.2 Basic situation of teaching staff of ping – pong course

Of the 31 colleges and universities that give the course, there are totally 106 ping – pong teachers. Among them, 31 teachers (which makes up 30% of the total) graduated as ping – pong majors. The restore in other PE majors, such as basketball, volleyball, football, gymnastics, track and field, etc, among them more than 1/4 ping – pong teachers are track and field majors. This indicates at the same time track and field events' present situation in colleges and universities. Although track and field event is good for bodybuilding, practical results and facilitation for physical exercise, few students choose this course as optional for their lack of interest. That leads to the result that professional teachers of track and field change to teach ping – pong for the latter is rather popular in colleges and universities.

At the same time, it is obvious that ping – pong teachers are comparatively old. Among 106 teachers, those who are over 45 make up 40% of the total. This phenomenon, I think, has something to do with people's cognition. It is generally believed that ping – pong is an indoor sport which requires less movement. For the sake of taking care of the old teachers, they' re usually given the priority to teaching ping – pong on condition that there are no professional teachers or any other suitable persons. It has been investigated that over 10 ping – pong major students are recruited in Peking Physical Culture Institute every year, and other PE colleges have the same situation, too. Some local PE colleges or departments don't have ping – pong major, or only recruit few students even if they have the major . Due to the popularity of ping – pong and social need, the contradiction between offering and requiring leads to the short of professional teachers.

4 Strategy and Suggestions

(1) The difference of the ratio of having ping – pong course in colleges and universities between eastern region and western region of China is not only affected by the condition of running a school, teaching resources and so on, but also has something to do with the situation of local finance, and the investment of government. It is expected that with the development of western region and the increase of investment put into western region education, the resources and condition of education will be improved in western area.

(2) Faced up with a series of transform in PE's major in colleges and universities, the PE colleges or departments should make respective adjustment in

the construction of teaching resources and the cultivation of talents. For the potential PE major with good prospects and social demand like ping – pong, more attention should be given either financially or physically to train more qualified people.

(3) It is needed to strengthen the training of working ping – pong teachers. The nonprofessional ping – pong teachers have accumulated plentiful teaching experience and practical ability after many years' teaching practice. Faced up with the development and innovation of ping – pong, it is also needed to strengthen the study and master professional knowledge as well as practical skills, try their best to demonstrate precisely and explain scientifically with possessed knowledge and skills. They also need to try to develop and use multimedia courseware to broaden students' vision and compensate the inadequacy of teaching and optimise teaching.

(4) Another advice is to recruit those sport talents, especially good ping – pong athletes to dedicate themselves to PE in college and universities. China is well – known for its ping – pong for many years, huge resources, either mentally, physically or financially have been put to train professional ping – pong athletes in National ping – pong Team, Youth Team, as well as in teams on provincial level. Therefore, a lot more professional personnel have been turned out. Yet, after they finish their career as professional ping – pong players, only a few of them become coaches or go abroad to play ping – pong. Most of them take the social jobs or go to schools for further education. An overwhelming majority of them take up profession or education, which have nothing to do with ping – pong. For example, many professional ping – pong players chose Non – PE College or major for further education after they left the team. It's a big waste of professional resources for them to compete in other majors with long years, learned and better academic achieved students, some off – career ping – pong players are unwilling to take PE teaching as a profession has something to do with their value for choosing jobs, and social identification for PE teachers. The case is that on the one hand there is a big demand for college ping – pong professional teachers, while on the other hand there is a big loss and waste of senior, well – trained ping – pong personnel. How to combine and balance the two sides need a better bridge for communication and coordination. What I can do here is to raise the question and to give suggestions. It is expected that the experts and leaders in National PE Head Bureau and the Administrative Center of ping – pong and badminton can consider the problem.

44 A research on preliminary selection of table tennis athletes

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1 Introduction

Selection, training and management are the three factors that restrict the development of ping – pong. The scientific selection of ping – pong players is a major problem nowadays in China. The issuance of Standard of the selection of enfant and juvenile athletes in the early of 1990s accelerates the development of ping – pong of our country.

However, the standard caters for key P. E. schools, that is, the medium level. There still is a urgent need to solve the problem of preliminary selection. The medium level should be based on the preliminary one. We here put forward a research of the preliminary selection to perfect the preliminary selection mode and improve its quality.

2 The characteristics and analysis of the current preliminary selection

2.1 The characteristics

2.1.1 Universality

The main task of the preliminary P. E. schools is to choose the talented pupils to develop their interest in the game and to equip them with basic skills. The selection of this level has the characteristics of universality. Effective ways should be used to find, identify and grasp those hardly found real genius on the basis of large scale testing.

2.1.2 Feasibility

Because the preliminary selection is on a large scale, the testing items should be practical. Its difficulties should be suitable to juvenile physical and mental characteristics. The means should be simple and easy to carry out so as to fit the large collectivity.

2.1.3 Validity

The testing targets should not follow the medium selection mode. Uncontrollable and stable factors should be used in the testing and judging. Only after a

newly learned child receive systematic training can we see whether he is suitable for the game or not. Because the objects of preliminary selection are not systematic trained, it is meaningless to use the results of some special testing. Owing to the differences in region, age, education, family economic background, mental and physical state, intelligence, etc, the scoring standard should not simply follow those already existed chart to avoid inaccurate evaluation.

2.2 Analysis of current means of selection

Since the end of 2002, we have had an investigation to the tutors in amateur ping – pong schools, key ping – pong schools and ping – pong clubs in more than 10 regions in Guangdong province and discuss with them about the problem of preliminary selection. The investigation shows that problems still exist in the preliminary selection in many ordinary basic amateur P. E. schools. Without a scientific testing system, the testing is simple and impractical.

The medium selection standard is tailored to the samples from medium level athletes and isn't in accord with the characteristics of preliminary selection. Using the medium standard to choose the basic level athletes will easily ignore those really talented ones. Because of the judgmental attitude of some tutors, some children with high sports potential are not trained in their early stage. The traditional experiential selection mode hinders the development of scientific preliminary selection and vice versa.

3 Choice of the targets

From the above analysis, we hold that the target should be based on its own characteristics. The basic principles are followings. (1) simple and easy to carry out for large scale testing. (2) effective so as to identify and find the potential talent of the juniors. (3) the general testing and the special testing should be divided into stages; the targets should be different from one another. Based on the principles mentioned above, our long – term experiment and research meanwhile referring to theory and means of other sport items, we establish a target system of preliminary selection (Figure 1).

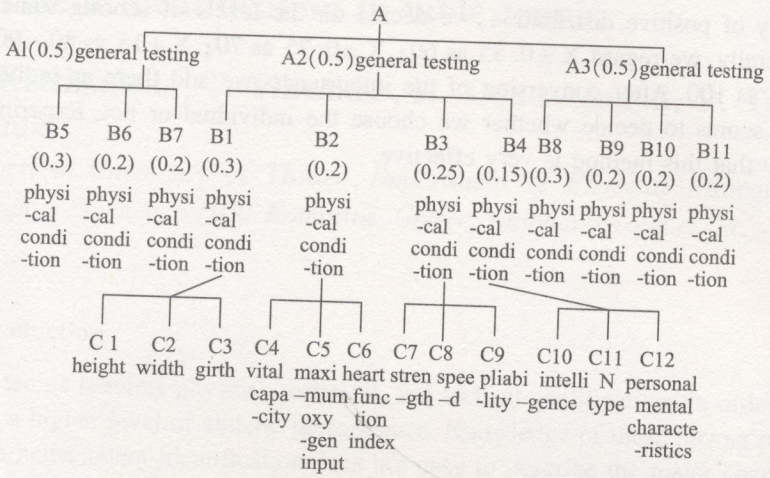

Figure 1. choice of the targets

According to the above division and classification, we set up specific testing items of the third level C. write – in methods is used in B4 to test the intelligence. A2 is a special quality testing decided by the tutors according to the special characteristics of ping – pong. B8 is related with the 80. 8 nerve type testing methods. Considering the recent reformation of the management system in amateur P. E. schools and the maturing rule of ping – pong players, we add B9, B10 and B11to A3. The 3 targets play an important role in the development of the skills of the ping – pong players.

4 Establishment and application of the standard

The scoring and evaluation of the testing results are important in the selection. Firstly, we should consider the importance of the targets that are on the same level. In order to decide which the more important one is, we can consult the experts, refer to literature about different kinds of selection, ask the opinions of tutors from different levels, etc. Then we establish the standard of scoring. We can refer to relevant mode charts but should modify and justify them to suit our needs.

Some tutors are used to borrowing existed mode chart, which will lead to low scores in the testing. The mode charts often adopt the means of adding and the low scores are very close. The lack of difference in the low scores makes us hard to identify the different levels of ping – pong players. Thus, inaccurate evaluation will appear. Our method is to classify the original scores and calculate the average score and standard one in every item. Based on the

theory of positive distribution, we decide on the levels of scoring standard. Generally, we regard $X \pm 0.55$ as 60; $X \pm 0.75$ as 70; $X \pm 15$ as $80-90$; $X \pm 35$ as 100. After conversion of the importance, we add them as individual total scores to decide whether we choose the individual or not. Experiments show that this method is very effective.

45 Talent identification in table tennis

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1 Introduction

Table tennis requires physical, technical, and tactical qualifications in order to obtain a higher level of athletic performance. Knowledge of these factors may lead to better talent identification. It is not easy to describe the major characteristic of Table Tennis. Table Tennis is an intermittent exercise (Watanabe et. al, 1992). As an "open lopped" skilled sport requires various skills. Some of the most important principles of the sport are anticipation, speed, precision, and concentration (Yan, 1992, Gadal, 1997). However, many other factors such as psychocological, physical and technical are the key of success too.

Although Table Tennis is very famous worldwide there are not many talent identification reviews that can express the factors that are necessary in one or another way for "selecting" players. Thus, the purpose of the present study was to determine the specific physical fitness characteristics of male and female table tennis players aged 11 to 12 years old in order to improve the talent detection process.

2 Methods

2.1 Subjects

In this study participated 75 children at the age of 11 ~ 12 years old that were separated into two groups: table tennis athletes (n = 15: 6 boys and 9 girls) and the control group (non – athletes n = 60: 20 boys an 40 girls). The athletes had training age between 2 ~ 4 years, were signed for a professional club and also played in the national table tennis championship. The non – athletes had never played table tennis, and Control Group.

2.2 Measurement

All subjects performed selected motor fitness tests of the Euro fit test battery: flamingo balance (general balance), plate tapping (coordination and speed of limb movement), handgrip test (static strength), and 10X5 – m shuttle run

(speed and agility). Also, they performed specific table tennis tests: Ball Balance, Ball Bounce Relay, and Volley Relay.

2.3 Motor Fitness Tests (Euro fit)

2.3.1 Flamingo Balance

The subject should balance on one leg on a balance beam. A stopwatch was used per beam. The subject was required to stay balanced as long as possible on the long axis of the beam using his/ her preferred foot for one minute. Each time subject loses balance test stops. The number of attempts needed to keep balance for 1 minute was the score of each subject.

2.3.2 Handgrip Test

This test i measures the isometric grip strength of the hand. The subject stands with the arm extended and then squeeze the dynamometer. Every subject had two attempts.

2.3.2.1 10x5m. Shuttle Run

Each subject had to run as fast as possible 10x5 metres on a slip – proof floor, which was between four traffic cones.

2.3.2.2 Plate Tapping

This test measures how fastness of the hand. Each subject had one attempt.

2.4 Specific Table Tennis Tests

2.4.1 Volley Relay

Subjects had to hit the ball vertically using forehand side of the racket without the ball touching the floor. Each subject had two attempts.

2.4.2 Ball Bounce Relay

Each subjects had to bounce the ball using forehand side of the racket. Each subject had two attempts.

2.4.3 Ball Balance

Each subjects stands with a ball balancing on the racket face up. Each subject had two attempts.

2.5 Statistical analysis

Descriptive statistics (means and standard deviations) were calculated for each group for each age level to describe central tendencies and dispersion. The two – way analysis of variance (group X sex) was applied in order to determine if any significant differences existed between the groups of the

study (athletes and non – athletes). An α level of $p < 0.05$ was used as a criterion of significance.

3 Results

The two – way analysis of variance (group X sex) found that there are significant differences between table tennis players and non – athletes in Volley Relay ($p < 0.05$), Ball Bounce Relay ($p < 0.05$) and Ball Balance ($p < 0.001$). Not significant differences were found in other test (Table 1).

Table 1. Results of the two – way analysis of variance (group X sex) (n = 75).

VARIABLES	F	p
Volley Relay	5.95	0.05
Group	1.95	NS
Sex	1.08	NS
Ball Bounce Relay	4.60	0.05
Group	7.33	0.001
Sex	2.11	NS
Ball Balance	11.01	0.001
Group	0.00	NS
Sex	0.04	NS
Flamingo Balance	1.50	NS
Group	0.04	NS
Sex	1.50	NS
Plate Tapping	2.40	NS
Group	0.00	NS
Sex	0.39	NS
10x5m. Shuttle Run	2.75	NS
Group	0.25	NS
Sex	0.18	NS
Handgrip	3.76	NS
Group	3.56	NS
Sex	0.18	NS

4 Discussion

From the analysis of the results it was obvious that the Table Tennis group achieved better records at the total results. With regard to the measurement of height, the total of sample (both groups) presented prices that are found in harmony with other previous studies (Moravec, Sedlacek, 1993; Joan, 1990; Mechelen, Lier, Hlobil, Crolla, Kemper, 1987). Similar values found also with the measurement of weight, in the total of sample, where they agree with the studies that were reported. The unique difference is located in the measurement of weight of girls, where the control group girls are heavier. It is not however statistically important difference and likely is accidental. Similar conclusions are also exported concerning the height of two teams, where not observed important differences as well as the two teams are moved near in the means.

No significant difference found between Table Tennis and Control group in Flamingo Balance test. Table Tennis group had numerically better records than Control group. Both group values were in satisfactory levels marking better prices than Slovak students (Moravec, Sedlacek, 1993) and of course better than similar measurements in Spanish students of same age (Joan, 1991).

The output in the ordeal locomotion of hand and for the two teams oscillated in the mean of category. It should be marked, that the records of boys and girls of team of Table Tennis are better than the corresponding team. This can be explained because the nature of sport requires from the athletes of Table Tennis they use more utmost and particular the sovereign hand or we could say the one that keeps the racquet. Taking into consideration of what they (Levarlet – Joue, Fieventz, 1990) point out, that the sports that their nature requires use more or under utmost overcome and more specifically in basketball and the tennis, is justified also the difference in the prices. Concerning the corresponding studies that are reported in Slovaks (Moravec, Sedlacek, 1993) and Spanish's (Joan, 1991), students of same age present itself lightly more low than the two groups.

Statistically a significant difference was achieved in all the measurements that were related to the movement of arms and hands and possibly that can constitutes a criterion for the selection of talents for the sport of Table Tennis. However, we have to take into consideration that the results will be evaluated in total and also to consider other factors such as biological etc. Further more the analysis with t – test showed statistically a significant difference among the girl from Table Tennis group and Control group which can possibly constitutes indication that the training irritation was more efficient because of

previous maturing of the girls of that age against boys. Biological age measurements were not accomplished in order to have scientific results.

Concluding we would like to stress that it was not easy to compare the founding of this study because there is not enough bibliography reviews. Of course more research is needed in order to receive more valid results. The next target is the realization of new measurements and greater range of tests, having taken into consideration that the theory of detection and selection of athletic talents has to act consultatively and not prohibitively for the future of an athlete and in relation to the fact that training is the one which plays the main role as the will of trainees to succeed in something better.

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46 A survey of table tennis coaches' opinions of some criteria in talent identification

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1 Introduction

"Talent is a word we hear so often in sport. Whether it be parents, coaches, other athletes, managers or whoever, someone is always telling someone that he or she is talented or has heaps of natural ability" (Stojanovic, 1997).

"Talent is the substance that a person or group has that sets them apart from other people" (Wikipedia).

Jurgen Kozel (1996) describes talent as "extremely complex attribute, genetically determined, complicated in structure and subject to environmental conditions."

How can you find the sport which an individual is most suited to? In addition, how does the coach and sporting organization identify the athlete who is most likely to succeed in a given sport?

"The answer is talent Identification (TID), although this method is far from perfect, it does offer athletes, coaches, and sporting organizations an opportunity to identify talent and direct it towards the sport which he/she is most suited" (Stojanovic 1997).

Talent Identification in sports is a process in which individuals, who are more likely to prosper in a given sport, are identified according to the results of the tests of specific factors (Hadavi, 2000).

"TID was established as early as the late 1960, s. East European countries were the first to involve TID into their sporting programs and as early as the 1970, s they were using specific methods for identifying potentially high – class athletes. Gradually, in some western countries including Australia we have seen the adoption of TID" (Stojanovic 1997).

Due to the increasing competitive factor and Specific sport programs, talent identification methods became very common (Baur, 1975, Woodman, 1985).

There have been variations of talent Identification methods employed in several countries such as German Democratic Republic (G. D. R), the Soviet Union (USSR) and China over the last three decades (Baur 1988, Jarver 1981, Peltola 1992, Thomson 1985, and Wu 1992).

Talents can be analyzed and identified from three dimensions of physiolog-

ical, somato – type, variable trainability, and motivation. He also believes that talent depends on both the *internal* (heredity) and *external* (environment) factors (Gimble, 1976).

Bompa (1985) states that level of performance in a sport is determined by three factors: (1) motor capacities (psychomotor skills), endurance, strength and power, (2) physiological, (3) somato – type.

According to some studies, researchers categorize the effective characteristics of talent identification into six groups: (1) physiological and bio – mechanical, (2) anthropometric, (3) biological, (4) genetic, (5) psychological, (6) sociological. (Thomson 1992, Hanson 1989, Bevis 1985, Ward 1981).

Considering researches conducted out of Iran and studying more than seventy questionnaires answered by Iranian high – level coaches in 15 sports, Hadavi (2000) suggests a model of Talent Identification process in which the following characteristics are measured to identify talented individuals: physiological, anthropometric, psychological, psychomotor, physical – motor, biological, and health condition

Recognizing a talent in sports and accordingly in table tennis is very important. There is no doubt that identifying a talent is a complicated and heavy task. This requires not only the theoretical knowledge, but the experience gained through practice (Uzorinac, 1997).

Potter and Anderson (1996) surveyed some table tennis players' perceptions of the ideal table tennis players. The players consistently identified psychological, fitness, and table tennis specific characteristics of an ideal player.

Limoochi (1996) reported that the main factors that are considered in selecting talented players in Beijing Sport School are anthropometrics, psychological and physical – motor factors.

Lapszo (2002) found that there was a very strong correlation between all the general factors of psychomotor efficiency and sporting rank for senior Polish National Table Tennis Team. "These general factors are probably strongly genetically conditioned. Accordingly, these factors can be treated as predispositions to investigate the degree of aptitude for table tennis."

Djokic (2004), analyzing the heart – rate values in competition conditions for a sample of top players, concluded that modern table tennis requires both sub – maximal and maximal work and this puts pressure on both aerobic and anaerobic energy systems.

The purpose of this study is to determine some critria and principles in talent identification based on the views of the table tennis coaches about anthropometrics, physical – motor ability, physiological, psycho – motor, psychological, and somato – type factors.

2 Methods

2.1 Design

This is a descriptive study that aims to survey the opinions of the international table tennis coaches, concerning some important factors and characteristics in Talent Identification and finally establish a basis for determining the most important and effective elements.

2.2 Participants

The participants in this study included 40 international – level table tennis coaches (26 from Iran and 14 from other countries), who were selected on the random basis. The foreign coaches were chosen and sent questionnaires by the ITTF Research Committee. Among the coaches who were contacted, 26 from Iran and 14 from other countries filled out and returned the questionnaires.

2.3 Data gathering

In order to obtain the coaches' views of important factors in talent identification, a *closed – form* questionnaire consisting of two sections requiring personal and specialized information was used. The questionnaire was designed by the researcher and got its content and face validity confirmed by experts in this field. The reliability was computed as 0.70.

3 Results and Discussion

According to the data collected in the personal information section of the questionnaires, 55% of the respondents held a international degree in coaching. The average coaching experience of the respondents was 15.74 years.

About 50% of the respondents considered the ages 7 ~ 8 while 27.5% of them suggested 5 ~ 6, and 17.5% regarded 9 ~ 10 as the most suitable period for Talent Identification (Table 1).

Table 1. Distribution and percentage of the coaches' views about the most suitable Age for Talent Identification

Ages / Coaches	5 ~ 6	7 ~ 8	9 ~ 10	11 & over
Distribution	11	20	7	2
Percentage	27.5	50	17.5	5

According to the analyses illustrated in table 2, it was found that 66.5% of the respondent chose observation method and 48.1% ranked the scientific method as their priorities in Talent Identification.

Table 2. Distribution and percentage of the coaches' priorities of Methods for Talent Identification

Coaches' Priorities \ Method		Festivals & Competitions	Scientific Method	Observation Method	Experimental Method
1st Priority	Distribution	7	13	20	10
	Percentage	22.6	48.1	66.7	37
2nd Priority	Distribution	14	2	4	5
	Percentage	45.2	7.4	13.3	18.5
3rd Priority	Distribution	3	9	5	6
	Percentage	9.7	33.3	16.7	22.2
4th Priority	Distribution	7	3	1	6
	Percentage	22.6	11.1	3.3	22.2

On the whole, 34.2% believed that the Educational Department/ Ministery has the prime responsibility for Talent Identification.

Table 3 illustrates that among *anthropometric* characteristics, *standing height* was considered as the most effective element by 21% of the respondents.

Table 3. Distribution and percentage of the coaches' priorities of Anthropometric elements for Talent Identification

Features / Coaches	Standing height	Weight	Length of straight arms	Length of stretched arm	Length of forearm	Ratio of trunk to legs	Ratio of trunk to standing height	Pelvis width	Sitting height
Distribution	8	4	4	1	2	3	1	6	4
Percentage	21	10.5	10.5	2.6	5.3	7.9	2.6	15.8	10.5

Furthermore, concerning somato – type factor, 59.4% of the coaches take Mesomorph as the most suitable somato – type for Table Tennis.

Among psycological factors illustrated in table 4, intelligence was taken as the most prominent element by 57.5% of the respondents. Reaction time with 21% and decision making with 13.2% respectively took the second and third place of importance for Talent Identification.

Table 4. Distribution and percentage of the coaches' priorities of Psychological elements for Talent Identification

Features / Coaches	Intelligence	Anticipation	Decision making	Recognition	Reaction time
Distribution	23	3	5	3	8
Percentage	57.5	7.9	13.2	7.9	21

92% of the coaches ranked *psychomotor* factors first, among which *motivation* was considered by 50% as the primary element for identifiying the talented; *self – confidence* by 30% ; *concentration* by 27.5% , *handling mental pressure* by 22.5% , and *hard – working* by 17.5% of the respondents (Table 5).

Table 5. Distribution and percentage of the coaches' priorities of Psychomotor elements for Talent Identification

Features / Coaches	Motivation	Concentration	Self – confidence	Handling mental pressure	Boldness	Arousal	Attention	Hard working
Distribution	20	11	12	9	2	4	1	7
Percentage	50	27.5	30	22.5	5	10	2.5	17.5

Based on the results shown in table 6, among the physical – motor factors, agility was taken by 60% of the coaches as the most dominant characteristics for the Identification of talented individuals. Explosive power with 37.5% and coordination with 23.5% were established as the next priorities.

Table 6. Distribution and percentage of the coaches' priorities of Physical – motor elements for Talent Identification

Features / Coaches	General strength	General speed	Flexibility	Agility	Muscular endurance	Explosive power	Coordination	Dynamic balance	General endurance
Distribution	2	5	2	24	—	15	9	1	6
Percentage	5	12.5	5	60	—	37.5	23.5	2.5	15

Table 7 shows that 82% of the coaches answered the question concerning *physiological* factors. Among these factors *ATP – PC* was chosen by 45.2% as the most important element for identifying talented players. *Fast tissues* with 15.3% and *heart – rate threshold* with 12.9% ranked respectively as the second and third important elements for Talent Identification.

Table 7. Distribution and percentage of the coaches' priorities of Physiological factors for Talent Identification

Features / Coaches	Lactate threshold	Vo_2 max	Heart – rate threshold	ATP – PC	Percentage of fast tissues in bat arm	Percentage of slow tissues in bat arm	Percentage of fast tissues in legs	Percentage of slow tissues in legs
Distribution	3	3	4	14	8	2	3	4
Percentage	9.7	9.7	12.9	45.2	15.3	6.4	9.7	12.9

In conclusion, anthropometric factors were the most important in the views of 36.1% 0f the respondent coaches. Psychological factors with 33.3% and Psychomotor with 25% , physical – motor with 13.9% , physiological with

11.1% , and somato – type with 8.3% respectively fall in the next orders. (Table 8, Figure 1)

Table 8. Distribution and percentage of the coaches' views about the most effective factors in Talent Identification

Factors / Coaches	Anthropometric	Physiological	Physical – motor	Psychological	Psychomotor	Somato – type
Distribution	13	4	5	12	9	3
Percentage	36.1	11.1	13.9	33.3	25	8.3

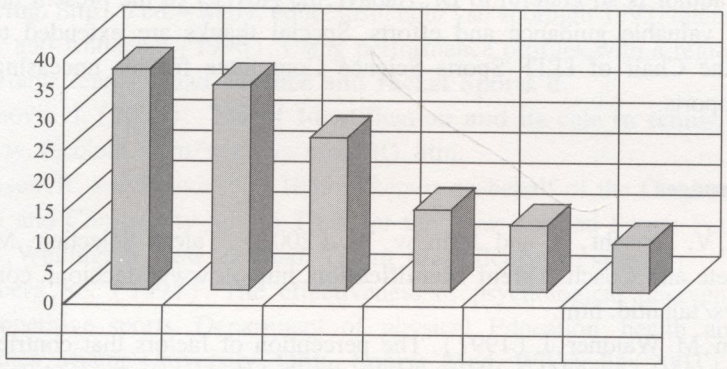

Figure 1. Percentage Illustration of the coaches' priorities for effective factors in talent indentification

4 Conclusions

Although there is no evidence of any similar reaseach on talent identification specifically in table tennis, the results of present research, in general, are comparable with the findings of some studies by many researchers such as Bompa (1985), Russel (1989), Thomson (1992), Hadavi (2000), and Ibrahim (2003), etc., who considered Talent Identification of great importance in different sports.

This study is in line with some research, particularly, on demands and requrements of table tennis like physiological, psychological, psychomotor, physical – motor elements, etc. by Potter & Anderson (1996), Limoochi (1996), Givehchi (1997), Lapszo (1997), Kondric & Leskosek (2001), Bawden, Waldner & Maynard (2001), Djokic (2002, 2004), etc.

Despite the fact that in the history of table tennis championship, there have been some elite players, world and olympic champions who lacked some typical table tennis characteristics (physical or anthropomeric, for instance), by utilizing some other capabilities, styles and techniques, and modern equipment (rubber & blade), they have compensated for their shortcomings and have made outstanding achievements.

On the other hand, we are aware of that in the countries with small population, the need for this compensation is highly felt. However, concerning table tennis demands and fast development of this sport throughout the world, paying due attention to Talent Identification is crucial.

5 Acknowledgements

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47 Research on the relationship between blood – type, fingerprint and pick of table tennis players

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1 Introduction

Some research shows that there is a close relationship between the blood – type, fingerprint and sports ability. To learn about the relationship between these two lifelong attributes and bodily agility, in this research we measured the blood – type and ten fingerprint configuration of some table tennis players in Sichuan whose sports rank are over national first grade. We hope to learn the relationship between the two attributes and the bodily agility, and reveal the possibility of applying the relevance in picking the potential players.

2 Methods

The testers are the currently active table – tennis players in Sichuan Sports Institution, as well as some retired players in Sichuan province, including 18 males and 19 females. The blood – type is determined by the method Flat – Plate – Blood – Type – Determination, and the ten fingerprint configuration is sampled using the method of Ink – Print and Tracing. The distribution ratio of the blood – type and fingerprint configuration is calculated separately for the male and female players, and statistics study is applied to compare with non – players. The percentage of the ten fingerprint configuration distribution is also calculated, comparison is made with non – players.

3 Results and Discussion

3.1 The distribution ratio and comparison of blood – type and fingerprint configuration for male and female table tennis players

Table 1. The distribution ratio and comparison of blood – type and fingerprint configuration for male and female table tennis players

	Blood Type (percentage)				Fingerprint Configuration (percentage)			
Group	A	B	O	AB	Filter	Ulna	Radius	Bow
Male	44.44	22.22	22.22	11.11	48.89	45.00	5.00	1.11
Female	33.33	38.89	16.67	11.11	45.50	46.56	2.12	5.82
X2	0.47	1.18	0.18	0	0.42	0.09	2.26	6.02
P	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	<0.025	

Seen the sequence of blood – type distribution ratio from table 1, in the male group type A is most observed, and type B and type O are equal, while in the female group, type B is most observed, then type A, type O and type AB. As to fingerprint configuration distribution ratio, in male group the sequence is Rule, filter, bow and Radius, while in female group the sequence is rule, filter, Radius and bow. Comparing the blood – type and fingerprint configuration distribution ratio, except that significantly more bow shaped fingerprint is observed in female than in male, ($P < 0.025$), there are no obvious difference for the other attributes.

3.2 Percentage distribution and comparison of players and non – players

Seen the sequence of blood – type and fingerprint configuration distribution ratio from table 2, blood – type of A is most observed in the players group, than type B, type o and type AB. In comparison, blood – type B is most observed in non – player group, than type O, type A and type AB. Players group has the same fingerprint distribution as non – players group: filter shape is most observed, than rule, bow and Radius.

In conclusion, there is no distinct difference in the distribution ratio of blood – type and fingerprint distribution ratio between table tennis players and non – players.

Table 2. Percentage distribution and comparison of players and non – players

Group	Blood Type (percentage)				Fingerprint Configuration (percentage)			
	A	B	O	AB	Filter	Ulna	Radius	Bow
Non – palyers	27.51	32.33	30.49	9.22	49.77	45.53	2.27	2.43
players	38.89	30.56	19.44	11.1	47.16	45.80	3.50	3.52
U value	0.23	1.44	0.29	1.53	1.00	1.11	1.60	1.36
P value	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05	>0.05

Note: the fingerprint configuration distribution ratio of non – players is excerpted from the Third China Heritage Annual Academic Meeting Press P16

3.3 The ten fingerprint configuration distribution of male and female table tennis players

As to the fingerprint configuration, the statistics for the ten fingerprint shows that 2 male players from 18 (11.11%) have all filter shape, 1 has all rule shape (5.56%), while 10 female players from 18 (16.67%) are all filter

shape, and 1 has all rule shape (5.56%). It is not observed that male and female players have all Radius and bow shape in the ten fingerprints.

Analyzing the ten fingerprint configuration, statistics shows that table tennis players are most filter shaped in thumb, second finger and forth finger, then rule shape; they are no bow shaped in the middle finger and the small finger. The fingerprint configuration of players is very similar to that of the non – players.

4 Conclusions

(1) There is no distinct difference in the distribution of AB O blood type system and the ten fingerprint configuration for table tennis players

(2) There is no distinct difference in the blood type and fingerprint configuration between the table tennis players and non – players.

(3) The ten fingerprint shape coordination is basically the same.

(4) The author thinks that although there is some relationship between the sports agility and the two attributes of blood – type and fingerprint, they are unsuitable to be taken as the basis for picking potential sports players.

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48 The present situation and prospect of talent identification of table tennis players in China

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1 Introduction

From weak to strong, Chinese table tennis team has a lasting prosperous development for more than 50 years, which was a big wonder in the sports history of the world. It continually comes forth rookies and talents in a large number, carries out sustainable development strategy, and pays more attention to building the reserve talents. We have taken a series of effective measures and have cultivated solidly reserve talents trying to form a science, rational, high – efficient "talent production line", in purpose of having laid a rich foundation for the development of China's table tennis.

2 China's table tennis circle has a correct lead thought for cultivating talents in reserve

In 1960s, along with the development of sports and with the government's support to sports, we studied the advanced experiences of foreign countries and began to study the problem of talent identification of table tennis players. The policy makers of China Table Tennis Association utilized scientific means to make the policy for cultivating the talent, which is based on the trend of the development of table tennis, combined with the objective reality. They also made and released the document "The suggestion of strengthening scientific talent identification", which leaded China's table tennis to develop in a correct direction.

China's current situation and remarkable characteristics of talent identification are as follows: The system of talent identification of table tennis players all over the country, including the general survey and the setting up of sieving out the talents, the exploring of the theory and practice of "talents production line" in the table tennis circle. The training of players to be started from childhood, fully supporting the focal points and setting up a small Table Tennis World in China. The competition system was closely cooperated with talent identification at each level and insisted on reforming the rules and regulations in table tennis competitions. The study of the theories of talent identification was emphasized. The index system of talent identification was established and perfected. The government exerted social power to form the com-

petition and training network for juveniles in the basic levels. The training of coaches at basic level, assurance the input into the training of talents for personnel in reserve was strengthened.

3 The organization of talent identification is on the way to perfection

China has gradually built a set of perfect networks of talent identification at home, and the system of the networks is sound. "The National central group of talent identification" is established, attached to State Physical Culture and Sports Commission. An importance national study of this group is to search the elementary and intermediate standards of talent identification of table tennis.

China has already established the leading group of talent identification in 26 municipalities or autonomous regions or provinces, and also established research organizations in 18 sports departments of cities or provinces, and there are almost 100 full – time researchers . We set up the network of county, city and province, which have nearly 1000 part – time and full – time workers for talent identification. In some provinces they made a comprehensive evaluation criterion and test in table tennis or other important items and built talent identification database, track system of regular test and so on. They also made a corresponding working system and incentive method, and succeeded in getting a large quantity of the scientific result about talent identification. So, a group of outstanding young players were trained. A lot of them got excellent achievements in world competitions.

Every year Chinese table tennis association organizes an expert panel which is made up of outstanding coaches from city, province and national sports team. They go to the local places to guide, inspect and collect informations, in order to offer reliable basis for table tennis association to make its policy.

4 The player's echelon of Chinese table tennis is complete and links up rationally

4.1 Paying attention to echelon's construction

The system of current training of our country is the so – called system of "pyramid" or "a dragon". After the talent identification, some outstanding young players who experienced a successive sieving out are completely absorbed in "a dragon" of the system, and then they are recommended to get training at a higher level. Some teenagers who are not suitable for competitive sport are eliminated, and then they will change their sport item in order to "make everyone bring into full play". That is to give them display their ability and try to reduce the waste of money, time and talent. China generally divided talent identification of table tennis players into 4 levels, including foundation, primary, intermediate and advanced(Figure 1).

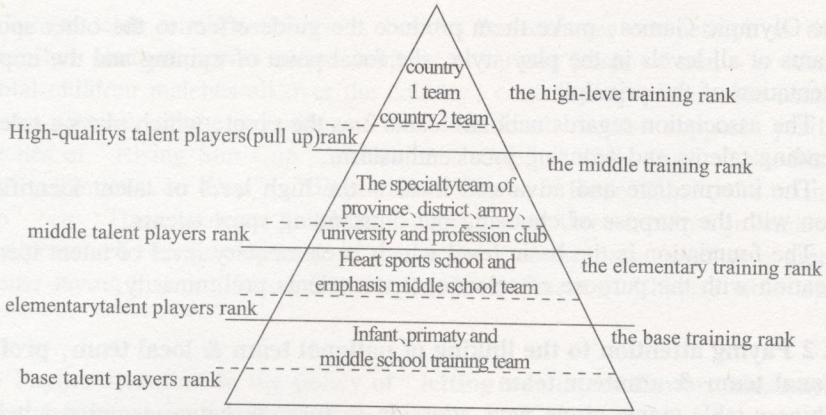

Figure 1. The excellent sportsman of our country fosters the system

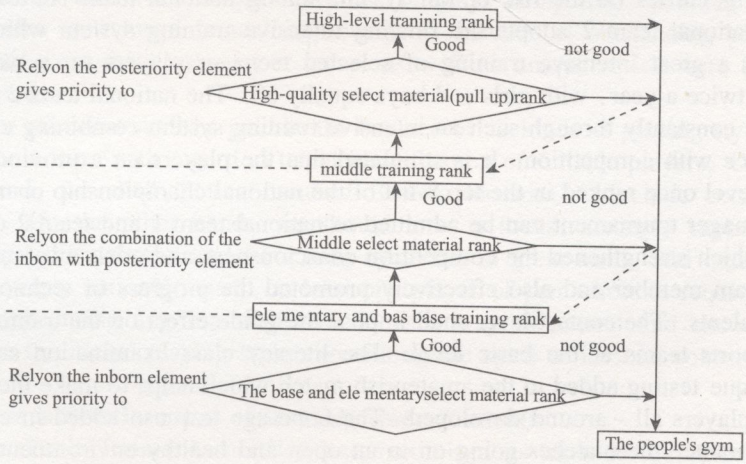

Figure 2. The architecture picture of different ranks in sports talent identification and training of talent players

The work on the talent identification of Chinese table tennis players pays attention to combining popularization with improvement (combining test and assess with extensive general survey), and profession with avocation. It proved that the talent identification of table tennis players was effective in China. There are above 30,000 juvenile players who take part in the training of the amateur sports school and key sports schools in China at present. There are nearly 2000 adult professional and amateur juvenile players registering in the Chinese table tennis association. Nearly 100 players of national team 1 & 2 formed the top of the "pyramid" with a unanimous goal. The system of traing has shown the rich strength of the table tennis of our country.

Chinese table tennis association organizes national team 1 to win honor in

the Olympic Games, make them produce the guide effect to the other sports teams at all levels in the play style, the focal point of training and the implementation of the principle.

The association regards national teams 2 as the pivot, which plays a role in sending talents and arousing local enthusiasm.

The intermediate and advanced level is the high level of talent identification with the purpose of choosing out outstanding sport talents.

The foundation is the basic level which is elementary level of talent identification with the purpose of selecting sport talents preliminarily.

4. 2 Paying attention to the linking of national team & local team, professional team & amateur team

Chinese table tennis circle pays attention to the link between national teams and local teams, professional teams and amateur teams with the mutual support among every level.

China carries on the rise or fall system among national team 1& team 2. The national team 2 adopts the flowing intensive training system which includes a great intensive training of selected teenager players on a national scale twice a year, with girls and boys equally 60. The national team 2 is adjusted constantly through such an intensive training system combining closely practice with competition. It is stipulated that the players on a provincial or city level once ranked in the top 8 list of the national championship or national teenager tournament can be admitted to national team 1 and team 2 directly, which strengthened the competition consciousness and crisis awareness of the team member and also effectively promoted the progress of technologies and talents. The contest lever shall impose the guide effect on the trainings of the sports teams at the basic level. The literacy class examination and the physique testing added to the amateurish match which helps to make the teenager players all – around developed. The bone age test also added in contest to guarantee the matches going on in an open and healthy environment. Besides, in terms of changing the method of teenager match, instead of the elimination system, the round robin system was adopted, which provides an opportunity for players with different playing styles to communicate as many as possible, so as to make the match more exciting.

To guarantee a rational link between every echelon, the national team refuses to accept he juvenile players under 14 years old, which also helps to keep a reasonable number of city and province teams and the normal organization and training.

Those coaches having made remarkable achievements in the national teenager competitions are rewarded so as to further arouse the enthusiasm of the coaches at the basic level. In the annual assessment of Chinese "top ten" coaches, there are chances especially offered to coaches from amateur sports schools who are again fully considered in the recommendation of candidates for the emeritus medal of sports.

Chinese table tennis association, besides the teenager competition as the nation has planned, gives active support to various kinds of non – governmental children matches all over the country, contributing to the table tennis contest network of the juveniles at the basic level. It also supports yearly matches of "Rising Sun Cup", "New Star Cup", "Kid's Cup", "Seedling Cup", "Innovation Cup", "Exploration Cup", "Hope Cup", "Linking Cup", etc. These matches, each joined by two or three hundred juveniles, have promoted the development of this activity at the basic level to a great extent, laying a strong foundation for the development of Chinese table tennis.

4.3 Paying attention to the policy of "letting a hundred flowers blossom" and the support for key technique

One of the important factors of enabling Chinese table tennis to prosper forever is "letting a hundred flowers blossom" and setting up a peculiar Chinese table tennis circle. With various kinds of plays competing, learning from each other to achieve mutual improvement, batches of outstanding players possessing extensive capacity to adapt as well as unique styles were hence cultivated.

More attention shall be paid to the balance of all kinds of playing styles in the whole team with regard to talent identification of suitable players. On the one hand, we shall "let a hundred flowers blossom" (include complete plays). On the other hand, we should have a focus, strongly supporting technique difficult to train, of a long cycle but in great need, and creative. In the yearly national match, at least one player of pen – hold is required in the group during a group competition, as a way to protect and encourage Chinese traditional playing style, presenting the spirit of internal cohesion.

4.4 Guarantee the input of training reserve talents

Chinese Table Tennis Association has maximized its input to the cultivation of reserve talents in terms of labor, materials and financial resource, which has tremendously encouraged the basic – level staff in the table tennis circle, and aroused the enthusiasm of both coaches and players.

5 Chinese table tennis circle pays attention to experience summary and theoretic discussion of talent identification

5.1 Importance on the accumulation and summary of talent identification' experience

The table tennis coaches realize the meaning of talent identification gradually through the long – term training practice. They have accumulated rich experience from successful cases by which the coaches seek the law of talent identification. With the attention to the special demand of particular movements, they try to train the players with different ways, accumulating their prediction

experience of players' future development. At the same time, they keep developing scientific talent identification theories by summarizing specific experience.

5.2 Emphasis on the theory and applying study of talent identification

With the syllabus and teaching outline of teenager amateur sports school made, Chinese table tennis circle make clear the bases and principles of talent identification and master the scientific talent identification method, building up the ideal mode of forming key elements of special top – ranking players' sports ability and offering model modes and reference bases of talent identification. In addition, the index and standard of talent identification are carefully selected and reached (mainly covering age, figure, quality, physiology, psychology, skill, etc).

Aiming at cultivating all – around developed players, the table tennis circle pursue the combination between skill test and sport achievement, technique achievement and body character achievement, talent identification and training, the talent identification method of present test, assessment and future prediction, with the culture course and the physique testing added to amateurish matches. Defining the basic – level player selection and training, in a certain sense, prepares for the higher and multi level of talent identification and training. And talent identification, being an organic component of cultivating players, goes through the complete course of elementary and intermediate trainings. During this period, by testing and assessment with scientific theories and methods, the precise prediction to players' future sports ability is conducted, accompanied by persistent teaching and training, follow – up testing and assessing, predicting analyses and talent identification work.

A large number of scientific research theses and monographs are published which carried on a profound discussion on the theories, methods of table tennis players' talent identification (according to incomplete statistics, nearly a thousand articles, monographs and translated articles on talent identification of table tennis players have been published in China since 1950, over 97% of which were after 1980).

5.3 Strengthen the training of the coaches at the basic level

Coaches at the basic level serve as the basic element of talents' production line. The Chinese Table Tennis Association has already run the training class of coaches at the basic level four times since 1997, mainly targeting at coaches of amateurish sports school and P. E teachers of primary and middle schools. Leaders of the association, coaches of the national team and many experts have given lessons in the training classes and organized the coaches to view the training of the national team, letting them grasp scientific training methods by having top – ranking players do the technique demonstration. Much efforts are paid to guide the training of the basic link onto the scientific track, which will help to form a scientific, rational and efficient "talents'

production line".

6 Development trend of talent identification of Chinese table tennis players

Although the achievements already made in talent identification of Chinese table tennis players, but its level is behind the development of competitive sports with the "huge – crowd strategy" phenomenon still exists. Owing to the great difficulty brought by the social and natural science knowledge involved in the talent identification process, the subject has its breakthroughs on limited issues, with the scientific talent identification still at primary stage of research, testing and exploration. The relevant theoretical research, method and means have not yet formed a complete system. The difficult points and important points of table tennis players' talent identification research currently mainly include the followings.

(1) The use of heredity study's theories and methods in talent identification has just started a great deal of principles and methods not quite clear in the gene location and control. Current situation and level of discipline on gene hereditary research has restrained this study from a wide application in the field of talent identification. But it is an inevitable trend of applying genetic engineering to talent identification, which will cause the revolution in theories and methods of talent identification and promises a bright future. The problem of relatively low hereditary knowledge of players' congenital movement ability of table tennis and competence of testing and assessing at present still existed. The key problem is how to distinguish congenital and acquired sport ability and what the relations and influences are between the two. How the player's congenital movement ability takes place or develops? Which concrete index does it have? What method we should adopt to test and assess it in different stage for children and teenagers... All these questions are not really solved , although some researches already made.

(2) Predicting and researching of the theory and method about talent identification and, especially predict to the development which make up every factor of player's sports ability that demand urgently to further investigate. How confirm all sports congenital foundation, ability of factor which it might improve to be most enormous? How to predict the future movement quality degree with present movement quality? All of these are very difficult to calculate. Without this kind of estimation, ones that made talent identification and required at present it will be blind. Prediction is the core of selecting suitable players. If this problem is unsolved, scientific selection will become a empty verbiage. Predicting of talent identification extends from a short time (or stage by stage) at first to long – term forecast gradually.

(3) More efforts should be exerted on the appraisal and qualification of children players' development degree. The related methods still need further research and development, with the procedure of distinguishing simplified, the accuracy of appraisal improved and widely available as well as Apply

strengthened. With the matches among table tennis club taking little notice of the age currently, whether it will affect the cultivation and development of the juvenile table tennis players is open to discussion.

(4) The methods commonly used in China at present are the methods of screening, experience and tracing back. And the science and technology method is far from meeting the need of development, especially the evaluating test and result assessment with a close combination with the special Science and technology method still limited, which cannot change the domination of experience method as a subjective method. A lot of coaches (including middle and advanced coaches) have too much faith in the experience or screening method, or simply relying on the sport result comparison method to have talent identification. Therefore, research and development of the science and technology method will be the eternal subject of players' talent identification.

(5) Owing to the difference in the structure and content of different competition items, applying commonly used testing index and assessment standard to the players' selection reduces the effectiveness and pertinence of the testing result, its index and standards open to examination and ratification. How to develop validity high talent identification and evaluating the index and standard will be strong points to the special characteristic develop its comprehensive criteria for evaluation, it will be working difficult point and focus at present and in quite long period. From outward appearance to inner essence, from in great numbers to simple, sound is combined , the actual effect is reliable will select suitable players in the screening direction of the index , the design of the comprehensive criteria for evaluation will be developed in pluralism, stage, computer procedure and direction of simple and convenient automation.

(6) The developing direction of talent identification hinges on its close combination with sports training and sports competitions. Talent identification, as an organic component of cultivating players, runs through the course of elementary and intermediate training, with persistent talent identification work of training, test, assessment, prediction, competition and selection as well as elimination. A system of scientific examination and cultivation integrating talent identification, training and competition shall be established.

(7) Chinese and foreign comparison research on talent identification of table tennis players, especially with the expansion in scope and depth research on the centralized and dispersed system of talent identification, there is a trend of merging into each other and reaching a complementary and mutual development, which should draw much attention and deserve special research.

49. Introduction and Application of Multistage Compound Progressive Score Method in Grading of Physical Value

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1 Introduction

Multistage compound progressive score method is based on the foundation of progressive score method, which is a more scientific and rational method that can harmonize the range of quantified – increasing with the score increasing of the hardness distribute cent. Not only can it manifest that more hardness means more pay of strive, so that the notion of getting higher grade according to it, but also avoid the situation that the grade appears on the high side or on the low side with the simple progressive score method. And it also can avoid either that the over hardness of getting the excellence grade or getting the high score even with efforts, because of the relevant items which is over high, thus making people lose their enthusiasm. We thought there are several unreasonable points, with the analysis of point table in the "State Physical Culture Eligibility Standards" decreed by the State physical culture Commission and The State education Commission, which is pushed to all levels and all kinds of schools. The first: the arrange of grade elevation, i. e. in the 100m point table of nineteen year old or over mankind, it is the different hardness from 18″2 to 17″9 which is improved 0″3 and from 12″8 to 12″5 which is improved the same, but these two are all offered 5cents. The second: taking low and ignoring the high, i. e. in the shuttle run of the five – grade schoolboy of the elementary school, the score of 1′29″which is between 1′30″ (85 point) and 1′28″ (90 point) was kept the lower – 85 cents, which does not manifest the quantified scientific. The third: poor flexibility. With the analysis of the situation of reaching the mark in many schools, the excellence rate of the pupil real getting is very low. In the article, we will introduce a new, scientific and practical grading method – multistage compounds progressive point – score, to make the grading method in physical culture of our country more scientific, rational and standardized.

2 Methods

2.1 Participants

The 1000m running score of the nineteen years old nationality schoolboy

from 30 provinces, municipality and municipality directed under the central authority all over the country declared with the investigation of the pupil's constitution all over the country, totally 5604 persons.

3 Research tchnique

3.1 Testing and collecting the relevant data, and then figuring its mean ($x = 231.71$), standard deviation ($s = 20.35$) and effective number ($N = 5604$) up.

3.2 Listing D value list

When grading the physical culture grade, it is based on position (namely D value) of each score to figure the points up. But the Value means the position according to the standard deviation for unit on the axis of abscissa of normal curve, and because of the symmetrically arrayed with the mean of hub. In order to make the points calculated reflect the hardness of the athletic performance improved much better, we must lie our D value list which reflecting their positions (Table 1).

Table 1. D value list

	S	−5S	−4S	−3S	−2S	−1S	0	1S	2S	3S	4S	5S
±5S	D	0	1	2	3	4	5	6	7	8	9	10
	S		−4S	−3S	−2S	−1S	0	1S	2S	3S	4S	
±4S	D		0	1	2	3	4	5	6	7	8	

The area inside the ±5S occupies the total area 99.99995%, but the area inside ±4S occupies the total area 99.99366%. At the practice of physical culture, the width expanse of the ±5S curve impacts the balance ship between the curvature changing and the grade progressing. And the parallelism relationship is not so good too. Comparing with the ±5S curve, the ±4S curve is more practicable.

3.3 Calculating the parallelism proportion that the D value demanding

3.3.1 Confirm the basic point (0 point) and full mark point (100 point)

Confirm the position of $x \pm 1.5s$ (negative correlation means $x - 1.5s$, positive correlation means $x + 1.5s$) is 100 points, so the 100 points is: $231.71 - 1.5 * 20.35 = 201.185$ (second); the position of $x \pm 3s$ (negative correlation means $x + 3s$, positive correlation means $x - 3s$) is 0 point, so the 0 point is: $231.71 + 3 * 20.35 = 292.76$ (second).

3.3.2 Calculating the all right rate and the pass muster rate

According to the subject investigated and the object actuality, by the deliberation of the "Delphi method" body of experts, they study out impersonality

the rational excellence rate and pass muster rate. In this case, the excellence rate (90 – 100points) is intended to be 10% , and the rate (60 – 69points) is intended to be 90% .

3.3.3 Calculating the all right rate and the middling rate

According 1. 5s, excellence rate and pass muster rate, adopting the backward, calculate the proportion that the area of all right rate (80 – 90points), middling rate (70 – 79points) occupy the total area See Table 2.

Table 2. The list of excellence, all right, middling, pass

Points	proportion	area	positive value	difference	deviation
100			1.5	5.5	
90	10%	50% – 10% = 40%	1.28	5.28	0.22
80	20%	50% – 20% = 30%	0.84	4.48	0.44
70	42.86%	50% – 42.86% = 7.14%	0.18	4.18	0.66
60	90%	50% – 90% = – 40%	– 1.28	2.72	1.46
0			– 3	1	1.72

The calculation procedure of the value in list 3 is as followings:

(1) Calculate: D1 = 4 + 1. 5 = 5. 5; (2) According to the proportion – 10% , get the area, by checking the list that the positive value is 1. 28. D2 = 4 + 1. 28 = 5. 28; (3) Calculate the deviation between D1 and D2, getting the value 0. 22; (4) Calculate the D3 value, subtracting the deviation between Dl and D2 from D2, namelyD2 = 5. 28 – 0. 22 = 4. 84; (5) D4 = 4. 84 – (5. 28 – 4. 84) = 4. 84 – 0. 66 = 4. 18; (6) The positive value of D3 and D4are 0. 84 (4. 84 – 4) ,0. 18 (4. 18 – 4) ; (7) Check the positive value in the list to get the area, 30% and 7. 14% ; (8) After calculation, get their proportions are 20% and 42. 86% ; (9) It is same to get the D5's and D6's values; (10) D6 = 4 – 3 = 1.

3.4 Calculating Zi" Ki'

According the parabola formula: y2 = Ki * Di3 – Zi and the points in list of D value, solute the equation and get the list of Zi's、Ki's value (Table 3)

Table 3. Zi、Ki value

Point	100	90	80	70	60
Ki	99.0678	50.2690	37.1790	24.5696	188.2486
Zi	6483.8978	700.5083	– 2184.6397	– 3105.5707	188.2486

(in the formula is progressive fraction for coefficient, for the position of a certain grade at axis of abscissa of the normal curve for the left hand fraction of the basic score point)

3.5 making the point table

According the formula = x ± sx((y2 + s2)/k – 4) (positive correlation for " + " negative correlation for " – ") and the 1000 m running mean score of the nineteen year old Han nationality schoolboy declared with the investigation of the pupil's constitution all over the country in 1995(- = 231.71), the standard deviation(S = 20.35), and the calculatedZi、Ki, with the standard like this: excellence (90 – 99points), all right (80 – 89 points), fail (0 – 59points), and with the calculation of software package – excle2000, we get the points and the points list (Table 4).

Table 4. The 1000m running score of the nineteen year old school boy

score	time	1/10 s	score	time	1/10 s
100	3:21.19	3:21.2	45	4:26.84	4:26.9
95	3:23.44	3:23.5	40	4:30.02	4:30.1
90	3:25.67	3:25.7	balance	6.28	
balance	4.48		35	4.33.27	4.33.3
85	3:30.08	3:30.1	30	4.36.59	4.36.6
80	3:34.62	3:34.7	balance	6.57	
balance	8.92		25	4:39.97	4:40.0
75	3:41.07	3:41.1	20	4:43.36	4:43.4
70	3:48.05	3:48.1	balance	6.77	
balance	13.43		15	4:46.67	4:46.7
65	4:00.43	4:00.5	10	4:49.66	4:49.7
60	4:17.76	4:17.8	balance	6.3	
balance	29.71		5	4:51.90	4: 51.9
55	4:20.72	4:26.9	0	4:52.76	4:52.8
50	4:23.74	4:30.1	balance	35.0	
balance	5.98				

4 Results

According to the table 4, when the score is from 60 to 70, the grade add 1cent as improve 2:971; when the grade is from 70 to 80, the grade add 1cent as improve 1:343; when the grade is from 80 to 90, the grade add 1cent as improve 0:448. It is also concluded that the improvement of grade and the increase of difficulty are closely related to each other according to the grade from1 – 10 – 20 – 30 – 40 – 50 – 60. With the increase of the difficulty, the point value will build up. It is a scientific and rational method; with the purpose to get the appraisement in conform to objective law, that difficulty increase and improvement of homologous point value can be incarnated in the term of grade and score corresponding.

5 Conclusions

(1) Progressive score grade means adopt one parabolic form, which is incapable of incarnating the grade bump and wake point value on speaking terms. While multistage compound progressive score grade means was on the basis of grade point, adopting time after time parabolic form, incarnate the grade difficulty and eke homologous point value on speaking terms.

(2) Excellence rate (score 90 – 100) and check out rate (score 60 – 69) of certain sports evaluation item can be judged and confirmed by the specialists, and all right rate (score 80 – 90), middling rate (score 70 – 79) can be calculated with the backward methods. In this way, the problem of inadaptability between improvement of certain section grade and incremental point value during multistage compound progressive score can be solved better.

(3) It is the demand and necessary trend of the evaluation development that scientific and rational grade approach can be used to conform to athletic sports objectively and factually with quantify appraisement. However, our national physical evaluation appraisement still stagnate during isometric (grade) given detached valuation models in a great many aspect, which can not adapt with the development of our physical evaluation. Some irrationality or unscientific contradiction available in the process of physical evaluation appraisement can be solved preferably by multistage compound progressive score means, thereby improve the quality of physical evaluation appraisement continually.

50 Research on the Principles of Chinese Table Tennis Training

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1 Introduction

1.1 Dominance of Chinese Table Tennis in the world

From 1959 to 2000, Chinese table tennis team took up 55.6% of the total champions in the World Championships, 58.5% in the World Cup and 81.2% in the Olympics. All these repeated phenomena do not happen by chance, and there must be some regular pattern, for which many professionals and specialists concerned have done much research work as well as publishing large numbers of documents. Ichiro Ogimura, the former Chairmen of ITTF and the world champion said: "There is no secret in the technical training of table tennis in today's world."

1.2 The new explosion on the basis of past researches home and abroad

Reviewing successful experiences in its athletic training for over 40 years, Chinese Table Tennis Team should keep up with the pace of times and grasp the regular pattern of table tennis competitiveness for developing the research and generalization from the angle of higher – lever coach.

1.3 The tasks to be fulfilled

1) By analyzing and testing the constant phenomena, we can find the intrinsic relation and abstract the regularity.

2) The relation and regularity mentioned refers to the intension in the deep structure of athletic training system and the basic principles, which are not easy to discover, should be obeyed in the training practice.

3) A more important task in this article is to form a big system of the regularity of athletic training according to the logic relationship among various examples, experience and regularity. Three levels in the system include the principles, concepts and practice of athletic training (Figure 1 and 2).

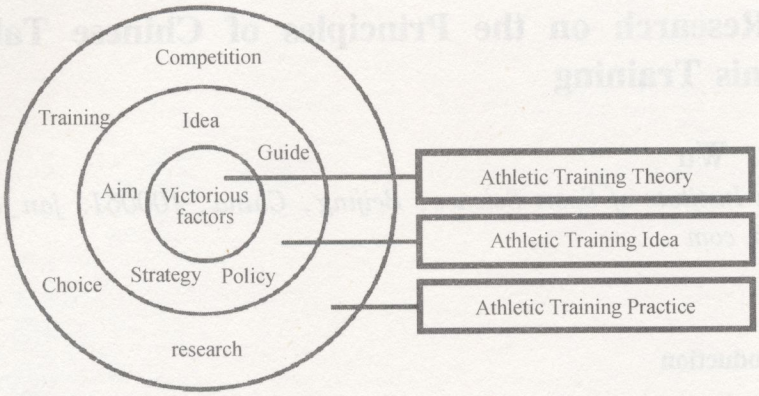


Figure 1. The athletic training structure

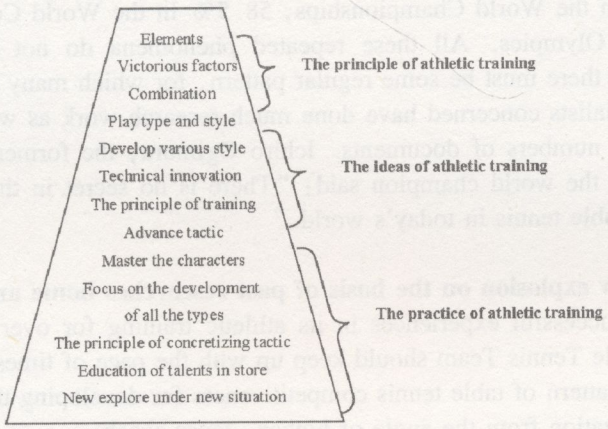


Figure 2. The regulation levels of the athletic training of table tennis

2 Methods

2.1 Research object

Chinese table tennis team

2.2 Research methods

2.2.1 Experience generalization

The writer has been in national team for a long time and participated the research all through.

2.2.2 Scientific experiment

All the data is the first hand by the author.

2.2.3 Document research

Summary documents of Chinese team in different periods; table tennis related essays written by the officials; specialists and scholars concerned; the articles of coaches and athletes; essays about table tennis event of different countries collected by Canadian Discus data base from 1990s (Table 1).

Table 1. The statictics of papers on table tennis (the amount of papers in 1990's)

Country	Amount	The percentage of papers in the past decade(%)
China	1097	76
British	194	13.6
France	85	6
Sweden	15	1
Germany	12	0.8
Spain	10	0.7
Russia	4	0.3
Australia	4	0.3
USA	3	0.2
Scotland	1	0.07
Finland	1	0.07
Canada	1	0.07
Italy	1	0.07
Czech	1	0.07
Portugal	1	0.07
Turkey	1	0.07
Total	1440	100

3 Results and discussion

3.1 Principle of Athletic Training

3.1.1 Elements of Table Tennis

Techniques of first service are such as forehand – attack, forehand – loop, and forehand – cut and so on, focused on standard and quality. Then each first service may contain five physical factors, there will be a certain speed, power, spin, loop, and spot after the ball leaves the bat (Figure 3).

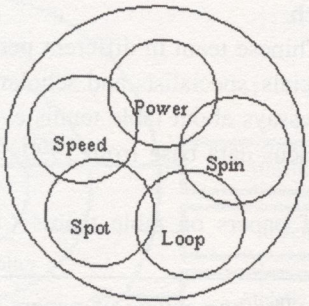


Figure 3. The athletic elements of first service

These five physical factors, which determine the space – time and moving characters of first service and its quality, can be defined as athletic factors from the object system of winning in athletics. What is the power of first service? It lies in the performance of these five factors , especially the combination of them . All these factors above can be strictly measured. The max speed of attack ball can be 19 – 25m/s, thus the player must choose how to deal within 0. 16 – 0. 4s. The fast spin should be 140 – 180r/s with 8 different directions even 20 different directions in theory. Also factors as power, loop, and a spot can be measured. These factors may be widely changeable. If the factors combined which determines the space – time and moving situations as a character, change of the character will be infinite large when it is understood in quantity. When we calculate all these athletic factors, we will get a certain date. Choose any factor from each sub factor to constitute a character, which can be called as characteristic stimulation combining 5 athletic factors, and then we would get 14000000 results.

3. 1. 2 Victorious factors of table tennis

In order to research and comprehend the most important principle on table tennis, we should look for each ball, each set and each match. One – ball confrontation always lasts more than two rallies. It is not only depending on the five factors but also depend on tactics as attack after service which includes 5 changeable athletic factors. Combat in a set will have four parts as beginning, hold, lead and backward. Each part will be fierce. Deal with different situations well, players should combat with each other both physical and on mental. Win and lose in one match will contain different factors as strength specialty and technique. Each player may learn how to take advantage of each other to get rid of passive.

What's the principle that will influence the situations illustrated above? It's about the victorious factors. For instance, the victorious factors concluded from the 1960 ~ 1970s about traditional pen – hold fast attack were "speed,

correct, tough, changeable and spin" and "speed, spin correct, tough, changeable" according to the attack and loop method.

The difference between the victorious and athletic factors is as followings. The victorious factors include the psychological and strategic fields, which are subjective perception and are difficult to be quantitated. Athletic factors include the physical technological fields, which are objective and easy to be quantitated. Athletic factors are abstracted from the experience of 5 physical athletic factors and are the intrinsic perception of the world.

3.1.3 The integration of athletic and victorious factors

The table tennis experts realized that by the time difference playing styles are combined with the five physical athletic factors of "speed, spin, strength, curve and spot", different playing styles are formed. Then the athletes form distinct technological styles when these victorious factors are combined with the athletes' personal character and spiritual strength. For instance, Zhuang Zedong exerts a speedy and tough style. Guo Yuehua exerts a special and tough style. Deng Yaping exerts a tough and strange style. Liu Guoliang exerts a speedy and delicate style.

3.1.4 Different playing styles

We can classify the playing styles on the basis of two points: The abundant technique contents. The playing styles can most efficiently combine the athletic factors with the victorious factors on a certain player. The so – called 'economic and effective' means that a player is more suitable for a certain playing style according to different personal characters. And if the playing style is not well chosen, the combination of athletic and victorious factors can reach the best result. Most top players, including the 80 Chinese world championships, don't experience many changes from the specific training to the world championship. From this point, it is important to make the limited training period most efficient. Because of the five points, the athletic development will definitely lead to various playing styles. And the responsibility of a coach and the outcome of research lie on classifying the various playing styles into authentic scientific playing styles. This will help to quickly cultivate talents. The purpose of researching and discriminating the various playing styles of table tennis is to summarize the common principles. After the understanding of the commonplaces, we can continue our research on the special principles to improve the playing skills (Table 2).

Table 2. Statistics of technologies of different Countries

type \ country		China	Japan	Korea	Hungary	Sweden	Czechic	Poland	Yugoslavia	England	France	Belgium	White Russia	Germany	Croatia	Taipei	Korea
Fast Attack	Pusth + Attack			△						△							△
	Two wings attack	△		△													
	Attacks + Push	△	△	△													
	One side attack																
	Attack + BH	△	△														
	Back side																
Cut	Cut	△	△	△						△	△						
	Cut + Attack	△			△												
	Attack + Cut	△	△	△	△												
Attack + Loop	Attack + Loop	△				△	△	△	△	△	△	△	△		△	△	
Loop	One side loop	△	△	△					△								
	Two side loop	△			△		△	△	△	△							
	Loop + Attack	△	△		△	△		△									△
	Anti – loop + Attack	△															
	Loop + Two side attack	△					△										
		△															
Cut + Attack	Cut + Attack	△															△
	Cut + Attack + Lift	△												△			
	Cut + Attack + Push	△															
	Attack + Cut	△		△													
18 plays in 5 styles		16 plays in 5 styles	6 plays in 3 styles	7 plays in 4 styles	4 plays in 2 styles	2 plays in 2 styles	3 plays in 2 styles	3 plays in 2 styles	5 plays in 4 styles	3 plays in 3 styles	1 plays in 1 styles	1 plays in 1 styles	1 plays in 1 styles	2 plays in 2 styles	1 plays in 1 styles	1 plays in 1 styles	1 plays in 1 styles

3.2 Athletic training concept

3.2.1 Booming of different playing styles

After athletic training theory, athletic factors, victorious factor and playing style are being discussed, we have to aim to the idea, the technique style and policy so as to most effectively achieve our strategist goal. And this is show "the booming of different playing styles", "training principles" and "advancing with each passing day" as well. "Booming of different playing styles" is the policy to the prosperity of art and science. According to the fact in the international and domestic table tennis community, the leading board implement this principle on time and effectively. The put up the technical policy of booming of different playing styles, focus on ourselves, take others' advantages and have one's own way. ' The correctness of this technique policy is discussed as follows: Release the circuits of a certain playing style to stimulate the booming of different playing styles; however, there will be no policy without key points. We should focus on our own to enhance our strength through the learning of others' advantages. There was a saying at that time.

"We should have some features that the foreign countries do not have." The foothold of this technique policy is to make the way by ourselves. This is an overall and complete policy. We should make the way by ourselves while booming of different playing styles.

We should carry out the policy according to the trend of the development of the ITTF technique, and take all kinds of skills. In the decades, it has obvious effects. China's main skill, pen – hold fast attack won a lot of champions. From 1959 to 1989, the 42 players in the man groups final games, 21 players use pen – hold, which accounts 61.9%. The 35 players in the woman group's final games, there are 19 players using pen – hold. On the other hand, the foreign players also can win the champion.

This technological policy's scientific point is that, it grasps the basic contradiction of table tennis. It is determined by 5 contest properties and 5 winning issues. Besides this, it has the difference between different playing styles and different properties. For example, long – glue is much different from surfaced rubber, inverted sandwich rubber, and anti – loop. These properties make such happen, for example, why it easily causes fault. Chinese student's techniques are trained out in this way.

It is indispensable to take part in more competitions and rival with different foreigners, with different ball characteristics, like European competitors in order to adapt different situations. However, it is not economic, and the efficiency is limited. In one competition, it is impossible to meet all playing styles.

The economic and efficient approach is to have all kinds of playing styles cultivated and supported. By "Collecting the advantageous sides of playing" and gathering the different playing styles and schools in the world, we introduce the "World competitions" that couldn't be often held to our stadium in a "Chinese Table Tennis Small World". Broadly speaking, this is the "simulated experiment".

In this experiment, on the one hand, different playing styles and athletes' ability to make new stimulation are trained and examined. On the other hand, abilities are cultivated to adapt to different playing styles and different heroes in this game. In particular, the simulated training accord with the training that stem from real competitions and make athletes command the skills, in addition, it is beneficial to transfer certain skills in the real competition and cultivate the psychology in competition.

These regular recognitions, ideas and policies are of Chinese characteristics. In the past several decades, those ensure the great success of Chinese Table Tennis Team.

3.2.2 Technology innovation

Technology innovation revives the Chinese TT Team. Technology innovations used in the competition are based on the two points as follows.

New stimulating Theory – it is difficult for the opponents to adapt to the new stimulating approach. In the training the innovators try to adapt to ten different opponents of one kind of playing styles with their own skills, thus gaining ten similar experiences. To these ten opponents, they could only obtain one experience compared with innovators. Innovation technologies, especially new people new technology, often win the championship at their first attempt to World Competition, such as Xie Saike and Cai Zheng hua who attended the 36th World Table Tennis Championship.

Winning out of surprise Theory – secret weapon, such as Lin Huiqing , Zhen Minzhi in 1960s , Ge Xin'ai in 1970s, Chen Xinhua in 1980s and Liu Guoliang ,Ding song , Deng Yaping in 1990s.

Table Tennis teams advocate innovation and support each member to explore new technique and playing style, forming innovative environment and soil. The three innovations once induced chain – link response, making contribution to broaden the expedition of Chinese team. Among them Zhang Xielin, the long – glue chop player played in the 26th 27th 28th World Competition in the 1960s beat the former Japanese Champion for many times. Along with the road, Lin Huiqing, Zheng Minzhi, Liang Geling,Wang Hao , Deng Yaping and so on tool advantage of the long glue and became the world champion.

The second is in the 1970's. Du Enting, the penhold sandwich fast attack changed to inverted sandwich and invented the new loop playing style. Facing the new playing style of Europe, Chinese penholder must take the new way of "Speed, tough, correct, spin, changeable". Xu Yinsheng, the chief coach at that time hoped that the athletes would try new playing styles. For example, Xi Enting, Guo Yuehua, Cai Yanhua, Qi Bao xing, Wei Qingguang, Ma Lin, they all have won the Championships over 20 times.

Third stage is the 1990s. The attack of backhand penhold of Liu Guoliang, which is the attack + BH back side. In 1988, facing with the fact that gradually perfect shakehand hold overwhelmed Chinese penhold, Xu Shaofa, general coach of Chinese team at that time, and Wu Huanyun, researcher of Chinese Sports Science Institute, suggested trying the attack of backhand penhold together, Xu Yinsheng and Li Furong highly supported it and cared. Under the direction of Cai Zhenghua and Yin Xiao, Liu Guoliang and other young players were devoted into this experiment.

Three years later, as the fruits, Liu Guoliang won Wahdner, the world championship with 2 to 0. Another three years, Liu won Wahdner again in the 43rd World Table Tennis Championship. Now, Liu has become the first

Chinese player who has won the WTTC WC and Olympics.

Chinese innovations are not only in one aspect with the development of confrontation in ITTF. Another article once mentioned Chinese innovations had occupied 58.7% of all personal innovations.

3.2.3 The principle of training

It means that training must be difficult, strict and practical with large energy expenditure. The principle was raised in the middle of 1960s. Chinese TT team carries out it seriously all the time.

In the early time, Chinese TT team has realized that the key point of the table tennis contest nature is technical factor. So, how to grasp the key point and apply it to practice? It requires the principle that all complied with actual competition which means any training requirements, attitude, measures should be implied strict and hard.

When great intensity training ends, pulse can reach 192 time/min. When a high frequency training ends, attack back multi - ball from left and right can reach 50 ~ 60 time /min. Players usually train beyond the limit. Everything can follow the principle that all complied with actual competition. The core of training guiding thought is stick to the distinguished and comprehensive technique.

Generally, it is technical training guideline of the whole team; individually, it is technical requirements. The Chinese successful out comes prove that it is an objective principle of development and that it fits the principle of success psychology. It becomes inner motive that stimulates individual practice. The training principle, which we conclude, is the understanding of the world nature.

To stress the specialty is main way to get point in the match. The special play styles that the sportsmen comprehend are the techniques and tactics trained again and again which can lead to win. These techniques and tactics are mostly used to win the point during the match. For example, "Pre - three bats" technique is once a specialty of Chinese players. Individual style depends on one's certain special play style.

Overall technique is also an important part. It is accordance with the current situation that there are improved technique, eventually acute confrontation and changeable characters in the world table tennis champion. We should combine overall technique with special style in the athletic training (Figure 4).

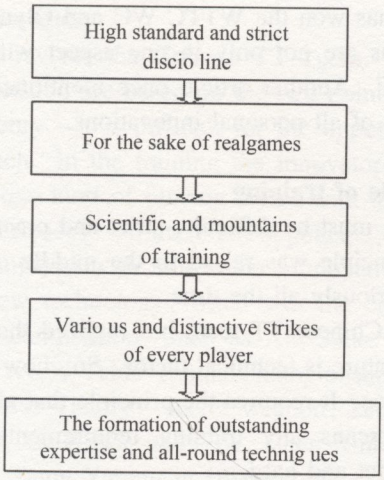


Figure 4. The principle of the hard, strict, actual beginning with lots of training

Since 1990s, new generation of coach deal particularly well with these relationships such as the relationship between training and contest. Change the long – term training circle into short – term in order to meet the situation which can be described as the need of frequent international contest and developed domestic contest. China now changes the training pattern and research the principle of athletic training to keep up with the date.

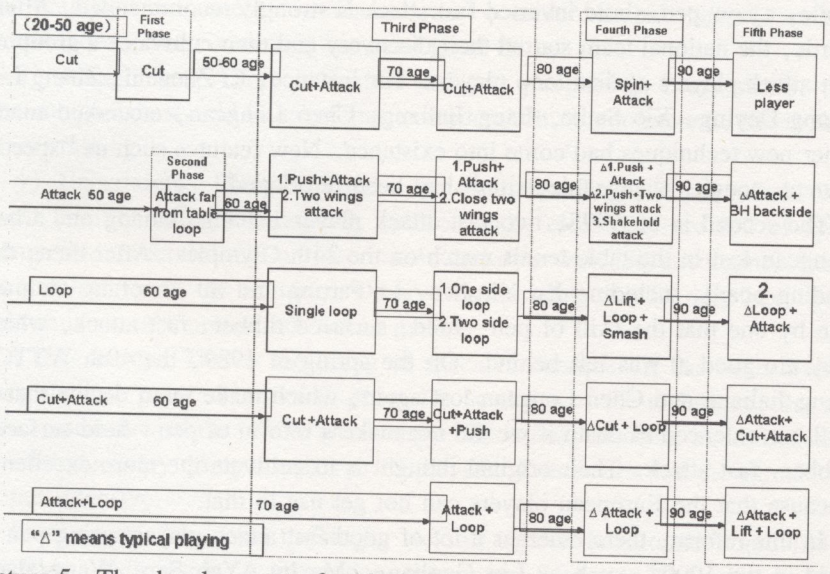
We should handle well the relationship between the athletic sports and reward income, perfect the training system and enhance the fluency and athletic items in order to build a great situation. Deal well with the relationship between contest and research useful principle. We assurance that the essential training time before international contest in order to get great effects.

3.2.4 Idea of the play style reform

Headquarters in the Chinese table tennis community, standing at the first – rate all over the world in some decades, know almost everything about the changing situation. Face to the challenge from the different rules and high technique, the headquarters and coaches always can keep fresh mind to make forgoing ahead. It can be divided into 5 levels during the evolution of technique and play style (Table 3, Figure 5)

Table 3. The development of technology of the world table tennis

Stage(period)	Typical technology	Country
First (1926 – 1951)	Cut	Hungary
Second (1952 – 1959)	Attack far from table	Japan
Third (1961 – 1981)	Fast attack、Chop、Attack + Loop、Loop	China、Sweden、Hungary
Forth (1982 – 1989)	Fast attack、Attack + Loop	China、Sweden
Fifth (1990 –)	Fast attack + BH back side	China
	Shakehold loop + Attack	France、Sweden、Germany
	Lift + Loop	Belgium、China
	Loop + Attack	Byelorussia Croatia Sweden China
	Attack + Cut + Attack	China



Ficture 5. The development of table tennis playing

During the five – phase development, various kinds of playing styles are making progress through competition. Some of them have been eliminated due to their inadequate integration of athletic and victorious factors. Howev-

er, some of them, which can manage the integration, can optimize themselves through tough confrontation and then evolve to advancing playing styles.

From the five – phase development, we can conclude that skills, development and motivation are still the five athletic factors and the combination of the five as well, especially when a certain core athletic factor is combined with another core victorious factor. For instance, there are combinations such as speed, spin, spot and fastness, toughness, correctness. At the same time, the evolution of technique and play style is closely related to the racket attribute. A athlete can win his or her survival, even to achieve greatness if he or she can properly deal with the relationship between the athletic and victorious factors. According to the concept above, it is better to state that reform is coherent with the objective principles, illustrated by the reform of Chinese traditional pen – hold fast attack.

The features influence and achievement of Chinese National Team returned to the international stage, we discovered that the European skills had become a great threat toward the national male team.

From long eyesight, the Chinese fast attack playing style should focus on the speed while combined with spin and then make it more abundant. Meanwhile, a new pen – hold inverted fast attack is strongly recommended. Afterwards, the national team started their discovery and then cultivates a group of fast attack players against loop players. For instance, Li Zhenchi, Zhang Li, Zhang Deying, Xie Saike, Jiang Jialiang, Chen Longcan, etc. And many other new techniques had come into existence. New features such as "speed, correct, tough, changeable, spin" had been developed.

The second is on 1998, two fast attack players, Jiang Jialiang and Chen Longcan lost in the table tennis match on the 24th Olympics. After then, the leading board, including Xu Yinshen, Li Farong and Su Shaofang claimed one by one that the skill of pen – hold, surfaced rubber, fast attack, which they are good at was left behind. On the spring of 1989, the 40th WTTC, Jiang Jialiang and Chen Longcan lost again, which make them decide that if will be sentenced to death if we did not make a reform of pen – hold surfaced rubber, fast attack. Their original thought is to cultivate the more excellent, because that the European players can not get use to that.

In this reform, there emerges a lot of good fast attack players using pen – hold in the 1990s, such as Liu Guoliang, Ma lin, Yan Sen, Wang Hao, Wang Fei and Feng Zhe. In the international table tennis field, China seized back the advantages of pen – hold fast attack.

The two successful reform of pen – hole showed that we can not be conserved, must advance with the each passing day and seek reform and development. Meantime, if we restructure the athletic elements and victorious fac-

tors, it is possible to refresh combat capacity, technique and skills.

3.3 The practicing of athletic training

3.3.1 In practice, understand the arrangement the special characteristics and several contradiction

The general feature of the table tennis training is training everyday. If player enters the provincial team or national team, the average training is 5h a day, all in the range of 7 * 14 indoor, about 5000 times a day. The item training is just the same, the tactic, warming – up exercise for 30 – 45 minutes, focus on multiple balls training, single ball training, and open competition. But there are various results, and the coaches play an important role. That is due to the scientific arrangement.

3.3.1.1 Understand and master the 5 characteristics' of training ideologically

1) Direction. From the respective of the technique development history from 1950s to the 21st century, it is different on technique development direction.

2) Complexity. In the competition, the ball prosperity changed a lot. In the training arrangement, we should fully consider the ball have 14 million permutation. That is to say, we need good fit.

3) Antagonism: There is control and anti – control in every strike, thus the antagonism should be taken into consideration, i. e to increase the intensity of training.

4) Uncertainty: Different strikes are used disorderly, characterized with mean position of ball and speed, spin or both, etc. They are full of fierce competition, control and anti – control, and disorders. So uncertainty should be emphasized in the training. Otherwise, the athletes will only have good performance in trainings but not in games.

5) Accuracy: That is the being of special technique. It has been divided very delicate parts. In order to prove the accuracy of the technique, the science research institute. Take an example of loop experiment, under the same condition; every group consists of 12 players. It indicates that the stimulation is not intensive.

Final exam after seven trainings, we still used 141.7 round/s and 133.6 round/s. As a result, A group does better than B group. The difference between them is obvious ($P < 0.01$). It proves enough that techniques, which form through reactions of some stimulation, appear different because of different training requirement in certain time. The difference can be estimated by statistics. It is obvious and actual.

3. 3. 1. 2 In practice and operation, we must deal with the extent of six pairs of contradictions

1) Stress the specialty, and optimize the technique. Specialty is the most important and the ultimate technique to get score, such as what Chinese championships did. Li Furong pointed that specialty itself also means comprehensive.

For example, serve technique contains special serve and assistant serve. We can't serve ball in a single way. Someone can serve near – net ball but topspin long ball with changeable spot. And receive, forehand and backhand techniques are also alike. We should develop overall technique with individual specialty.

During the training, the key point to deal with the relationship between the overall technique and specialty is not to enlarge the difference. We can treat them as the first and the second not the best and the worst. Otherwise, due to the advantage excite level; the specialty would be with confidence. For example, high toss services were used by everyone at that time. They had capacity to serve different ball but they had no confidence to do so because of the advantage excite level.

The theoretical basis of the point view: when one nerve center is stimulated, the excitement level is increased, which is called "advantage excitement level". It can accumulate the excitement from the other nervous centers, and constrain the nearby ones. " Advantage excitement level" occurs, even when other nervous center are stimulated, and " advantage excitement level" is intensified, in this way it becomes the special shortage. And it also is like this.

2) Multi – ball training and single – ball training

Multi – ball training can easily make the special techniques in to being, for example, in the hand and foot work. Long time till now, every level's table tennis team is benefit much from it. However, every coin has two sides, sometime there is goodness, while sometime bad. Multi – ball training has some shortcomings; one of it is that it can only have one bat. When the stimulation is reacted, there win be no drawback after the attack. It equals to the separated activity, not an integral one. If the problem of the transmission of attack and defend.

Its mechanism is Pavlov's conditioned response. There is more conditioned response of operation in real games. The response to the opponent's strike is called post – function, and such control and anti – control are more like the real condition in games. Therefore, the multi – ball training, the providing of balls in which should be more orientated and imitating the match condition, works with the single – ball training for the combining separated activities with complete ones. Additionally, the percentage of each training mold

should be different in different stages, ranged from 1/3 to 1/2 in the total training.

3) Inducing training and imitating training:

a. negative inducement is the process of inhibition intensified by stimulation

b. positive inducement is the process of excitation intensified by inhibition

c. concurrent inducement and successive inducement

Inducing training is realized by the high – lever athletes helping the lower ones and the male athletes helping the female ones, which seems like the training of pace – setting running by the lead runner in periodic events. It was applied in table tennis earlier, and now many other ball events also adopted this training method.

Guidance training has a lot of good examples, for example, in early days, Cai Zhenhua and Deng Yaping. In the younger time of their training, they both experienced this guidance training from adult and strong counterparts.

Simulated training is "weakness verses strong and treats it as the assumed opponent." The simulated training is implemented in the mature and peaked training. The simulation partner, in usual case, cannot surpass "assumed opponents".

The simulated training's function is that in the 2 to 3 months before the match, to make the trainee have the ability to beat the specified opponents. The most important part in it is to "simulate assumed opponents".

There are 4 concrete functions in the simulated training. First, it can simulate these assumed opponents to be played with for many times, and take the training as match. Second. It helps the athletes to apply the specified technique in the read match. Third, it helps the athletes to cultivate a good psychological mood in the need match, just like some players say, "it does make me feed confident in fee match", besides, it improve the adoption and confidence.

4) Forehand explosion force training and two – sided swing speed training. Explosion force is the instant and integrates force. The explosion force is mainly determined by the maximum force and fast speed contract ability. Power = force X distance . In table tennis training, to ask for the property is to use the whole body's strength. To improve the property is to maintain the highest speed when hitting the ball. In this way, we have to pay attention to the preparation pose and hitting speed.

Explosion force and two – sided swing speed. First important is use to the training. The common problem is that there who have good two – side swing speed do not have an ideal explosion force. If there is no explosion force, there with not be any destructive weapon.

5) The training of leg and hand training. The main problem in it is that

we Chinese athletes can net have these skills as good as these of Korean and European ones. The reason of it is that in China, when choosing young players, we pay more attention on the hard work, but lack much emphasis on the foot work. In history, many people play near – table fast attack, in this way, it will not become so apparent as today of the paradox of the foot work. The hand work does not have a strict regulation.

The paradox is mainly in the foot work. The foot work is the base of the scientific training. The accuracy, explosive force, hold – on ability, continuous attack, and so on, are all dependent of the foot work. It had to be cultivated in the real match. Those athletes who begin to emphasize the training on foot work can not have a good solution of the foot work training.

6) Sequential and random training. Sequential training is the basic technique training of the fixed point and fixed line, required by the coaches. The formal saying of the sequential training is regular training. This training is in accordance with the status from easiness to difficulty.

Random training is accorded with the match requirements.

In the basis training phase, how to increase the real match playing ability effectively?

The arrangement of sequence – random – sequence – random. With the rise of basic skill, the competition capacity is gradually rising.

The arrangement of random – sequence – random – sequence. We will get good score on competition at early time, but it will be slow to upgrade without the solid basic skill.

Some regions occurs the problem of "talents production line". Except other reasons, there are something related to the training arrangement.

But the rules of basic training stage are only suit the primary stage. To the top player of the national team, there are other rules.

The top players of the national team also have the problem of basic skill training, but the competition schedule is busy. We must focus on the "take competition as training", but the aim of training is specialized. According to the situation of the world table tennis community, it is "survival the fittest" to pay attention to the aspect of "competition instead of training", combining competition with training" of the top players. By doing this, random training is straight out on the basic stage. But, in the random, there is lots of focus. In the focus, there are lots of sequence.

In conclusion, in the training arrangement if we understand the direction, complexity, antagonism, random, accuracy of the training, we understand the scientific basis of the special training.

In the practicing of training, it is the key to improve the training quality to deal with the arrangement of the six contradictive factors.

In the practice of training principle, it is advantage to meet the requirement

of distinct and comprehensive skill, various tactics without obvious weakness and to improve the training quality and growing efficiency to understand and master the 11 points mentioned above.

4 Conclusions

This paper, from the perception of the general rules of table tennis competitiveness and the view of coaches, in the range of training, make an analysis and summary of the inner principle to the long time prosperity of table tennis.

This paper makes an abstract of the experience of the long time prosperity of table tennis and make an conclusion of the system of table tennis training rules.

The system of training rules of tables tennis long time prosperity composes of 3 level, including athletic training principles, ideas and practicing. Each level makes a sub – system. The principle of athletic training sub – system includes athletic elements, victorious factors, combinations of elements and factors, and play type and style. The ideas of athletic training sub – system include development of various types, technical innovation, and the principle of training and advanced tactic. The practice of athletic training sub – system includes the arrangement of characteristics and contradiction, focus on the development of all the types, and on the basis of competition, segments the tactics.

The content of each sub – system has its procedures and orders.

51 The efficacy of Yek Ghol Du Ghol (An Iranian girls traditional game) in improving table tennis skills in later life

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1 Introduction

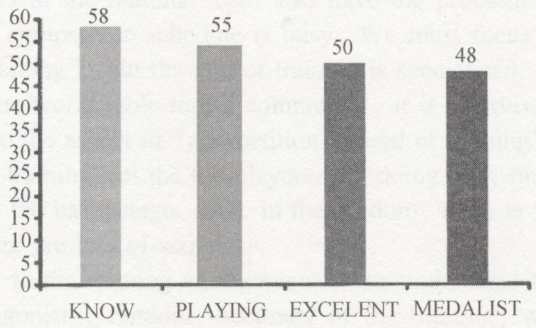
Now that science and scientific standards have found their place in even the smallest of areas. With this study we will try to find the relationship or this traditional cultural game (Yek Ghoi Du Ghol) with obtaining medals in table tennis and also analyzing it scientifically.

What are the traditional and cultural games?

They are games in which the people of a community or society play them generation by generation. The children learn them in their childhood without any specific educational studies. They learn the games form their parent's peers and play them accordingly.

2 Methods

By completing questionairs and using statistics. This covered more than 60 table tennis players between the years 1945 until 1980 who didn't have any modern or technical scientific training and were scattered around the country.



The questionnaire included these questions, which were then studied

Date of birth.

Are you familiar with the YEK GHOL, DU GHOL game?

Have you played YEK GHOL, DU GHOL?
What is the level of your playing YEK GHOL, DU GHOL?
What kind of medal do you have in table tennis?
(School, Province, Country, National)
The following formula was used and the results were obtained:

3 Results and Discussion

What is Yek Ghol Du Ghol?

This is also a traditional cultural Iranian game played with five stones of approximately a weight of 10 – 20 grams and with a round shape. This game can be played by two people or more.

The game is played as shown in the film, by acquiring the most points at the beginning. This means that the person, who starts, is the person who starts, is the person who, with throwing the 5 stones in the air at the same time, will be able to control more stones on the back of his/her hand. Then, by throwing them again in the air, to be able to catch them with the same hand (that has played). Then the players, in the same order that they acquire the scores, will play by turn. And the rest of the players will observe, evaluate and referee the game. The person will be the first winner, and the next winners will come accordingly. The game will be started from Yek Ghol and win reach Five (Panj) Gbol and then will arrive on the back of the hand and then it will finish. Again, if no – one has a foul, the game will be repeated, and after each turn the scores will be added to the previous amount. At the beginning or the game, five stones will be thrown on the ground while the players sit in a circle. The player, choosing one stone, will throw it up in the air and in the interval of it's falling down must take another stone, and this will be repeated in the same order until all the stones are collected.

Du (2) GHOL

The stones are again thrown on the ground. The player will choose one stone and whilst throwing it in the air has to pick up two stones and then catch the stone that has been thrown up.

SEH (3) GHOL:

The stones will again be thrown on the ground and this time the player, after throwing one stone up, must at the same time collect three stones and then catch the one stone.

CHAHR (4) GHOL:

The stones are thrown on the ground and this time by throwing one stones in the air four stones must at collected at the same time.

PANJ (5) GHOL:

Four stones are in the player's first one stone is thrown up in the air and the index finger should touch the ground without any of the stones falling down.

BACK – HAND:

At the end of one full course of the game, the player, by throwing five stones in the air at the same time, must at first control as many of them as possible, on the back of his/her hand, and then by throwing all of them in the air are able to catch them by hand. The total of these back – hands will be the score of the player, and it will continue until the player loses.

The fouls are:

Movement of two stones if they are placed side – by – side, release of the stone that has been thrown up, on to the ground. Yek Ghol Du Ghol has advanced stages that can be played by older players with more skills. The children will play in these stages, depending on their skills in the experimental stage. This game is not expensive, and needs no "special" clothing, or playground or tools, or referee etc. In Iran, because of the culture, it is mostly played by girls, as girls usually play in the house and not on the street, there fore they acquire more skills than boys.

The research Goal:

After years of working at table tennis, I realized the similarities of Yek Ghol, Du Ghol and table tennis and I think it could be a pre – sports or preliminary game or activity for table tennis, especially as it begins in childhood and can quicken and facilitate the next training stage. This will be a positive step towards the general development of this sport.

4 Conclousions

We have proven that in the 40 + ping pong players with no formal and scientific training, the ones who played and were good at Yek Ghol Du Ghol in childhood did better than the ones that did not play the game.

We can use Yek Ghol Du Ghol In childhood and improve table tennis skills in the following aspects:

(1) Enhancing hand feeling.

(2) Enhancing coordination of eye muscles.

(3) Improving the speed of decision making.

(4) Shaping the alignment of hand and arm angles in forehand strikes.

(5) Strengthening of wrist, elbow and arm musculature.

(6) Appropriate use of gravitational center in the forward position of the player.

(7) Use of fine muscles of the fingers and wrist.

(8) Improving coordination.

5 Suggestion

We believe that reintroduction of this game to children can act as a joyful training for table tennis skills.

52 A Research on the training measures of basic table tennis skills for college students

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1 Introduction

Since the principles of ITTF have been adjusted from time to time, table tennis skills have taken many changes, which aim to make the play enjoy more returns and more attractiveness. In the past few years, both the skills and the racket have been greatly improved, so the ball's travelling speed and circumrotating, the two most important factors in the light of reforming table tennis, have been much enhanced, which help boost modern table tennis skills. New rules and skills ask for corresponding basic skill training. Accordingly, colleges, in which posterity players of table tennis are prepared, must make feasible training measures to strengthen basic skills so as to, on one hand, to get used to new changes, and on the other hand, to build for the student players a solid skill foundation.

2 Research Methods

2.1 Literature Data Method

By means of studying the materials concerning table tennis training skills, we can come to have some understanding about the changes, laws and development trends of the basic skills. Considering the students' practical needs, we can invent some practicable training skills and methods.

2.2 Observation Method

Through the observation of the students' learning, training and match, we can do some analytical work on their technical problems and adopt the pertinent measures.

3 Research Outcome and Comment

3. 1 Understand the development trend of modern table tennis in the world

The development of modern table tennis is oriented in four aspects such as "full – scale skills, outstanding specialty, initiation, and more offensiveness". The days when players won the match by means of a certain unique technique or skill had gone. Today, with the short lifespan, unique skills have become

rarer. In the future, a winner must rely his/her victory on the solid foundation of basic skills.

The changes of rules and the application of bigger balls have some effects on players' techniques and tactics. But the effects will surely benefit the development of table tennis. They make a match more alluring and eye – catching. Therefore, more people will involve themselves in this sport. A research explains that if a point round can last as long as seven or eight returns to both players, it may be rewarded with spectators' applause; if the point round lasted more than ten returns, it can win more than spectators' enthusiasm and interest. If there is more enthusiasm and interest from spectators, the sport can develop a good market, which means that more benefits can be produced. In return, table tennis will enjoy more existence places. That's why both ITTF and China's Table Tennis Association hold varieties of matches such as tournaments, performances and roundabouts in order to meet the needs of the market. In view of the development trend of table tennis and the requirements from the audience, we can conclude that players' basic skills are essentially important not only to the players themselves but also the sport events.

3.2 Intensify students players' basic skill training

3.2.1 Basic skill in foot and hand

Concerning student players, their foot movement skill is comparatively weaker. But one serious problem is that coaches usually ignore their weakness, while turning their emphasis on the training of their hand skills. The consequence is that the training quality can not be guaranteed. Therefore, the solution lies in the fact that both foot movement training and hand skill training must be integrated.

The basic foot movement include: preparation gesture, judgment reaction, treading power, the transference of physical center, waist flexibility and foot movement. Hand skills are related with preparation gesture, judgment reaction, physical center and waist flexibility. We can find that hand skills have covered some foot skills. In the course of training, basic hand skills and foot skills should be practiced simultaneously.

Foot movement is classified into two kinds, namely, singleness movement and doubleness movement. The training must be taken from singleness to doubleness and from easiness to difficulty.

Meanwhile, foot movement must be integrated with hand skills. Good hand skills are essential to playing table tennis. In other words, foot movement and hand skills are interdependent.

3.2.2 Make good use of the relationship between basic skills and techniques

Technique is an important means in table tennis, but it can be easily seen through and then lose its effects. Besides, it tends to be limited within the

rules. We can find that a large number of distinguished table tennis players who can have a much longer career and still make great achievements. How can they prolong their athletic career? The answer is that they have laid a very solid foundation in skills when they are young. Accordingly, sound basic skills, together with outstanding physical and psychological quality, play a very important part in table tennis. That is also true for the student athletes. After that, a good athlete can develop unique skills or techniques.

3.2.3 The content of basic skill training

(1) near – the – table fast break: improve the ball's travelling speed and power. Emphasis must be put on the ball's point of fall and the change of the rhythm. Of course, attention can also be given to the circumrotation. Athletes must develop their ability to get accustomed to the opponent's rhythm, the ball's point of fall, the change of power, the ball's circumrotation. In the training, they must also practice their eruptible power and durable power.

(2) Circumrotation: Improve the ball's circumrotation and power and accuracy. In the training, circumrotation must be emphasized, aided with the speed, the change of the point of fall. In the meantime, athletes must also develop their reaction to the opponents' circumrotation and power. In the practice of basic physical quality, emphasis is placed upon the explosive power of hitting the ball, the speed of hitting the ball and durable power.

(3) Undercut: improve the ball's circumrotation and accuracy. Develop the ability to adapt oneself to the opponents' circumrotation, and the change of the speed. As for the practice in physical quality, emphasis is placed on the speed of movement, reaction, judgment and the speed of hitting the ball.

By the way, the training of the basic skills is tedious. But it is quite demanded that athletes must be aware of the importance of basic skills.

3.3 The vertical – racket – and – fast – break technique should not be ignored

China has rich experience in the vertical – racket – and – fast – break technique. But we still have to make reforms in this technique. As for the student athletes, they must pay attention to the following aspects in their training.

3.3.1 Service and preemptive attack after service

At present, China's vertical – racket – and – fast – break technique has a leading position in the world. One advantage is service and preemptive attack after service. Student athletes must develop this technique.

3.3.2 Successive forehand attack power

It has been proved that the world top players must have a very outstanding successive forehand attack power. It is very difficult to win a match with just one hit. Besides, it is also very necessary to pay attention to the ball's point of fall and angles. Therefore, student athletes must have more practice in develo-

ping their successive forehand attack power.

3.3.3 Develop push – and – block and horizontal attack skills

Quite often, horizontal racket players tend to attack vertical racket players' backhand position, which are the weak points to the latter. Therefore, vertical racket players must develop push – and – block and horizontal attack skills. From the perspective of physiology and biology, it is feasible to take horizontal attack for vertical racket players. But today, we seldom find student athletes employ this skill. In another word, student athletes have not come to realize the importance of this skill. They have to have more training practice.

3.3.4 Develop the skill of circumrotation

If the vertical – racket – and – fast – break technique can make good effects, it must be merged with the circumrotation skill. If a student player can make good use of the skill of circumrotation, he can have more chances to win a match. Only simple push – and – block and attack skills are not enough for a good player.

In all, we must have a clear understanding about the student athletes' weakness in basic skills in order to lay out a complete training programme. Players must develop a full – scale skill through hard practice.

3.4 Physical Training

Physical training is a kind of basic training. We must get rid of the ideas of "skill first, physical training second". Some coaches think student athletes have already some certain physical qualities, and then have jerry – build physical trainings. This is quite wrong. We must attach much importance to the training of physical quality, which can help prolong the athletic career. What's more, a player with good physical qualities can better use his skills and techniques.

4 Conclusions

(1) We must get aware of the development trend of table tennis, the change of principles and spectators' demands, so that we can have corresponding training. Student athletes must have solid basic skills so as to make good achievements.

(2) Student athletes' basic skill training includes: foot movement and hand skills; basic skill and basic techniques, and physical qualities. Both athletes and coaches must realize the importance of basic skill training, which is the only access to victory.

(3) In the training, we must do research work on vertical – racket – and – fast – break technique. In addition, we must integrate the students' qualities with their intelligence and rich imagination and creation, so that the training can produce better fruits.

53 An analysis of the training of young table tennis players study about the structure of the training process in the training centres of the Portuguese table tennis federation

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1 Introduction

In Portugal, the number of Table Tennis players has been increasing and the qualitative level has been improving significantly, as demonstrated by the more recent international results. Since 1994, the number of inscriptions in the Portuguese Federation has increased from 2000 to 5000 players approximately.

In Paris, in the1996 European Youth Championships, for the first time in the long history of the Portuguese Table Tennis a player won a bronze medal in an individual competition. In the two following years the Portuguese young players continued to win medals and to win international tournaments, as well as to settle in the European top 5 and top 10.

In the last four years (2000 – 2003), in the European Youth Championships, World Junior Table Tennis Championships and European Top 12, the Portuguese players accomplished a set of high level results, consubstantiates in the conquest of 3 gold medals, 3 silver medals and 6 bronze medals.

If we take as reference the 90's from last century and the beginning of the 21st century, and if we consider this moment as the one from which the Portuguese table tennis reached results of high European level in the young categories, we verified that, these years passed, the results of the seniors are very far away from the reached in young.

So, in the context of the Portuguese table tennis, it seems pertinent to go back and to begin by analyzing the formation process as it has been done with the Portuguese children and teenagers. We should not exclude the possibility of the signs of discontinuity of results in the class of seniors have already their origin in this phase.

Thus, the purpose of this study was to describe, to analyze and to understand the formation process developed in the training centres of the Portuguese Table Tennis Federation and to verify if the strategies adopted promotes children's harmonious development and facilitates the best performances in the adult age.

1.1 Characteristics of the game today

The appearing of the fast glue, the use of materials that provide great speed

and adherence and the tactical intention of playing very close to the ball's rebound, made the game reach a very high rhythm. These facts had consequences in the game's characteristics: (I) The modern table tennis is getting more and more fast and dynamic; (ii) The rallies are concluded within 2 to 4 strokes, using, basically, topspins with lots of rotation and strong terminal strokes; (iii) The increasing speed of the game implied the decrease of the time available for each stroke; (iv) The mean time of active game is about 3,6 seconds per rally and the mean time of inactivity is about 9. 41 seconds.

In view of this set of features, Ouyang and Wu express the importance of a complete technique, that they describe as the capacity to play in different times, with different strengths, using different parts of the body (fingers, wrist, forearm, arm, waist, haunch and legs), and of being capable to coordinate and emphasize each one of them. At the same time, they mention as priority factors to win the point the capacity to assume risks, as they reinforce the importance of the effectiveness in the first three balls, of possessing a good displacement capacity and a good balance of the game on the two sides (right and left).

1.2 Characterization of the activity

As a duel sport, when playing Table Tennis one has to deal with a situation in which two opponents with opposite interests are in confronts. It is common to conceive table tennis as an opposition sport, acyclic, ballistic, of situation.

This set of aspects make table tennis in its structural elements a sport that demands technical and strategic competences highly developed.

Séve refers that in table tennis one has to develop an unusual kind of quality of motor skills, associated to the accurate accomplishment of complex movements. Hudetz points out the fact that the table tennis technique includes the execution of the strokes and the needed displacements for their accomplishing, forming an organic whole.

The basic gesture structures don't constitute models to reproduce, but rather correspond to the invariants of the movement. In this sense, the teaching should not seek the reproduction of formal gesture forms; instead it should privilege the basic biomechanical principles. In table tennis the base for success lies, therefore, in the execution of the best stroke in the appropriate instant.

In the tactical plan there are eight key factors that should be considered in the table tennis: strength, speed, rotation, placement, trajectory, direction, rhythm and variation. Following the same idea, Erb reminds that table tennis is a tactical sport that lies on several duels, whose purpose is to break the balance of forces, intervening on the factors referred by Wu. This balance/unbalance of forces is the result of three other duels: (i) management of the expected/ unexpected (certainty/uncertainty); (ii) Chain/rupture (to chain several strokes according to a plan /to provoke ruptures in this connection); (iii) Safety/risk.

In the physiologic plan, table tennis is characterized for an energetic predominance of the system anaerobic alactic, which provides the athlete a fast supply of energy, being characterized by the speed of the execution and for the power of the strokes. The anaerobic lactic system is only present in the longer rallies. The duration of the games, which varies between ten to twenty – five minutes, also implies an aerobic metabolic component. The duration of the periods of activity and the intermittence among effort and pause demand a physical conditioning that associates both systems – anaerobic alactic and aerobic.

From a psychological point of view the demands are big. The variables that a player has to face are many and create a very complex situation, since one never known how, when and where the ball will arrive. This point is emphasized by Vilani et al as they refer that if we analyze physical measures as time, space, speed and acceleration, and if we think of relationship among these measured and, for example, the surface of the table (friction, elasticity, height and surface type), we can observe an extremely critical situation in which the attention to certain stimulus and the concentration during the game are essential factors for success.

2 Methods

In this study, once it intended to observe, register and analyze facts or phenomenon without the intention of manipulating them, we have opted for a methodology of descriptive character. More specifically it is considered an exploratory – descriptive study.

The technique of research adopted was the documental analysis, that allowed characterizing the structure and the contents of the training, from documents specifically elaborated for the investigation.

2.1 Sample

The objects of analysis were the dossiers of the 2002/2003 season from the three training centres the Portuguese Table Tennis Federation.

The analyzed documents included 739 units of training corresponding to 1641 hours of training, distributed in the following way: Training Centre of Bragan – 221 units, 529 hours; Training Centre of Madeira – 288 units, 576 hours; Training Centre of Porto – 230 units, 534 hours.

Those dossiers included the training plans of 32 young athletes – with ages between 10 and 15 years – of the Training Centres of The Portuguese Table Tennis Federation – 11 athletes in Bragan? 6 athletes in Madeira and 15 athletes in Porto, that integrated the so called Stage of Specialization of Base from the Program of Sport Preparation for the High Level.

14 of these 32 athletes are international cadets (athletes with less than 15 years) and they still integrate the project for detection and improvement of talents of the Portuguese Table Tennis Federation.

The reason for the choice of this sample is strictly related with the definition of the investigation problem, since we considered that the youths that integrate these training centres are a representative part of the athletes that have recently integrated, or have the potential to integrate, the national youth teams. In other words, we think that the training process in these centres is representative of the type of training that the "national" young elite are actually submitted.

2.2 Categories of the study

We have defined four great categories, which are factors of performance in any duel sport, as it is the case of table tennis. Those categories are reported to the nature of the training (technical, tactical, physical and psychological). To these four categories, one fifth was added – beginning and ending of the session – to establish coherence among the real time of training and the one spend with such group of the categories.

In each one of these categories several sub – categories were defined (Table 1).

Table 1. Categories and sub – categories for the analysis of the training structure

Technical Training	Tactical Training	Physical Training	Psychological Training
– Technical Strokes – Service – Lateral displacements – In depth displacements – Precision – Adaptability	– Initiative/ three first balls – Counter initiative – Play schemes – Play	– Strength – Speed – Aerobic resistance – Anaerobic resistance – Speed of gesture execution – Speed of displacement – Speed of reaction	– Concentration – Attention – Competitive routines – Self confidence – Formulation of goals – Sefl control – Relaxation

2.3 Statistical procedures

The analysis of the dossiers was done in an exploratory way, appealing to counting and frequencies that allow the description and comparison of the different categories of analysis of the group of the training centres.

3 Results

3.1 General parameters of the training load

Table 2 presents us the results referring to the general parameters of the training load in the three training centres.

Table 2. Values of the general parameters of the load in the Training Centre

	Bragança	Madeira	Porto	Mean Values
Annual n° of training units	221	288	230	246. 3
Annual n° of weeks of training	47	48	46	47. 0
Mean n° of training units per week	4. 7	6	5	5. 2
Mean duration of a training session (minutes)	143. 7	120	139. 3	134. 3
Hours of training per week	11. 26	12	11. 61	11. 62
Annual volume of training (hours)	529	576	534	546. 3

The number of weekly units of training (5. 2) and the annual number of weeks of training (47) are in agreement with the proposals of some specialists. Martin refers 45 weeks of training a year and 4 to 6 units a week, for the phase which we considered in the athletes of this study. In the same line, Gadal proposes as training volume between the ages of 11 and 14, to arrive to the high level 5 to 7 units of training a week.

Table 3 presents the values of reference of the weekly load of training for these ages.

Table 3. Number of hours of weekly training proposed by the specialists, compared with the values of this study

	Carl (1993)	Gadal (1997)	Martin (1999)	This Study (2004)
N° hours of training a week	15. 2	≤14	8. 14	11. 6

Martin proposes 8 to 14 hours, while Gadal speaks in a maximum of 14 hours. In a study dedicated to the hours of weekly training of young table tennis players in the first phase of the training for the high level, Carl (1993), mentioned by Martin, registered mean values of 15. 2 ± 3. 6 weekly hours of training. Our study registered a mean value of hours of weekly training (11. 6 hours) that, although inside the limits just referred, it is far away behind the proposed maximum limits. If we have in mind the values suggested by Platonov – 600 at 800 annual hours in the phase of specific preparation of base, in which we can place the athletes of this study – we verified that the mean annual volume of training in the training centres of the Portuguese Table Tennis Federation is not enough.

3. 2 Training categories and sub – categories

Not having found any research or data indicating the percentages or relative times of training dedicated to each one of the defined categories, we base our

analysis upon indicators given by the specialists' of the training of young players. From Table 4, we can say that the values in the categories technical training, tactical training, physical training, put in evidence that the times of training are in agreement with the needs referred by several authors for these ages.

Table 4. Annual volume and percentage of training dedicated to the four categories in the 3 training centres plus means values.

Categories	Bragança		Madeira		Porto		Mean values	
	(h/year)	(%)	(h/year)	(%)	(h/year)	(%)	(h/year)	(%)
Beginning and ending of the session	128.87	24.36%	144.00	25.00%	134.17	25.13%	135.68	24.84%
Technical Training	162.22	30.66%	159.57	27.70%	154.32	28.91%	158.70	29.05%
Tactical Training	167.63	31.69%	95.23	16.53%	149.50	28.01%	137.46	25.16%
Physical Training	70.32	13.29%	153.20	26.60%	95.83	17.95%	106.45	19.49%
Psychological Training	0	0.00%	24.00	4.17%	0	0.00%	8.00	1.46%
Totals	529.03		576		533.82		546.28	

Table 5 allows us a more detailed reading of the sub – categories of the technical training.

It is possible to verify that the "lateral displacements" have an expressive percentage of training (14% – 76 hours/year), what is in agreement with its importance in the game. In what concerns the "in depth displacements", the annual mean values are very inferior (1% – 5 hours/year), which, having in mind the values found by Djokic (3), it is clearly inferior to the desirable, once in each game the "in depth displacements" are about half of the "lateral displacements". On the other hand, and having in mind the *sensitive phases of learning*, Martin says that the spatial orientation has a optimal development period between the ages of 12 and 15 years, what justifies the importance of the training of the displacements in this period.

The annual mean values for the training of "service" are about 3% (16 hours/year), what doesn't correspond to its relevance in the modern table tennis.

The remaining subcategories – "precision" and "adaptability" – they are here present in very small values (0.2% – 1 hour/year and 1.4% – 8 hours/year, respectively). In effect, referring to the training of precision, its interest is recognized by several specialists (8, 10, 15, 23). Referring to the subcategory "adaptability", Séve alludes that the activity of a table tennis player on a competitive interaction has components that include the exploration, the disguise and the indetermination, ending by stating that, being like this, the program of daily training should have a strong component of exploration and disguise. In this sense, the values found in these two subcategories are far away from the desirable.

Table 5. Distribution of the volume and percentage of the sub – categories for the technical training in relation with the total volume of training

	Bragança		Madeira		Porto		Mean values	
Technical Training	(h/year)	(%)	(h/year)	(%)	(h/year)	(%)	(h/year)	(%)
Technical Strokes	66. 30	12. 53%	65. 15	11. 31%	26. 83	5. 03%	52. 76	9. 62%
Service	18. 42	3. 48%	14. 63	2. 54%	15. 00	2. 81%	16. 02	2. 94%
Lateral displacements	77. 50	14. 65%	74. 25	12. 89%	76. 67	14. 36%	76. 14	13. 97%
In depth displacements	0	0. 00%	3. 33	0. 58%	11. 50	2. 15%	4. 95	0. 91%
Precision	0	0. 00%	2. 22	0. 38%	1. 32	0. 25%	1. 18	0. 22%
Adaptability	0	0. 00%	0	0. 00%	3. 83	0. 72%	1. 28	0. 23%
Technique (Multiballs)	0	0. 00%	0	0. 00%	0	0. 00%	0. 00	0. 00%
Adaptability (Multiballs)	0	0. 00%	0	0. 00%	19. 17	3. 59%	6. 39	1. 17%
Annual Volume of Training	529. 03		576		533. 82		546. 28	

Table 6 give us a detailed reading of tactical training and its sub – categories.

Table 6. Distribution of the volume and percentage of the sub – categories for the tactical training in relation with the annual volume of training

Tactical Training	Bragança		Madeira		Porto		Mean values	
	(h/year)	(%)	(h/year)	(%)	(h/year)	(%)	(h/year)	(%)
Initiative/ three first balls	37. 6	7. 11%	24. 12	4. 19%	15. 33	2. 87%	25. 68	4. 70%
Counter initiative	18. 8	3. 55%	4. 45	0. 77%	19. 17	3. 59%	14. 14	2. 59%
Play schemes	29. 77	5. 63%	13. 33	2. 31%	15. 33	2. 87%	19. 48	3. 57%
Play	81. 47	15. 40%	53. 33	9. 26%	99. 67	18. 67%	78. 16	14. 31%
Annual Volume of Training	529. 03		576		533. 82		546. 28	

What stands out, in this picture, is that the time of training dedicated to the subcategory "play" (about 14% – 78. 1 hours/year average), is very superior to the time dedicated to the remaining subcategories.

The values found in this study for "initiative/three first balls" (4. 7% – 26 hours/year) are in agreement with what it is considered to be necessary in the tactical work in table tennis.

If the first three balls win relevance, and if the initiative is taken as soon as possible, through the improvement of strong terminal strokes, these facts has as consequence the demanding to dominate, also, the "counter initiative". So the values for this subcategory founded in this study are considered insufficient (2. 6% – 14. 1 hours/year).

In what concerns the last two subcategories – "play schemes" and "play" – the numbers here registered seem to meet the needs of the table tennis training in these ages.

Table 7 refers to the sub – categories of the Physical Training.

Table 7. Distribution of the volume and percentage of the sub – categories for the physical training in relation with the total annual volume of training

Physical Training	Bragança		Madeira		Porto		Mean values	
	(h/year)	(%)	(h/year)	(%)	(h/year)	(%)	(h/year)	(%)
Strength	2. 95	0. 56%	12. 00	2. 08%	0	0. 00%	4. 98	0. 91%
Speed	3. 13	0. 59%	12. 00	2. 08%	0	0. 00%	5. 04	0. 92%
Aerobic resistance	2. 35	0. 44%	12. 00	2. 08%	0	0. 00%	4. 78	0. 88%
Anaerobic resistance	3. 13	0. 59%	12. 00	2. 08%	0	0. 00%	5. 04	0. 92%
Speed of gestual execution (Multiballs)	0	0. 00%	16. 07	2. 79%	0	0. 00%	5. 36	0. 98%
Speed of reaction (Multiballs)	36. 82	6. 96%	36. 23	6. 29%	35. 07	6. 57%	36. 04	6. 60%
Speed of displacement (Multiballs)	21. 93	4. 15%	52. 9	9. 18%	60. 77	11. 38%	45. 20	8. 27%
Annual Volume of Training	529. 03		576		533. 82		546. 28	

The "speed", in particular the "speed of reaction" (36 hours/year – about 7%) and the "speed of displacements" (45. 2 hours/year – about 8%), possesses a nuclear role in the training of the young table tennis players of this study.

This skill is, as we saw, one of the most important in the game of the modern table tennis. We verified in table 7 that to the group of subcategories related to speed is dedicated a significant time (about 17% of the annual volume of training). The several forms of manifestation of speed here presented are, obviously, also worked out in another type of situations – in playing for example, play schemes, taking the initiative, etc. – what comes to reinforce the idea that the time dedicated to this component is compatible with its importance in the high level game.

Analyzing table 7, we can verify that the mean time of training of "strength" is residual (5 hours/year – about 1%), what doesn't match the importance of the training of this capacity referred by the specialists, in particular in the more advanced ages of the interval we have worked with

The values respecting the subcategories "anaerobic resistance" and "aerobic resistance", being residual, don't seem to be in agreement with the picture established by the specialists.

Finally, table 8, reports the subcategories of the Psychological Training.

From the analysis of Table 8, we can verified that only the subcategories "formulation of goals", "self – control" and "relaxation " are worked out, and even this ones only in the Madeira training centre.

Table 8. Distribution of the volume and percentage of the sub – categories for the psychological training in relation with the annual volume of training

Psychological Training	Bragança		Madeira		Porto		Mean values	
	(h/year)	(%)	(h/year)	(%)	(h/year)	(%)	(h/year)	(%)
Concentration	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Attention	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Competitive routines	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Self confidence	0	0.00%	0	0.00%	0	0.00%	0	0.00%
Formulation of goals	0	0.00%	8.5	1.48%	0	0.00%	2.83	0.52%
Sefl control	0	0.00%	7.5	1.30%	0	0.00%	2.5	0.46%
Relaxation	0	0.00%	8	1.39%	0	0.00%	2.67	0.49%
Annual Volume of Training	529.03		576		533.82		546.3	

Among the categories defined in this study, the values registered in the category Psychological Training are those more distant (being, in most of the cases, nonexistent) from what is indicated by the experts. The psychological training involves continuous and long processes that need much more superior volumes of training than the ones registered in this study.

4 Conclusions

Being this a first study on Table Tennis in Portugal, we expect that it can serve as reference for future studies and contribute like this to deepen the answer to problems that the present study doesn't drain.

The results of this study allow us concluding that:

(1) The annual number of weeks of activity in the training centres of the Portuguese Table Tennis Federation is in agreement with the reference values proclaimed by the specialists, but the values of the annual volume of training are not enough in order to obtain the best performances in the adult age. In what refers to the number of weekly units of training and the number of hours of training, the values founded are far behind the maximum numbers suggested by the specialists.

(2) The distribution of the training among the categories defined in the present study; show that the emphasis is placed in the technical and tactical training, in agreement with the characteristics of table tennis and with the specialists' recommendations. The fact that the volume of physical training is inferior cannot mean however disregard for the same, once, as it is known; he can be trained in a integrated way with the technical and tactical training. In what refers to the psychological component, and having in mind the relevance that is attributed it in the modern table tennis, it is notorious the lack in the training of this element.

(3) The analysis of the subcategories of the training allows detecting flaws that can contribute to prevent the accomplishment of good results in the adult

age and deserve to be underlined. Analyzing the subcategories of the technical training, it seems to be insufficient the time dedicated to the subcategories "service", "in depth displacements", "precision" and "adaptability". In fact the training of those subcategories is very far away from the importance of these parameters in the modern table tennis. In what concerns to the subcategories of the tactical training, the time of training dedicated to the subcategory "counter initiative" is not in agreement with the present needs, having in attention the attacking intentionality that marks the contemporary table tennis. In what concerns the subcategories of the physical training, the values registered are fundamentally due to the training of speed with resource to the training with multiballs. In what concerns the training "off the table", of the four great components (strength, speed, aerobic and anaerobic resistance), the times are not very significant and they are not in agreement with the needs of the sport. In what concerns the psychological training, subcategories as "concentration" and "attention", unavoidable dimensions in sports with the characteristics of the table tennis (situational/duel) they are completely devaluated.

5 Suggetion

From the options and results of this study, it is possible to suggest future investigations:

This study makes us feel the need of an analysis of the way the physical training is present in the technical and tactical. The same for the psychological training.

Since the subject of this study was the training processes, it is natural the arisen of some questions and that some suggestions are made:

(1) Once we have been analyzing the characteristics of the training with the purpose of reaching the high level in the adult age, and having as reference the maximum values pointed, it is desirable that the number of weekly hours of training is increased.

(2) On the other hand, the effectiveness of the training can be improved through the increase of the quality hence justifying an analysis to this parameter.

(3) The time of training for subcategories as service, in depth displacements, precision, adaptability, counter initiative, strength and the aerobic resistance, should be increased. Such can be achieved through a redistribution of time of training, but also increasing the number of hours as already proposed

(4) The inadequacy of the training in these subcategories would not, by itself, be very preoccupying if these could be workout later and if it didn't put in cause the maximum development of the athletes' potentialities. However, it is known that if certain skills are not stimulated with the right amount and in the right moments, in agreement with the theory of the sensitive phases of the

learning, the optimal development of those skills will be inhibit, consequently, it can be one of the causes preventing the achievement of high performances in the adult age.

(5) Knowing the importance that components like attention, concentration, self – control and relaxation have in table tennis, it is justified its integration in the process of the young athletes' formation, but never sacrificing the time dedicated to the technical, tactical and physical training.

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54 Situational leadership® II and the coach – athlete relationship in Brazilian table tennis

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1 Introduction

Interaction processes between athletes and coaches have always been considered to be determinant factors for sport performance (Serpa, 1999). The coach leadership in sport texts has been the principal theme for the coach – athlete relationship studies. According to Horn (1992), "research in sport leadership area has been conducted under the general assumption that the type of leadership behavior exhibited by a coach will have a significant impact on the athlete's performance and/or on their psychological or emotional well – being".

Leadership has been rather generally conceived as "the behavioral process of influencing individuals and groups toward set goals" (Barrow, 1977).

In this text, "the Chelladurai's Multidimensional Model of Leadership (1980) will be used as framework" (Horn, 1992). On the other hand, second Case (1987) a contemporary leadership theory that may have particular relevance for sport setting is Hersey and Blanchards's Situational Leadership® Theory (1969). Although some researches (Turman, 2001; Case, 1987; 2001; 2002) point inconsistent results on the application of Situational Leadership Theory in sports texts, they also pointed that Situational Leadership® may be a new perspective to study this theme.

According to Chelladurai (1999), the multidimensional model of leadership is an attempt to synthesize and to reconcile existing theories of leadership. Essentially, the model focuses on three states of leader behavior – required, preferred, and actual. It classifies the antecedent variables that determine these leader behaviors into situational characteristics, member characteristics, and leader characteristics. The consequences (i. e., outcome variables) in the model are performance and satisfaction. So, the Situational Leadership® is a part of Multidimensional Model of Leadership.

The Situational Leadership® Theory is based on the interaction between the amount of direction or task behavior that a leader gives, and the amount of social – emotional support or relationship behavior that a leader provides, and finally, the specific task "maturity" level of the follower(s) (Case, 1987).

Blanchard, Zigarmi & Zigarmi (1985) adapts some concepts of Situational Leadership® Theory and proposes a new model named Situational Leadership® II (SL® II). According to Case (2002), the SL? II, is a popular leadership theory that has practical appeal but very little research support in the literature. The theory emphasizes the importance of matching leadership style with the maturity/development levels of followers or subordinates in order to optimize leadership effectiveness. When an athlete (or group of athletes) is at the M1 or D1 maturity/development level, the theory indicates that a S1 (high task/low relationship) style would be the best leadership style to use with this athlete or group of athletes. If the athlete is functioning at the M2/D2 level, then an S2 (high task/high relationship) style would be most effective, etc. To be effective in this style, leaders must be flexible; they must adapt their styles to the challenges presented by a variety of different situations.

Specifically on table tennis context, El – Kurdi (1993) pointed that "one imperative variable that affect coaching of table tennis is adopting leadership style in order to assist the players reach the peak". Wei (2003) found that there are significant relationships between table tennis coaches' leadership behavior and levels of emotion found among team members.

Based on this context, the present study aimed at (1) verifying the applicability of the Situational Leadership® II Model to the coach – athlete relationship in table tennis; (2) analyzing whether leadership antecedents influence the coach's leadership behavior, according to athletes, to athletes' satisfaction, and to the coach – athlete relationship; (3) analyzing whether congruence between athletes' answers and those of their respective coaches' affects leadership as per the Multidimensional Model of Leadership in Sport. In other words, the purpose of this study was to test the Situational Leadership® II Model utilizing the Multidimensional Model of Leadership in Sports as theory support.

Actually, Situational Leadership® is a study object of many contemporary scientific researches in different areas of the knowledge (Osburne, 1989; Fernandez & Vecchio, 1997; Graeff, 1997; Turman, 2001; Case, 2002; Lee – Kelley & Loong, 2002). These studies aimed at verifying the consistent application of this model, creating evaluations instruments to give more precision on the leadership process evaluation and/or analysis.

The emphasis of the sport leadership studies is on the age in combination with the level of competition and/or years of sport experience. Specifically, the researches in this area have tested hypotheses inherent in both Hersey and Blanchard's theory and Chelladurai's model suggesting that the degree of maturity characteristic of group members will affect their need for particular leadership styles or behaviors (Horn, 1992). In the sport context, maturity has been defined as "the relative mastery of skill and knowledge in sport, the development of attitudes appropriate to sport, and experience and capacity to set high but attainable goals" (Chelladurai & Carron, 1983). So, this study is

justified on these aspects and concerned on these bases.

To evaluate the coach leadership, Chelladurai & Saleh (1978) developed the Leadership Scale for Sports (LSS). The LSS consists of 40 items representing 5 dimensions of leader behavior (Training and Instruction – TI, Democratic Behavior – DB, Autocratic Behavior – AB, Social Support – SS, and Positive Feedback – PF. The coaches were asked to asses how they currently perceived themselves (self perception version). The players were also asked to asses their coach on current leadership style (athletes' perception version) and secondly on how they would like to be coached in an ideal situation (athlete's preferences' version).

The studies that reported age, competitive level and years of experience on leadership behavior showed interesting and important results. Chelladurai & Carron (1983) in attempt to test Hersey and Blanchard's Theory, administered the preference version of the LSS to high school midget, high school junior, high school senior, and university level. The results show, firstly, that training and instruction progressively decreased from high school midget through junior to senior levels and increased at university level. Secondly, the preference for social support progressively increased from the high school midget level to the university level.

Serpa (1990) made a comparison between 12 to 15 years old (n = 17) and 17 to 29 years old (n = 23) women Basketball players in Portugal. The results showed that the younger players, relative to the older players, preferred more social support and democratic behavior, and less autocratic behavior.

Synthesizing some researches limited results, Chelladurai (1993) concludes that it can be drawn from these that as athletes gain experience and/or ability; they seem to prefer their coaches to be more autocratic and socially supportive. Although, Case (1987) and Turman (2001) can't find consistent results about the application of Hersey and Blanchards' Theory, they explained it more studies in this area are necessary.

In general, the athletes' perception and coaches' self perception studies showed that the training and instruction and positive feedback are the major values on LSS, although in many studies, the intensity of athletes' and coaches' LSS responses are significantly different. As far as decision making is concerned, there are some differences and divergent views in autocratic behavior and democratic behavior. Autocratic behaviors have the lowest values in some studies while democratic behaviors are less frequent in some others (Serpa, 1999).

2 Methods

2.1 Participants

Subjects were 61 Brazilian table tennis athletes (39 boys and 22 girls), ages from 12 to 18 years old, and their coaches (n = 10) from nine Brazilian Teams.

2.2 Procedures

A Portuguese version of the Leadership Scale for Sports – LSS (Chelladurai & Saleh, 1980), translated and validated by Serpa et al. (1988) in Serpa et al. (1990) was used in this study. The coaches completed the LSS self perception version, and the athletes completed the LSS athletes' perception version. For experience evaluation, a specific demographic questionnaire was developed applied both for coaches and athletes. The athletes also completed the Athlete Satisfaction Questionnaire – ASQ, (Chelladurai & Riemer, 1998) in only four dimensions related to coach leadership satisfaction. The ASQ was translated by the researches and the psychometrics proprieties were satisfied (Cronbach Alpha between 0.79 ~ 0.89 for the four dimensions). For the evaluation of performance level, the national ranking was used.

Three ages groups were formed for analyses of the development level according to Situational Leadership aspects (12 ~ 13 years old, 14 ~ 15 years old, and 16 ~ 18 year old). Every antecedent such as performance level, years of experience and time of experience with actual coach were categorized in 4 stages based in demographic questionnaire responses.

The instruments were applied in the interval of the games in 2003 Brazilian National Championships in São Paulo, Brazil. Athletes, their parents, and coaches were notified by a Brazilian Table Tennis Confederation – CBTM official note. This note informed the nature of the study, its importance to develop the Brazilian table tennis, and they were invited to take part in the research. All participants signed a permission term and the research project was in accordance to the terms of National Health Council and was approved by the Minas Gerais Federal University Ethics Research Committee.

2.3 Statistical analysis

All statistical procedures were calculated by the Statistical Package for Social Sciences – SPSS? for Windows®, 11.0 version, except the Coach – Athlete Congruence Index (CACI) that was calculated by a specific Microsoft® Excel 2002 worksheet developed based on the methodology used by Lauglhin & Lauglhin (1994).

A Reliability Test was used for analyze the internal consistence of LSS and ASQ (Cronbach alpha, > 0.70 was adopted). Kolmogorov – Smirnov of Lilliefors and Shapiro – Wilk tests were applied for normality verification. The Mann Whitney U Test was applied to compare two groups' responses. The Friedman test was used to compare the coaches' responses for the three different age groups. For comparing the three different athletes' age group responses, the Kruskall – Wallis test was applied. Finally, the Spearman test was used for correlate satisfaction, performance and CACI.

3 Results and Discussion

The Table 1 and 2 indicate the athletes and coaches respective responses for

the LSS questions in the three different ages' groups.

Table 1. LSS Athletes Perception of Coaches Behavior

Dimension	12 ~ 13 years old		14 ~ 15 years old		16 – 18 years old	
	Mean	SD	Mean	SD	Mean	SD
PF	4.200	0.793	4.295	0.531	4.274	0.372
TI	4.198	0.557	4.142	0.455	4.145	0.558
DB	3.614	0.656	3.693	0.520	3.801	0.468
SS	3.386	0.739	3.316	0.620	3.849	0.515
AB	2.774	0.929	2.561	0.594	2.679	0.718

PF – Positive Feedback; TI – Training and Instruction; DB – Democratic Behavior; AB – Autocratic Behavior; SS – Social Support.

The Table 1 shows that athletes perceived their coaches with high positive feedback and training and instruction dimension values. Democratic behavior and social support were the intermediate dimension values. The Autocratic behavior was the smallest value. Only in 16 – 18 years old age group was a difference was observed. In this age group, the social support was higher than democratic behavior. In the other two age groups, this order was inverted.

Table 2. LSS Coaches Self Perception

Dimension	12 ~ 13 years old		14 ~ 15 years old		16 ~ 18 years old	
	Mean	SD	Mean	SD	Mean	SD
PF	4.580	0.329	4.920	0.169	4.720	0.140
TI	3.885	0.534	4.355	0.315	4.262	0.332
SS	3.662	0.391	4.325	0.318	4.063	0.340
DB	3.165	0.896	3.478	0.658	3.167	0.336
AB	3.060	0.806	2.420	0.561	2.440	0.409

PF – Positive Feedback; TI – Training and Instruction; DB – Democratic Behavior; AB – Autocratic Behavior; SS – Social Support.

The Table 2 shows that the coaches' self perception was similar to the athletes' perceptions. The order of the LSS values was the same of the 16 – 18 year old ages group.

Although the intensity values of coaches and athletes were not the same, these results presented that when the maturity level was higher, the order of responses values was exactly the same.

These results (Table 1 and 2) are in conformity with international literature (Serpa, 1990; Chelladurai & Saleh, 1978; Terry & Howe, 1984; Terry, 1984; Chelladurai, 1984; Costa, Costa, Samulski & Noce, 2003; Silva, Costa

& Noce, 2003). Specifically in table tennis research, Sriboon (2001) found the same order in LSS applied in Rajabhat table tennis athletes.

When coaches' and athletes' responses are compared (Mann Withney Test), differences in intensity values were clarified. Three LSS dimensions were different. The coaches self evaluated themselves with higher values than their athletes for social support, Mean Rank = 59.40 (coaches) and 39.41 (athletes), $p = 0.001$; positive feedback Mean Rank = 63.02 (coaches) and 57.63 (athletes), $p = 0.001$. However, the democratic behavior was lesser Mean Rank = 34.62 (coaches) and 51.60 (athletes), $p = 0.004$.

Table 3 shows the coaches' and athletes' LSS compared values.

Table 3. Coaches' and athletes' LSS values compared (Mann Whitney Test) in each of three ages' groups

Dimension	12 ~ 13 years old			14 ~ 15 years old			16 ~ 18 years old		
	Mean Rank		P	Mean Rank		P	Mean Rank		P
	Coaches	Athletes	value <	Coaches	Athletes	value <	Coaches	Athletes	value <
PF	21.60	15.00	0.07	19.50	12.63	0.04 *	22.65	10.97	0.01 *
TI	14.50	18.09	0.33	15.70	14.63	0.75	16.00	14.47	0.65
SS	22.40	14.65	0.03 *	20.70	12.00	0.01 *	17.25	13.82	0.30
DB	11.15	19.54	0.02 *	11.40	16.89	0.10	13.05	16.03	0.37
AB	16.75	17.11	0.92	15.15	14.92	0.95	13.15	15.97	0.39

* Significant Difference at $p < 0.05$.

These results show that except for democratic behavior and training and instruction, statistics differences were observed in the other three dimensions.

Similar results were found by Liukkonen (1999) that verify differences in all LSS dimensions. Danielson, Zelhart Jr & Drake (1975) related that it is usual for coaches to self evaluate themselves higher that athletes. Horn & Carron (1985), Baric & Horga (2003) and Jerz, Fabrycszewska, Araskiewicz & Sluwaski (2003) also found results in this way.

Although, the democratic behavior presented higher athlete values, this result is not unusual. Leit? o, Serpa & Bártolo (1993) and Salminen & Liukkonen (1996) found similar results. So that it is curious but not unusual.

Comparing the athlete's responses on ages groups, the Kruskal – Wallis tests show only differences in LSS social support, Mean Rank show a higher value for 16 ~ 18 years old group, 12 ~ 13 years old = 28.76; 14 ~ 15 years old = 25.45; and, 16 ~ 181 = 39.26. $p = 0.041$. This result confirms the Chelladurai's (1993) review that demonstrates that social support increases from the minors age groups to the majors.

So theses results suggested some applications of the Situational Leadership® II, but couldn't demonstrate the applicability of this model in this context, because it wasn't possible to describe a precise pattern like Blanchards' Model suggests.

No difference was observed in LSS and ASQ results for the leadership antecedents. So the athletes' perception of coaches' behavior and athletes' satisfaction didn't present any influence, in a first view, in the leadership antecedents.

In spite of these results, when the congruence of coach – athlete relationship was analyzed by CACI, the results demonstrate some influence in leadership antecedents. When the athletes had a better performance, the training and instruction dimension presented a higher level of congruence in comparison with the athletes in the last national ranking positions, $p = 0.019$.

The more experienced athletes in the national level presented more congruent responses with their coaches for training and instruction, $p = 0.003$, social support, $p = 0.01$, and positive feedback, $p = 0.009$ when compared to less experienced athletes.

The more time of experience with actual coach presented more congruence responses for training and instruction, $p = 0.003$ and social support, $p = 0.011$ when compared to less time of experience.

So the CACI presented as an important instrument to analyze the leadership antecedents. Some coach behaviors were disguised in simple LSS analyses, but they were evidenced in CACI analyses. This fact may represent a better communication of coach – athlete dyad, which in table tennis represents an essential performance aspect according to Messinis (2000).

The major congruencies presented in the CACI were observed in the following order: Positive Feedback, mean 0.87 ± 0.57; Training and Instruction, 1.00 ± 0.35; Social Support, 1.09 ± 0.45; Democratic Behavior, 1.28 ± 0.53; and, Autocratic Behavior, 1.44 ± 0.48.

A high level of athlete satisfaction could be observed in all scales: Training and Instruction = 5.72 ± 1.03; Personal Treatment = 5.64 ± 1.22; Strategy = 5.41 ± 1.14; and, Ability Utilization = 5.12 ± 1.27.

The 14 ~ 15 year old age group athletes in general presented less satisfied than the other age groups. For Ability Utilization they presented statistical differences in Kruskal Wallis Test $p = 0.003$. Maybe the process of coaches' formation to deal with conflicts common to this age group has not proved to be efficient. – Coaches do not show changes in their behavior among age groups.

Positive correlation among every dimension of LSS and ASQ, except Autocratic Behavior, was presented in the Spearman Test. Riemer & Chelladurai (1997) and Altahayneh (2003) found similar results.

The athletes' performance level presented a positive correlation with general CACI, $p = 0.039$, pointing that a higher general CACI is associated with a better athlete performance. Laughlin & Mc Glynn (1983) and Laughlin & Laughlin (1994) presented similar results demonstrating that a high similarity between athlete and coach responses are predictors of a high efficiency in the coaching process.

These results demonstrated that higher CACI and leadership behaviors influence the athletes' performance and satisfaction, as demonstrated in the

Multidimensional Leadership Model.

4 Conclusion

The results presented in this study revealed important findings related to Brazilian table tennis coaches, such as the importance of a good communication and the necessity to change their behavior according to different situations. Although the applicability of the Situational Leadership® II Model could not be confirmed, important findings could be revealed for further researches. The results reached also underline the relevance of the Multidimensional Model of Leadership in Sport in order to achieve effective leadership, and they suggest that a better methodological adequacy based on this model may be the key to verify a greater contribution on the part of the Situational Leadership? II Model to the sport's environment.

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55 A feasibility study of interval hypoxic training of table tennis players

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1 Introduction

In accordance with the Sports Event Classification Theory, the table tennis falls into the category of skill – leading dual events over the net. In other words, skill is the decisive factor in a table tennis match. As far as the Chinese national table tennis team is concerned, the ever – victorious exploits in the past fifty years mainly resulted from the excellent skills. However, with the gap of skills narrowing down among the world's top players, and the rules undergoing quick changes, the Chinese players are gradually losing their competitive edge in technical skills. As a result of the exceptional heredity and the well – balanced diet of European athletes, they are generally superior to the counterparts in China in terms of physical strength. Suppose two equally skilled players have a match. Winning the match calls for not only excellent tactics and psychology, but great physical strength as well. Nothing but great stamina enables players to bring their skills and tactics into full play. So, how to use scientific training methods to improve Chinese players' physical strength is a big challenge we have to take up.

2 Methods

Literature review; theoretical analysis; inductive method; statistical method.

3 Results and discussion

3.1 An analysis of table tennis energy supplying features

Ever since the 1980s, table tennis scholars have carried out a series of in – depth researches into the energy – supplying characteristics of this sport and achieved extensive consensus on this subject. The research findings by Welble (1985), Liu Xun (1986) and other scholars indicate that table tennis is an aerobic metabolism sport requiring great endurance, which often alternates with short – interval intense non – aerobic metabolism. The main ways of energy supplying can be seen in table 1.

The energy – supplying characteristics show themselves not only in the come and go of the ball, but also in games, sets and the length of days. For example, an international table tennis tournament often takes six to ten days.

Fine players usually enter for quite a few items of the event, and the games he participates in often come up to seven a day. In each game there are often five sets on the average (see also table 2 and table 3). Since the international tournament often adopts the single elimination system, the gap of the professional skills among contestants becomes smaller as the match goes on. Usually players are not only exhausted in the body but also highly tensed in the mind, so the great endurance performance is the decisive factor in the success.

Table 1. A comparison of Table Tennis Energy Supplying Systems

Energy systems	ATP ~ CP energy supply	Sugar anaerobic glycolysis	Sugar aerobic oxidation	Fat aerobic oxidation
Energy – supply time	6 ~ 8 s	2 ~ 3 min	Over 3 min	Over 10 min
Characteristics of metabolism	Anaerobic	Anaerobic	Aerobic	Aerobic
Characteristics of Exercise	Maximum intensity over a brief interval	Great intensity over a somewhat long interval	Moderate intensity over a long interval	Moderate intensity over a long interval
Corresponding movements	Attack (drive) or backhand attack (drive) with maximum strength; Fastest pace movement	Drive, chop and other skills with moderate strength	Return the shot with a chop, stop to pick up the ball and take a rest between intervals	aerobic oxidation

Table 2. The Number of Games for Top Chinese Players at the 47th World Table Tennis Championships

Name	Kong Linghui	Ma Lin	Wang Liqin	Wang Hao	Wang Nan	Zhang Yining	Li Ju	Niu jianfeng
Number of Games	12	16	15	15	19	17	12	16

Note: No mixed doubles for Kong Linghui and Li Ju

Table 3. The average sets in each game & the sets in the finals for the Top Eights at the 47th world table tennis Championships

Event	Men's singles	Men's doubles	Women's singles	Women's doubles	Mixed doubles
Total sets	90	81	78	77	84
Total games	15	15	15	15	15
Average sets	6	5.4	5.2	5.1	5.6
Total sets in finals	6	6	7	5	7

3.2 The Endurance performance and features of chinese table tennis players

Zhang Hua and other scholars conducted a survey of the endurance performance of 20 Chinese Table Tennis players (10male and female each). Their findings show that the somatic function of the Chinese national team is excellent on the whole, but the cardiovascular and respiration function is relatively weak. This mainly manifests itself in the following ways: Judged from the morning pulse and blood pressure, the Chinese players' cardiovascular function ranks only among the average; Seen from the vital capacity and height – to – vital capacity, the cardiovascular function of some Chinese players is even not so good as that of the average teenagers of the same age in some European countries. Peng Rui and other research fellows once conducted a survey of the somatic function of the Guangdong table tennis players, and they found that the testees' anaerobic metabolism is fairly good while their aerobic metabolism is poor. Lu Yunxia's findings indicate that the coach often attaches much importance to the skills and tactics training, but pays scanty attention to the training of their physical strength, for they think players' achievement is not so closely related to their physique. From the researches above, it can easily be seen that the Chinese table tennis players are inferior to their counterparts in terms of endurance performance and so their physique in this respect remains to be strengthened.

3.3 A Comparison of the advanced endurance training methods

At present there are three universally recognized training methods to improve the endurance performance and physical strength of table tennis players: altitude training; living high – training low; interval hypoxic training. The three methods mentioned above are fairly advanced in improving players' physique, and aerobic endurance in particular. Besides, the methods have already been widely used in long – and medium – distance running, cycling, kayaking, basketball and football playing, and other sports events.

3.3.1 Mechanism for altitude training

By altitude training we mean transporting table tennis players to a certain region of a moderate altitude, where they receive special training at regular intervals. The main mechanism is as follows. When athletes receive training in the environment of hypoxia and depression at a moderate altitude, the dual stimulation of anoxia and intense training helps to arouse their potentials in the body, and thus produce a series of anti – anoxic physiological reflections that are conducive to sports capabilities. This method will go a long way in helping improve the function of the athlete's respiration and cardiovascular systems, and especially the ability of the aerobic metabolism.

3.3.2 Mechanism for living high – training low

The living high – training low method is a very innovative way of endurance performance training in comparison with the altitude training. Its main pur-

pose is to effectively handle the somewhat low intensity of training that exists in the altitude training. As the term living high – training low suggests, athletes live at an altitude and train near sea level. The athletes living at an altitude can acclimatize themselves to the changes brought about by training at sea level and thus improve their endurance performance, while athletes training at sea level can keep away from the adverse influences brought about by altitude training. However, this kind of training is hard to be put into practice as a result of the high cost and the high demand for the terrain.

3.3.3 Mechanism for interval hypoxic training

In view of the huge costs of living low – training high, scholars come up with the idea of interval hypoxic training in table tennis. It has the following advantages. Firstly, athletes can receive special training at simulated altitudes without having to go to the plateau areas. Besides, the simulated altitudes can be adjusted according to the individual conditions of athletes. By interval hypoxic training we mean athletes breathe in low – oxygen gases through apparatuses so long as the gas doesn't exceed the scope that the human body permits. Often the higher the simulated altitude, the lower the oxygen content. Intrinsically speaking, the interval hypoxic training is to use artificial methods to create a hypoxic environment to boost the athlete's aerobic endurance capacity. Hopefully, it can achieve the desirable effects of the simulated altitude training. At the same time the other training programs and the regular rest time will not be disrupted.

Table 4. A Comparison of the Three Endurance Capacity Training Methods

Training Method	Altitude Training	Living high – training low	Interval hypoxic training
Main training results	Improved aerobic endurance capacity	Improved aerobic endurance capacity	Improved aerobic endurance capacity
Effects on training intensity	yes	less	less
Adjustment of altitude	impossible	impossible	possible
Effects on athletes' original movements	yes	no	no
Effects on athletes living	Most obvious	A little	Not obvious
Domestic implementation of the methods	yes	yes	no
Abating after workout	yes	yes	A little
Cost	Fairly much	immense	Not much

As Table 4 shows, the interval hypoxic training has not only the merits of the altitude training and the living high – training low methods, but also the advantages of low costs, adjustable simulated altitudes, little effect on

athlete's living and regular training, and the like. In short, it is a most fitting physical strength training method for table tennis players.

3.4 Effects of the interval hypoxic training on athletes' locomotion capacities

3.4.1 Effects on the overall locomotion capacities

Great physical strength is essential for athletes to bring their tactics and skills into full play. The interval hypoxic training can improve the athlete's overall locomotion capacity. Li Qiang and other scholars conducted experiments of interval hypoxic training on after – workout badminton players for the purpose of researching into their physical strength characteristics. The results show that it can effectively enhance the locomotion capacity of athletes, registering an obvious improvement in locomotion capacity after the completion of a fixed amount of training load. Lei Zhiping's researches show that interval hypoxic training can greatly improve athletes' respiration function, enhance metabolism efficiency and thus promote the locomotion capacity.

3.4.2 Effects on anaerobic metabolism performance

Table tennis is an aerobic & anaerobic energy supplying sport event, but anaerobic metabolism occupies a dominant place in this game. For example, Li Shicheng and other scholars carried out a four – week interval hypoxic training experiment on white mice. The findings show that the metabolism of the lactic acid in the skeletal muscle of the mice greatly improved after simulated altitude training, which is evidenced by the decreased concentration of lactic acid, and the approach of the resting value at the sea level. This suffices to prove that the interval hypoxic training can enhance aerobic metabolism performance as well as anaerobic metabolism efficiency.

3.4.3 Effects on the excitability of the nervous system

As ping pong ball is small in size, quick in speed and spinning in motion, table tennis players are required to be agile and respond quickly. Chen Gengchun and other scholars' findings show that the interval hypoxic training can boost the brain's power against anoxia, enhance the nervous system's reflexive ability in the face of anoxia, and increase the athlete's locomotion capability as well. In short, the interval hypoxic training plays an active role in enhancing the nervous system's excitability and reflexive competence.

3.5 Present researches into the interval hypoxic training of table tennis players

Since the altitude training goes a long way in helping table tennis players enhance their physical strength and the nervous system's fatigue resistance, scholars carried out a lot of researches into the effects and characteristics of the training method. For example, the main researches in this field are as follows: some European athletes were transported to receive altitude training at

Granada, Spain, but the effects are unknown in the newspaper. Xu Xingguo and other scholars once studied the effects of altitude training on the speed, the skills of attacking and looping. They believed that an altitude of more than 2500 m exerts a considerable effect on table tennis skills. Cheng Yunfeng and other scholars (1990, 1996) believe that the merits in the altitude training outweigh the demerits, such as enhancing athletes' aerobic metabolism performance and increasing their explosive force. The table tennis team of Yunnan University received altitude training regularly, which significantly improved the athletes' performance. Thus it can be seen that the value and significance of the altitude training has been widely recognized in the circles of table tennis, but scholars have not paid due attention to the training – oriented practice. To the author, there are two main reasons behind it. 1) The theory and methods of the interval hypoxic training is still new to the table tennis circles. 2) There are no effective channel of communication between the academic circles and the instructing circles.

4 Conclusions

(1) It is widely acknowledged that table tennis is an aerobic metabolism sport requiring great endurance, which often alternates with intense anaerobic metabolism over a short interval.

(2) Among the three methods of the altitude training, the living high – training low, and the interval hypoxic training, the last one is most fitting for the training of athletes' endurance.

(3) Both the academic circles and the instructing circles need to redouble their efforts to research into the theory and practice of the interval hypoxic training.

56 The space-time feature and relativity of the competitive table tennis

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1 The space – Time classification of characteristics of the competitive table tennis

In the course of the research of this paper, we regard related essential factor and content as the time feature of competitive sport table tennis, such as, the ball speed concerning time , attack ball speed , wave racket speed , move speed , attack ball rhythm, the rotational speed etc. It is far and near to stand position , move scope, arc line difference in degree and movement size , attack ball point, attack ball period to belong to for the space of the competitive sport of table tennis feature (Table 1).

Table 1. The time and space classification of characteristics of competitive sport of table tennis

Time feature	Space feature
Ball speed , attack ball speed , wave racket speed , move speed , attack ball rhythm, the rotational speed etc.	Station position is far and near , moves scope, arc line difference in degree and movement range , attack ball point , attack ball period etc.

2 The space-time feature in the development of the competitive table tennis

Since the first World Championship of Table Tennis, the competitive table tennis has gone through 5 important periods of development. Each period has its primary technology (Figure. 1).

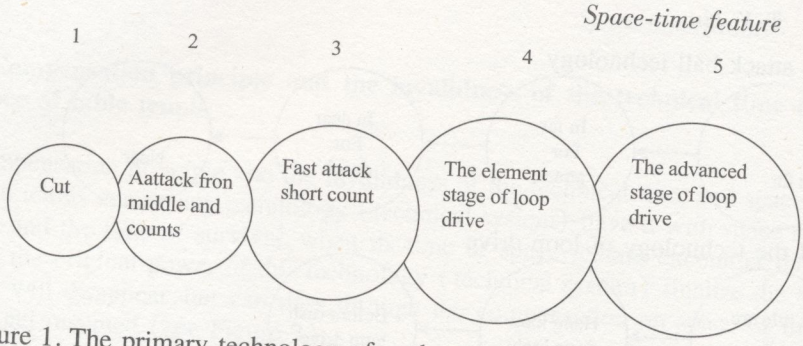

Figure 1. The primary technology of each period

The development of table tennis presents two characters: The first one is continuity that refers to the succession and development of the former technology that perfects and evolves along with the research about the competitive sport law of table tennis. From the angle of space and time, the technology has the relatively stainable future of space and time as well as the structure of technologies. The second one is irregular bounce of research which means that the change of external environment and the recognition of the law of table tennis initiate the innovation and grand change.

Fig. 2 shows the transition and forming of each historical period begin with the innovation of technology on the base of which form the different strike and characters from the past. For example, the transition of the first and second periods was caused by two essential changes of t he outside world. One is the transform in size of table in 1937 (146. 4cm width → 152. 5 cm; Net high 16. 77 cm → 15. 25 cm) ; another is the invention and use of sponge – rubber racket. Regular change has modified the space feature of competitive table tennis; the use of sponge – rubber racket has changed its time feature. The two changes establish the foundation for the attacking strike.

Through the discussion and the analysis for the above 5 technologies, though in different historical period, we can find that the strikes and technologies such chop – and – attack and rackets with rubbers of two properties, but what promotes the development of competitive table tennis is still the strikes with speed feature. Therefore, increasing the speed of attack as the primary trend should be taken into consideration.

3 The space – time feature of major technologies of competitive table tennis

With space – time sight make further investigation for the course of developing of every technology of table tennis, we discover , nearly each technology is along speed recover to recover rapid, technical movement recover to recover small change and development step by step (shown in Figure 2).

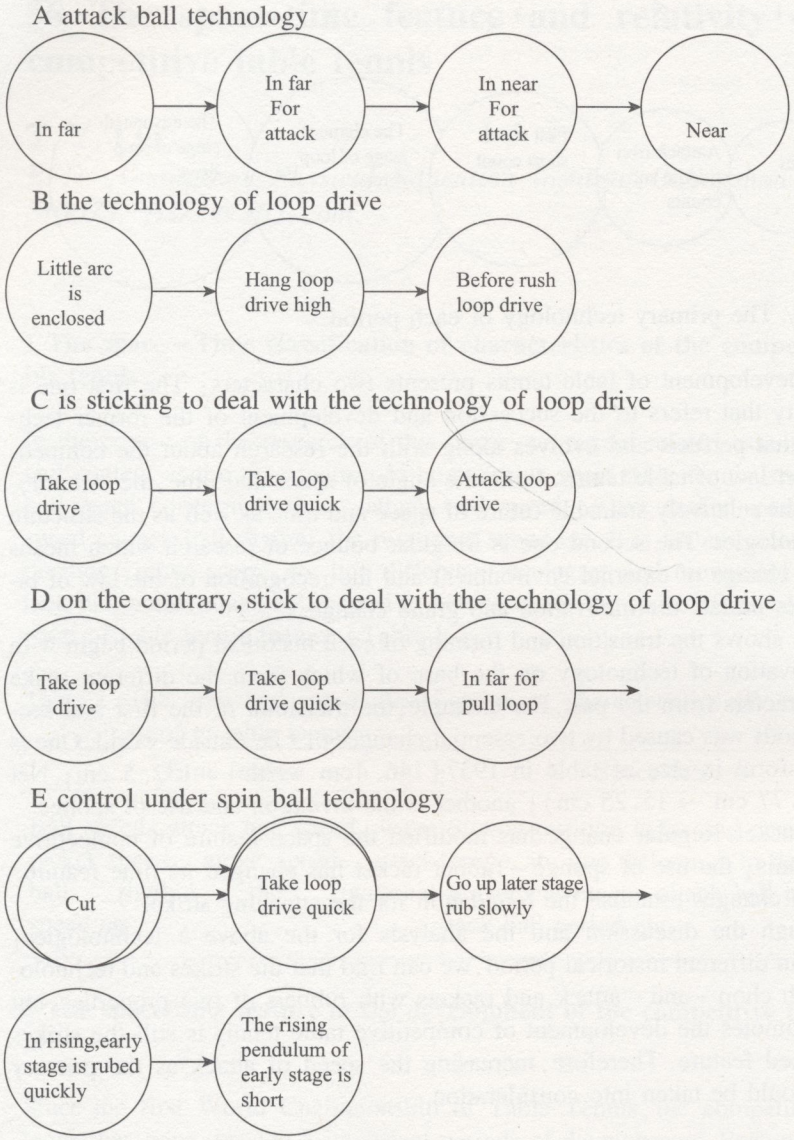

Figure 2. The space – time feature of major technologies of competitive table tennis

According to the more every technical use in different historical period frequency, we can reach , along with the development of the sport of table tennis the major technology of every type, toward to raising ball speed, decrease to attack ball time and space the direction development . Author thinks that this is the historical necessity that the sport of table tennis with speed as core.

4 Compensation principle and the invalidness of the technical time and space of table tennis

Compensation principle and the invalidness of the technical time and space of table tennis denote any technology (technical system) have it with space feature and the time of survival, when its time or space feature encounter damage, the original power of this technology (technical system) finalize the design will disappear, but can pass through the compensation on space or time and get resumed (see Figure 3).

The certain technical movement that needs 0. 2 seconds of completion changes along with the ball space of speed that quickly produces

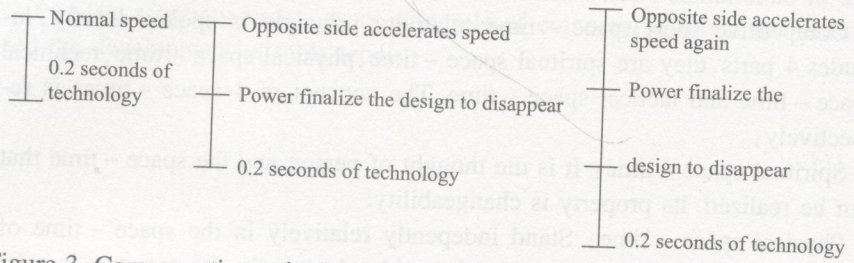

Figure 3. Compensation principle and the invalidness of the technical time

Fig. 3 shows us that on specific location, the certain technical movement that needs 0. 2 seconds to completion, but with the speed of ball is becoming faster and faster, the time (complete movement time) not enough, therefore, power determine the nature to disappear, in order to get necessary 0. 2 seconds, athlete can retreat backwards , increases distance , gains time with space. Since the more to be far away from table to move scope bigger (is shown in Fig. 4), it is passive to will inevitably also. Therefore, its very important to raise absolute velocity of each pace about ball and technology.

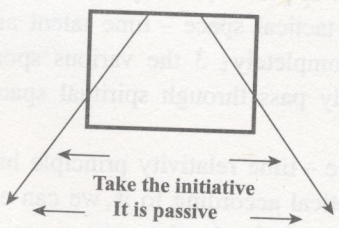

Figure 4. Compensation principle and the invalidness of space of table tennis

5 The space – time relativity principle of sport

Competitive sport space – time relativity principle produces in 1993, is author

in Beijing physical education university study sports training to study Master graduate student make. From this theoretical forehand near recoil that drawn forth with attack before rush the technology of loop drive, have gotten then China table tennis associate chairman Li Fu Rong, national team male team Cai Zhen Hua of chief coach, Yao Zhen Xu of the leader of group with Yin xiao support and the solicitude of clouds coach, at the same time, in Chinese country body department place, biological mechanics laboratory Wu yang – xi researcher he help of etc. research people take off , difference is for then Liu Guo Liang , kong ling hui, feng zhi、Huang da Wei, Wuang fei for 5 young team members test and study , through practice, this technology has become the now world most important esssential technology of the man excellent athlete of table tennis circles with score one of means.

Competitive sport space – time relativity principle is spoken briefly, includes 4 parts, they are spiritual space – time, physical space – time, technical space – time and tactical space – time. The concept of 4 space – times is respectively:

Spiritual space – time: It is the thought of person and the space – time that can be realized. Its property is changeability.

Physical space – time: Stand indepently relatively in the space – time of person that shows objective material world subjectively. Its property is relative stability.

Technical space – time: Is spiritual with material join the space – time with 2 of one. Its property is to have changeability , and is stabilized relatively.

Tactical space – time: Is basis opposite side and self more 3 space – time forms, and the corresponding space – time that adopted. Its property is flexible changefulness.

The core of competitive sport space – time relativity principle is spiritual space – time. Because: 1 , competitive sport is the sport of person , is the sport that controled by the spirit of person; 2 only, lead into the concept of spiritual space – time, with train , tactical space – time talent and the skill of closely related match establish completely; 3 the various sports essential factors in physical space – time only pass through spiritual space – time alternate get change.

Competitive sport space – time relativity principle has extensive actual application value , is theoretical according to it, we can establishment rise to be concerned with table tennis train development space – time model and the static quiet with every fields such as match, make former determine the nature research can fit in the research to ration come. Competitive sport space – time relativity principle is also that people break through spirit and old have habit tie with obstacle have offered strong weapon and theory sustain , therefore it is also the huge power and source that a sport creates and develops continu-

ously.

6 Conclusions

(1) "Speed" is the basic force power to promote the competitive table tennis in different historical periods.

(2) With the development of the sport of table tennis, the former technology (technical system) develops toward to increasing ball speed or decreasing strike time and space.

(3) Compensation and invalid of the principle of time and space of table tennis have revealed the space – time property about technical performance dynamic stereotype.

(4) The relativity time – space principle of competitive sports has promoted the development of table tennis.

57 A feasibility report of playing table tennis with both hands alternately (dragon ping – pong)——green ping – pong for activating the brain and enhancing the constitution

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1 The green "dragon ping – pong" concept is brought forward

1.1 The thinking of modern table tennis sport

Table tennis is a sport combining intelligence, physical ability and craftsmanship. It has wide and deep foundations in mass movement.

In any sport, the main aim is making people healthy and happy. So the more attention must be paid to human beings' health requirement in the development of table tennis sport.

Although table tennis is very popular with people all over the world, it is not perfect. People play table tennis with only one hand for a long time, which would make one hand agile while the other one awkward. Furthermore, it would cause one arm and forearm larger than the other, and the cerebral hemispheres would develop asymmetrically. In single side, the player will have postural scoliosis, and the body will tend to deform. Doctor Yanhu Li of the ChineseTTA often said: "They must do equilibrium exercise repeatedly. Equilibrium means both two sides doing exercise. It's good if they can play with both hands." What he said is concise and comprehensive and sets people thinking.

1.2 Green "dragon ping – pong" emerges with the tide of the times

The traditional Chinese culture "Heaven and Humans Combine as One" and "Balance between yin (negative) and yang (positive)" has a high philo-

sophic theory, which gives sports deep enlightenment.

The breakthrough in human cerebrum science indicates not only intelligence competition, but also the beginning of the right cerebral hemisphere revolution age of developing cerebrum potential energy. It also provides scientific basis for physical training.

The modern table tennis gives consideration to combining brainpower, system ability and craftsmanship. It is a sport that can keep company with a person the whole life.

The three aspects above mean a new method known as green "Dragon ping – pong" (below brief name Dragon ping – pong), which is played with two hands respectively according to the rule.

1.3 The merits of dragon ping – pong

Dragon ping – pong is based on modern table tennis sport. Stress should be put on the awkward hand driving ball. It has 4 virtues:

(1) It can strengthen brain and benefit intelligence: Using this method can exploit cerebrum potential energy, stimulate right cerebral hemisphere, make the two cerebral hemispheres have an equal chance to develop and cultivate the competence highly creative thinking.

(2) Players can exercise comprehensively: Two hands driving ball can make four limbs have benefit and brain and body universally develop.

(3) It can enrich the technique and tactics of table tennis: Using both hands to play ping – pong respectively can enhance the physiological function of the right cerebral hemisphere controlling left limbs and enlarge the way of thinking. It is beneficial to forming various styles. In the presence of interest, it can also enrich the antagonism of tactics and techniques.

(4) It can exploit right cerebral hemisphere potential energy and prevent the vascular disease of the heart and the brain. The majority of people use the right hand to drive ball for a long time. But the left hand has a rare activity. Thus the right cerebral hemisphere receives a rare foreign stimulus, and then the tissue of brain function is diminished. If we use right and left hand to drive ball respectively, it will equalize the two cerebral hemispheres and prevent the vascular diseases of heart and brain.

2 Analysis with discussion of dragon ping – pong feasibility

2.1 The foundation of scientific theory

2.1.1 "Heaven and humans combine as one" and "the balance between Yin (negative) and Yang (positive)"

(1) It is recorded that the theory "Heaven and humans combine as one" was created by our Chinese ancestor Fuxishi 5,000 years ago and was gradually

developed into the world view that humans exist in harmony with nature. The traditional culture admits not only the relation and difference between nature and human beings, but also the unconscious creation of nature (evolution) and the conscious creation of human beings (practice).

While laying stress on humans existing in harmony with nature, "sticking to making people the center" means making people develop completely.

(2) The dialectical thought of "The balance between Yin (negative) and Yang (positive)" is from the theory of "Yin and Yang" initiated by《Yi King》which influenced the chief basic foundation of traditional Chinese medicine.

It is used to analyse the physiological and pathological changes. The process of human life is the course of dynamic equilibrium. In the unequal conditions, diseases will come.

(3) The traditional knowledge of preserving health developed from central China. The essential of this knowledge is "Middle". "Middle" is praised highly by the doctrine of the Confucianism, Buddhism and Taoist. In traditional Chinese medicine "Middle" means recovering the balance between "Yin and Yang" (negative and positive).

2.1.2 Breakthroughs in modern encephalon science

(1) The new concept of health——Health depends on encephalon.

(2) Roper W. Sperry, professor of the U. S. A, discovered that human's right and left cerebral hemispheres control different intelligences. He acquired the 1981 Nobel Prize for medical science and physiology.

Currently, the logic thought function of the left brain has been partly performed by computer. But human "inspiration" and creating thought can not be replaced. The right brain is active in handling volatile sports information, while the left brain seems to be incapable of doing that. For most successful people and excellent athletes, the right brain is more developed.

Brain science foundation also proves that enhancing the left side body exercise can develop the latent energy of the right brain. As the saying goes, "clever heart and skillful hand". Here "heart" refers to the brain in reality.

(3) The famous American Professor of encephalon Jams White discovered that ordinary people in their life only used 10% latent energy of the brain, even much lower.

We must develop and train our brain completely. Mr. Xuesen Qian, the founder of the thinking as a process, recommended "the knowledge of successful wisdom". He set the foundation of creative thought by collecting human beings' terse thinking and culture as well as by integrating with various thoughts.

(4) The brain is a perfect pharmaceutical factory of the human body. The

α – wave of the electroencephalogram, cerebral morphine, and endocrine that it produces are good medicines that can keep fit and cure various diseases.

The method of creating more morphine inside the brain is happiness.

2.2 The development of modern table tennis

In recent years, the ITTA has taken a series of reform measures, which has marked a new epoch in table tennis sports.

Table tennis sports are popularized in China by public opinion. The Chinese team is a flag in the sports field. The cultures of Chinese table tennis inherit and develop the spirits of our traditional culture and meanwhile it keeps the feature of progress with times.

People like table tennis, because it can combine physique with intelligence perfectly. People benefit from playing table tennis the whole life.

We insist on expanding the creative spirit to present the scientific brilliance of modern table tennis.

2.3 The simple, easy and nimble competition rules

In order to promote this activity, through a lot of practice, HenanTTA has established the "Laws of Dragon ping – pong". (See the appendix)

Currently, people play ping – pong much better with the racket hand (the agile hand) than with another one (the awkward hand). Therefore in the rules, the special regulation is the way of limiting the racket hand of both parties' players in each match, that is, they can't change the racket hand as they please.

In the match of wining 3games in 5games, the system of 11 scores shall be used in 1st – 4th games.

In 1st and 4th games both of the players shall use their agile hands. In 2nd and 3rd games both of them shall use their awkward hands. In 5th game the system of 7 scores shall be used. In the beginning both of them shall use their agile hand. Then the racket hands shall be changed for 2 points in turn. Each player shall serve for only one point in turn. A game shall be won by the player first scoring 7 points.

Such a competition not only presents the principle of fair play but also ensures the players use both hands equally (except the final point). Thus the aim is also reached for activating the brain and strong body with both hands playing ping – pong.

Along with the development of Dragon ping – pong, its contest rules also want modifying and perfecting continuously.

2.4 The fulfillment and enlightenment

2.4.1 The review of playing ping – pong with two hands

In the match, some domestic and international players changed the racket hands by accident to drive ball when there was not enough time to use original racket hands.

In the middle of 1980's, there were some boys and girls trained to change the racket hand in China. Its way of thinking was in the aspects of contesting and technique.

Usually, part of the players and fancier changed the racket hand as they pleased when practising playing ping – pong. Among them some played very well with the "awkward" hand.

In spite of different reasons or purposes, they got intentionally or not intentionally to practise playing with both hands, which showed that it was easy to get such practice.

2.4.2 The 1st dragon ping – pong Invitational Tournament of Henan Province.

Under the support of CTTA, in 2004 from August 19th to 22nd, the 1st "Chaoji cup" Dragon ping – pong Invitational Tournament was held in Zhengzhou.

The tournament broke a new path and each player taking part in the match had a fresh feeling. The experts who usually used single hand seemed to have too many problems to tackle playing with the awkward hand.

CTTA said: "holding the match playing with left and right hands alternately is a kind of new trial to make table tennis sport better promotes the human body health with the balanced development". It sent Dr. Liu wei to attend and give advice in person. The Athletics Bureau of Henan, the Table tennis & Tennis Center of Henan and the Zhengzhou Athletics Bureau all gave support in the tournament.

2.4.3 The inquisition and deliberation of playing with left and right hands

Aiming at playing ping – pong with left and right hands, we made a inquisition and paid a special visit to some people.

(1) One can play ping – pong well with one hand before playing with both hands. Having been used to the thought of single hand playing and formed the habit of driving ball with the agile hand, when changing the racket hand, one will feel uncomfortable, which is normal. That shows one is in the state of imbalance, so one needs to establish the new "contrary" harmonious relation between thought and action through practice.

A person who can play with one hand makes much greater progress in playing with another hand than beginners. Good players are experienced so they progress much more rapidly in playing with the "awkward" hand than ordi-

nary people.

In practice, the player can afresh choose the way of holding the racket and the racket of different function, changing technique construction and style.

(2) At present, the number of people playing with left and right hands is small and the playing time is not long, so there has been no data contrast between psychology and physiology.

But as is shown in the inquisition, usually people playing with both hands (much using consciously the awkward hand) all have very good subjective feeling. They feel relaxed and comfortable. Their nervous system has been regulated. The coordination of their body equilibrium has been increased. Even the "stupid hand" can also do something.

(3) According to the investigation, the middle – aged and old people have interest in playing with left and right hands. But the teenagers lack motivation although advice has been given to them. As some amateur ping – pong coaches say: "it is good (playing with the left and right hands), but without support from leaders, we can hardly make it."

(4) Conceiving of putting the Dragon ping – pong into practice

We should carry on more active propaganda in order to be supported and approved by the leadership & society. We can cover and recommend this activity through various mediums. We can also deliver a course of lectures and start training classes to popularize the Dragon ping – pong. It is necessary to compile publicity pamphlets and teaching materials.

We'll try to hold a serious of Dragon ping – pong tournaments successfully, hoping to leave deep impressions on people and make people feel great interest in it, so that Dragon ping – pong tournaments can soon be brought into the normative competitions throughout our country or ever throughout the world.

We'll continue to make an investigation and study of playing with left and right hands. A detailed program will be drawn up. A long – term research will be done on the Dragon ping – pong sport. Some participants as well as non – participants will be classified, surveyed and contrasted with each other for a long time, so that an objective and convincing result can be obtained (e. g. a result with index). The research will be carried out at some athletics colleges, schools or clubs that have fundamental facilities.

We'll invite some famous authoritative experts with the scientific research institutions to constitute a special cooperative subject group.

Under the leadership of the CTTA, we'll study and discuss Dragon ping – pong and related activities together with foreign table tennis associations.

3 Conclusions

As is mentioned above, the dragon ping – pong is not only viable but also

beneficial.

The academician Han QiDe, vice – chairman of the Standing committee of National People's Congress, gives enthusiastic backing to the research of the Dragon ping – pong. He says: "I believe playing with left and right hands will be more beneficial to health."

Zhang Yixiang, vice – chairman of Henan People's Congress, says in his letter: "playing with left and right hands can certainly make up for the shortage caused by playing with a single hand and it will bring a better effect on keeping fit. Many ping – pong fanciers also have this desire." "This is really a ping – pong revolution, The burden is heavy and the road is long. But as long as you are perseverant and work hard, you are to succeed."

The Dragon ping – pong, as a new – born thing, has just started. It wants approbating and promoting by the leadership. It also wants supporting and encouraging by people of insight and noble aspirations.

We believe the Dragon ping – pong will play an active part in promoting the human health and setting up the harmonious society.

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Appendix

Laws of dragon ping – pong contest rule (try – out)

Chapter 1 General Rules

1 – 1 "Dragon ping – pong", a part of table tennis sport, is played with both left and right hands alternately.

1 – 2 The laws are based on "the Laws of Table Tennis" newly made by ITTF.

1 – 3 Equipment approved and authorized by ITTF shall be used in the competitions.

Chapter 2 Special Rules of Dragon ping – pong

2 – 1 In each match, players shall use either hand as racket hand alternately according to the rules.

2 – 2 Before the match, either of players shall choose the racket hand (Either left hand or right hand is OK and any way of carrying the racket is permitted). L stands for the agile hand and F stands for the awkward hand (according to Chinese "Pinyin").

2 – 2 – 1 1st game: L vs L (i. e. Both of the players use their agile hands). (The System of 11 scores shall be used in 1 – 4 games)

2 – 2 – 2 2nd game: F vs F (i. e. Both of the players use their awkward hands).

2 – 2 – 3 3rd game: F vs F (This game is the same as 2nd one).

2 – 2 – 4 4th game: L vs L (This game is the same as 1st one).

2 – 2 – 5 5th game: The System of 7 scores shall be used. The serving order shall be chosen again. Each player shall serve for only 1 point in turn. The racket hands shall be changed for 2 points in turn (first L vs L, then F vs F). A game shall be won by the player first scoring 7 points.

2 – 3 During the match, players are not permitted to change racket hands at will.

2 – 4 If a player doesn't use the specified racket hand in the match, he/she shall lose a point.

2 – 5 Besides the special rules above, other rules of normal table tennis competition shall apply to Dragon ping – pong competitions.

Chapter 3 Umpire

3 – 1 Before each match, the umpire shall first appoint the racket hands of both players, which shall be put on record. At the beginning of the game, the racket hands shall be made certain of again.

3 – 2 During the match, when the racket hands shall be changed according to the rules, the umpire is responsible for reminding both players.

Chapter 4 enacting & revision

4 – 1 The laws shall be released now by HenanTTA, which has the rights of explaining and revising them.

58 Leadership abilities of the table tennis coach

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1 Introduction

Leadership is the ability to inspire and influence the behavior, attitudes, and thinking of others (Bass, 1985, 1990; Bass & Stogdill, 1989; Northouse, 2001). Leadership is a key component to success in many fields (Schmoker, 1996). In today's society, leadership is a complex process and a very important strategic skill. Also, successful, good leaders guide people more effectively towards the achievement of goals (Sessoms & Stevenson, 1981). In order to achieve efficiency, solid leadership was needed. In the sport field, the coach has been playing a role of leader in sport teams. It is a challenge work (Cheng, 1996) to be a success and good coach. There are many roles for a coach in the professional career. A coach is not only responsible on training but also a role model of players. They also need to take care the players' life, such as their feeling, thinking, personal, academic and family problems. The role of a coach is diversity. Therefore, to become a successful coach, it is important to promote coaches' leadership abilities in order to lead players effectively to achieve success in the sport field. It is imperative to promote leadership abilities in table tennis coaches in order to be successful in this field. The present article is hoping to shed some lights on leadership in the table tennis coaches. In the following sections, leadership, significance of leadership abilities, leadership abilities of the table tennis coach and conclusion were presented.

2 Leadership

Edginton, Jodan, Donald & Edginton (1999) note, leadership is the key ingredient in ensuring success in any program or service. Kraus (1985) states, "Leadership is absolutely essential in providing the expertise, enthusiasm, and varied skills needed to make sports programs successful" (p. 4). Bennis and Nanus (1985) also note that the major force behind a successful organization is leadership. Admittedly, leadership is a key feature for a successful sports field.

A review of the literature revealed that there are many different definitions

for the term *leadership*; however, there were key concepts that generally appeared in various definitions. Although definitions of leadership vary, the essential elements of leadership remain the same. The key words most frequently used to define leadership were (a) process, (b) influence, and (c) goal achievement.

One concept frequently used in defining leadership was process. Leadership had been considered a process by many researchers over the years (Bass, 1981; Hersey & Blanchard, 1988a; Northouse, 2001). The process view of leadership has usually been applied in group situations where many people shared roles and responsibilities to achieve their goals (Sessoms & Stevenson, 1981). Bass noted, "leadership is the process of influencing group activities toward the achievement" (p. 9).

Another concept frequently used to define leadership is influence. This view regarded leadership as influencing people that ultimately would lead toward goal achievement (Fleishman, 1973; Hersey & Blanchard, 1988b; Northouse, 2001; Robbins, 1989; Schermerhorn, Hunt, & Osborn, 2000). Robbins remarked "leadership is the ability to influence a group toward the achievement of goals" (p. 302).

A third key concept in leadership is goal achievement (Bass, 1981; Fleishman, 1973; Hersey & Blanchard, 1988a; Northouse, 2001; Robbins, 1989; Sessoms & Stevenson, 1981). This view recognized leadership as a means to produce results in achieving goals. Sessoms and Stevenson stated, "Leadership is the act of moving people toward goal achievement" (p. 5).

In the present article, leadership is defined as techniques used by coaches that would influence a player or team through interaction leading them toward goal achievement (Bass, 1981; Fleishman, 1973; Hersey & Blanchard, 1988a, 1988b; Northouse, 2001; Robbins, 1989; Schermerhorn et al., 2000; Sessoms & Stevenson, 1981).

3 Significance of leadership abilities

Leadership is a complex construct. The leader's role is to lead, direct, and influence members through effective communication in order to achieve a goal. Goals need to be mutually agreed upon with members and leader (Ford & Blanchard, 1993). Ford (1977) suggested that a leader should motivate a group and encourage members into action toward a goal. In sports, coaches need to perform various functions in different places (Russell, 2001). The role of a coach is to lead a team to achieve their team goal. In order to achieve the goal, the coach needs "judging the situation and knowing the ability of their players, using different leadership styles to influence their players to contribute and commit to their team in order to achieve their team goal"

(Pon, 2003, p. 08 – 20). However, a coach is not only responsible for training his/her team but he/she also need to care and inspire his/her players in order to motivate their contribution to their team. Therefore, the role of a coach is diversity, such as planner, teacher, motivator, decision maker, communicator, leader, parent and friend. If a coach wants to achieve those roles effectively, it needs to rely on leadership abilities. Ulrich, Zenger & Smallwood (1999) noted, in a report published by the Harvard Human Resource Institute, that leadership was the most important attribute for leaders. Sessoms and Stevenson (1981) mentioned that "having good leadership and practices are important" (p. 206). Good leadership determined success whereas bad leadership produced failure. In order to achieve efficiency, solid leadership was needed. Also, successful, good leaders guide people more effectively towards the achievement of goals (Sessoms & Stevenson). In the sport filed, leadership abilities influence team cohesion, culture, commitment and athletes' satisfaction (Wu, 2002). Therefore, if a coach can use leadership abilities effectively, it could motivate team cohesion and commitment to their team and pursue higher performance to achieve the goal.

4 Leadership abilities of a coach

To be a success and a good coach in today society is a challenge. A coach has many tremendous responsibilities so he/she needs to have excellent leadership abilities to become an outstanding coach. Those abilities are:

4.1 Technical and professional knowledge and skill

A table tennis coach needs to have professional knowledge and skill in table tennis. It is better for them to arrange training plan and get respect from players. The technical and professional knowledge has two parts: basic and profession. The basic professional knowledge includes sport psychology, sport physiology, sport biomechanics, sport medicine, sport management, sport pedagogy, and sport training. A coach needs to apply basic theories to plan a training program to increase table tennis skills and prevent injure. The professional knowledge includes principle of table tennis skills, table tennis tactics, table tennis doubles, table tennis teaching and training. A table tennis coach needs to have professional and teaching skills. It includes demonstration, explanation, correction, and teaching strategy of table tennis skills. A coach is a role model of players. If a coach can perform well on table tennis, he/she will easy to convince players and they will feel confident to their coach. Moreover, if the coach has table tennis skills, they can give precise judgments and strategies during the competition and practice.

4.2 Planning

The planning ability is a very important ability for a coach. A long term or short term training plan and the goal setting need the coach to plan a process in order to achieve the goal. A coach needs to build up realistic expectation in order to enhance players' self – confidence and increase the development of capabilities. Leith (1990) mentions four ways to set a plan: (a) an integrity goal – an integrity goal is a future expectation of players' performance from a coach. Most of coaches emphasize on victory, team culture or athletes' physical, psychological and social development. (b) a specific goal – Athletes' training performance need to be observable, measurable and achievable. It needs to come along with an integrity goal. (c) execution – The practical way to execute a training plan is depending on the specific goal. (d) evaluation – In order to evaluate the training outcome, a coach needs to consider players' abilities and needs. If the training outcome did not reach the standard, the coach needs to review the training plan in order to improve and achieve the goal.

4.3 Decision making

Making a good decision is base on a coach's professional knowledge and experience. A successful coach needs to make decision actively. Cheng (1996) mentions that most of decision making is related with future oriented and problem solving. Therefore, a coach needs to consider players' needs, goal, and future oriented when they making decision. Cheng further states that a process of problem solving is: (a) what is problem; (b) find out the hinder problem; (c) Collect related information; (d) Analysis data; (e) solving problem; (f) assess outcome.

4.4 Communication skill

Communication is a positive and active way for a coach to interact with players. Giving a channel of communication also is a good way to increase team cohesion. A coach needs to encourage players to speak out what they think and communicate with them. Listening is an important skill in communication. Furthermore, enable to listen what players say and control their emotion when players communicate with the coach. Won (1997) notes those ten ways to increase the opportunity for communication: (a) meeting regularly; (b) having players participate team regulations; (c) participating social party with players; (d) talking with individual or small group; (e) filling out unnamed questionnaire; (f) announcing higher authorities' decision or policy immediately; (g) expressing feeling and thinking; (h) sharing responsibility; (i) making phone book of players; (j) assessing performance of the competition.

4.4.1 Motivating

A coach needs to encourage and motivate the players, feel confidence to their performance, respect players, demonstrate high consideration, understand what they think and reward their performance. Furthermore, a coach enthuses and commits on the table tennis then the spirit will influence and motivate players to follow the footstep of the coach to work hard on training. Build up the good environment on team will promote positive leading to the team. A coach needs to know how to use consideration, motivation and reward to encourage the players to do the best (Won, 1997).

4.4.2 Learning

A success and good coach needs to keep learning in order to get more information on training and leadership skills. Learning will keep coaches to get new acknowledge, new ideas and new challenge to enhance motive power (Chang, 1997). Willing to change is a way to become a success coach. A coach cannot stick on old concepts of training and leadership and not willing to change. They need to try new ways to enhance players' performance and manage team efficiency. In today, society is change rapidly. Therefore, coaches need to absorb multi – information and willing to change in order to lead their team effectively.

5 Conclusion

The leadership not only is a required competency but it also plays a crucial role in team effectiveness. A successful and good coach knows how to use individual influence and leadership abilities to develop athletes' potential to achieve higher performance. Leadership abilities need to be learning and practice. A coach needs to improve his/her leadership abilities in order to promote effectiveness and performance of their team.

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59 Research on the relationship between theories related to table tennis skill learning and its operation contents

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1 Introduction

From the dynamic angle of view, table tennis technique study process is from the skill practice to theories cognition, and again gradually converting theories cognition to the concrete operated steps. Seen from the static state, the practice and theory became a corresponding relationship in some degree. It would usually have a positive influence on skill learning, for the corresponding degree between operation contents and basic theories of study.

2 About the explaining theories on skill learning of table tennis

2.1 Conditioned reflex theory and the operation contents of skill learning

To explain the table tennis skill learning, the conditioned reflex theory is a basic frame for people to recognize and analyze it. The foundations of the conditioned reflex theory are advance motor nerve movement theory in physiology and behaviorism theory in psychology. The conditioned reflex theory emphasized that the process of skill learning is based on feedback, and the elementary learning, confirmation, and improvement have a direct relationship with feedback.

Wu Huanqun (1992) believed that the theory of Publoff could effectively explain the theories of the skill learning development, especially the stage of the primary controlling the skill, which emphasized the importance of the teaching and the demonstration, and was suitable for the training of the action which was unchangeable routine. The principle of Skinner explained the theories of creational combinational action in encounter sport, especially explained the practice of the higher stage, which was after grasping certain skill. Combined the ping – pong sport technique action teaching practices, the function of the two theories in table tennis training and teaching was induced as the followings (Table 1).

Table 1. The relationship between the two conditioned reflex theories and the skill learning contents of table tennis

the skill learning contents of table tennis	Classic conditioned reflex theory	Practice conditioned reflex theory	function
1 giving balls regularly	√		The construction of a singe action
2 many balls training	√		The construction of a singe action
3 all kinds of skill practice in some constrained condition (such as speed and routine)	√		The construction of a singe action
4 all kinds of skill practice irregularly		√	The construction of a singe action
5 match		√	The construction of a singe action

Referred to Wu huanqun (1994)

2.2 The relationship between the perception theory and the practice contents

During the process of table tennis skill learning, technique action should have a particular target. In the elementary learning phase, the main target is the operative feeling. In the proficient learning phase, the target is the operated effect. In the automotive phase, the target of operating feeling and operating effect are unified.

Referred to the basic recognition of the perception theory and the experience of the long training, the practice contents of the skill learning of table tennis could be divided into the followings (Table 2).

Table 2. The relationship between the perception theory and the difference skill learning phase

the difference skill learning phase	The focus of the perception	function
The primary learning phase	action	Learning action, forming the rational conception of action
The middle learning phase	Action + aim	Learning action, gradually forming the tactics of using action
The advanced learning phase	aim	Learning action, using tactics

2.3 The relationship between the inside study theories of skill learning and practice contents

The inside study theories give a good explanation toward basic characteristic of studying ping – pong technique. The inside study is another kind of study model about the skill learning different from beside study. Outside study is similar to the process of solving the question, which process of thinking is conscious all the way, the subjective effort is aware clearly. But inside study is not like this, it takes place unconsciously, which is a kind of automatic, almost unconscious process. In other words, the inside study is the study under the situation, the relationship among stimulates or between stimulate and action is not known. After 1967 the Robber discovers this kind of automatic, consciousness study process, people are very interested with the widespread and strong study methods. In table tennis technique act of teaching, the teacher generally pay attention to the outside study of students, emphasize conscious action such as notice intentionally, memory and participation of logic power. But they give little attention to the participation of unconsciousness. The research of the inside study enunciate that people can absolutely exert the function of Neumann feeling, grasp the key points and rules inside the movement.

In table tennis teaching and training, teachers often paid more attention to the outside learning of students, and paid less attention to the inside learning progress. The study of inside learning believed that people could grasp the action and regulation of the inside meaning of the action.

Table 3. The relationship between the inside theory and practice contents

The skill learning contents	The character of the inside learning	function
The repeat practice of the single action	The stimulation of the single action	Forming the practice concept of the single action
The repeat practice of the combined actions	The stimulation of the combined action	Forming the practice concept of the combined action

2.4 FITTS laws and Hank laws

During the process of table tennis skill learning, the relationship between speed and accuracy, the relationship between the stimulating and reaction are the important factors. As for speed and accuracy relationship problem, the FITTS laws, the principle of the relationship between speed and accuracy, give theory explains about how to handle the accuracy and speed of hitting the table tennis ball that, which is one of the motor learning theories (graph 1). Hank laws is about the relationship between stimulating and reaction, and it can explain the influence of varieties of the table tennis ball's characteristic

on reaction time of the table tennis ball (graph 2).

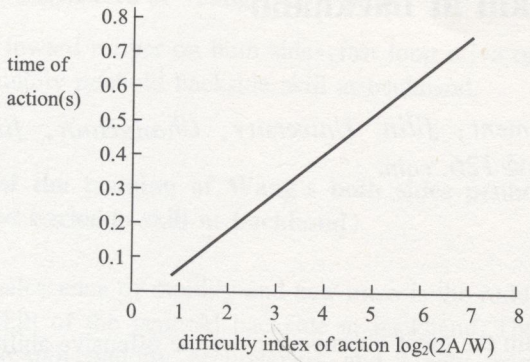

Figure 1. The relationship between the time of action and the difficulty of the action (Zhang Yingbo, according to FITTS, 1954)

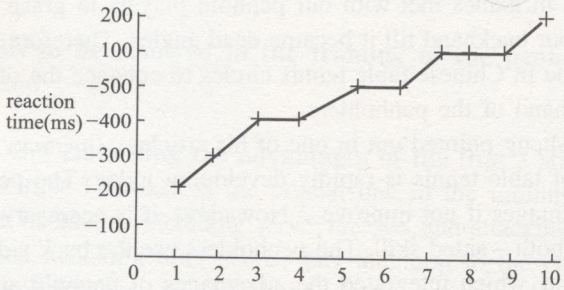

Table 2. The relationship between the reaction time and the varieties of the table tennis ball's characteristic (Zhang Yingbo, according to Woodworth, 1938)

3 Conclusion

In the process of table tennis skill learning, the theories related to sports skill learning and experience in table tennis skill learning are compared, and the content arrangements of table tennis skill learning are understood from a theoretical perspective and made more scientific.

60 Wang Hao's enlighten training of the penhold backside skill at backhand

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1 Introduction

In the 1980s, with the great improvement of the offensive ability of the excellent European open grip players, the limitation of our penholders' backhand exposed obviously, and that led to the situation of European double sides players beating Chinese single side players. It was the common tactics of European players in games met with our penhold players to grasp the offensive incapacity of our backhand till it became dead angles. Therefore, it became an important theme in Chinese table tennis circles to enhance the offensive ability of the backhand of the penholders.

Mr. Xu Yinsheng pointed out in one of his articles; *Creativity makes Vitality*, 'The skill of table tennis is rapidly developing today. The penholders will lose their advantages if not improve.' Nowadays, it is necessary for the players to possess both – sided skill. The penholders use the back side striking the ball at backhand, which integrated the advantages of penhold and open gripping, and makes it possible to attack from both sides and eventually get rid of the passive situation of the backhand offensive incapacity.

Presently, the outstanding achievements of penhold fast attacking athletes, such as Liu Guoliang, Ma Lin, and Wang Hao, in the international important table tennis games fully proved that the penhold backside skill at backhand not only makes the penhold fast attacking players get rid of the backhand offensive incapacity, but also take the advantages of both sides attacking to suppress the opponents, so that it earned the acknowledgement of the table tennis circle and compliments of the society.

The author had assumed the coach of Wang Hao from 1990 to 1996. With thoroughly summing and consideration of the experience of the enlightened training of Wang Hao's penhold backside skill at backhand, the author present it to provide some reference to the improvement of the efficacy of the penhold back side skill training in our country.

2 The type and characters of Wang Hao's skill

Type: penhold, inward rubber on both sides, fast loop drive on both sides.
Characters: mainly penhold backside skill at backhand.

3 The rudder of the training of Wang's both sides penhold loop drive (mainly penhold backside skill at backhand)

Primarily, the coalescence of rapidity and heaviness is the rudder of the training of Wang's skill of the penhold backside at backhand. The characters of his skill style are spin, rapidity, accurateness, and variety, primarily spinning and rapid, basically accurate. The characters reflect the principles of table tennis, which are strong spin, rapid velocity, and numerous variations.

4 The problems to be resolved in the training of the penhold backside skill at backhand

4.1 Retaining and enhancing the advantages of the first 3 strokes

The skill of the first 3 strokes is the crucial one in the training of penhold backside skill at backhand, including serve, receive, and attacking after serve.

(1) Serve and attacking after serve: pay attention to the coalescence of long and short, and forehand and backhand. After serve, not only smash backspin balls, but also able to attack or smash the returned loop ball. Dare to serve long ball, smash after serve, counterloop, or get immediately into counterbalance. It ultimately changes the status of only short, no long serve, and merely attacking backspin balls, unable to couterdrive topspin and loop drive balls. Thus, the attacking after serve was agilely managed to enrich the skill of the first 3 strokes.

(2) Receive in the aspect of the receive, enhance the sense and ability of first attacking, primarily backhand cross flipping, secondarily swinging, long or short balls. It breaks the backhand limitation, only short or pushing balls, no flipping, and only sideways forehand, no backhand loop drives of out court balls.

4.2 Strengthen the execution of the consecutive back side loop drives at backhand and the ability to coalesce the forehand and backhand loop drives

Some key points we should pay attention to in the training.

4.2.1 The extension of action, and the harmony of arm, waist and leg

4.2.2 The swift contraction of the forearm, but two tendencies should be avoided

(1) Too little amplitude of action chiefly depended on the upper and forearm, and neglected the harmony of arm with waist and leg.

(2) Too large amplitude of action, pay attention to the harmony of arm, waist and leg, but neglected the swift contraction of the forearm, therefore, lead to the decentralization of the strength.

4.3 The comprehensive development of the skill of the penhold backside at backhand

The attacking skill of the penhold backside at backhand is the basic skill and chief score method of penhold both – sided loop skill (mainly the skill of the penhold backside at backhand). With the development of the backside skill at backhand, some new skills were created, such as block, flip, loop, forward drive, lob, pick hit, ripping, and so on.

4.4 The sense and ability of the penhold counterloop is the key of the loop skill

With the rapid development of the table tennis, the higher the quality of the European loops, and the less the backspin and no – spin balls, it became the key conflict to deal with the topspin and loop balls. The backside counter loop skill at backhand is the most difficult, and important part of the loop skill. The quality of the counterloop may decide the results of the tournaments, the contention of the first 3 strokes, the alternation of offense and defense in counterbalance. Therefore, the counterloop skill is the necessary skill of contemporary penhold both – sided loop skill (mainly backside skill at backhand). It must be trained from childhoods, breeding the sense and ability in young. The key of it is to counterloop the first rival's loop from the backspin ball. In drive after serve, enhance the sense and ability of counterloop after medium – long and long serve. In receive, enhance the sense and ability of control the rival after receive and the counterloop of the fourth stroke. In counterbalance, enhance the ability of counterloop of forehand and backhand, especially the backhand.

4.5 Enhance the sense and ability of fast alternation of offense and defense

4.5.1 There takes place a crucial conversion of modern table tennis, giving more regards to the counterbalance skill

In the 1960s to 1970s, the Chinese advantages of the first 3 strokes have fainted away now, and with the improvement of the European skill of the first 3

strokes, the skill of counterbalance plays a more and more important role in the rally. The better the capability of counterbalance, the less pressure of using the first 3 strokes, and also lead to a free use of all kinds of skills. Therefore, the counterbalance skill is a key to exert steadily and win the rally.

4.5.2 Pay attention to the use of the skill of the fourth and fifth strokes, it is the key step to be in an active attacking counterbalance

With the increase of the strength and velocity of the modern table tennis, the late conversion of defense and counterattack of medium and far – off court play became less, while became more and more in the early (the fourth stroke) and medium (the fifth stroke). Hence, the proper and flexible coalescence of the skills of the first 3 strokes and that of the later rally not only stabilizes the exertion of the skills of the first 3 strokes, but also guarantees and facilitates the formation of the active counterbalance.

4.5.3 Master the condition of the conversion of the offense and defense is the guarantee of the active counterbalance

There are 3 conditions:

(1) Fast ball. The ball takes so short time moving in the air that the rival has no time preparing for attacking, and then comes the attacking chance.

(2) The returned ball is so crosscourt and artful in the placements that it is beyond the attacking range of the rival, and then comes the attacking chance.

(3) The returned trajectory is so low that the hitting point of the rival is below the net, and so that the attacking chance appears.

(4) Possessing the ability of near court fast attacking, counterdrive, and counterloop of medium and far – off court takes an important role in the enhancement of the strength and execution of the counterbalance, the improvement of the ability of the medium and far – off court counterbalance, and the enlargement of the active attacking space. It should be paid attention to in the training accordingly.

5 The principles of the Wang Hao's training of the penhold backside skill at backhand

5.1 Systemic principle

(1) Training from young, systemically for many years. From 1990 to 1996, the 6 years' time of training of Wang Hao, he had sticked to the systemic training of the skill of the penhold backside at backhand.

(2) Step by step, from easy to difficult. Be strict with the training, which began from the penhold backhand push and bound, then learning the gist of

the penhold backhand skills, such as block, fast flip, fast attacking, loop, fast hit, fast drive, pick hit, and receive, so that established the normal action conceptions, and pay attention to the prevention of the occurrence of the wrong action. along with the advancing of the skills, increase the difficulty of the skill, tactic, and physical training. Meanwhile, broach some new targets, such as the increase of the quantity, the velocity, the strength, the spin, the variation of falling placements, and the coalesce ability with other skills.

5.2 The principle of coalescing the tournament and training

The table tennis tournaments are not only the ultimate accordance of the whole training work, but also the basic form of the examination and manifestation of the training effect. The training is for the tournament, and serves the tournament. Meantime, the tournament is a method of training. It is very important for the improvements of the athletes' skill level to adeptly control the relationship of the training and tournament, and adjust the schedule and intensity of the tournament in accordance with the different training cycle. For instance, 15 minutes' consecutive penhold backhand cross attacking training, we can appropriate 10 minutes for exercise, and 5 minutes for virtual tournament in preparation period, while 5 minutes for exercise, and 10 minutes for virtual tournament in competition period.

5.3 The principle of appropriate exercise load

The appropriate exercise load arrangements are according to the athletes' possibility, the human physical adaptation rules of training, and the need of the enhancement of the athletes' competitive ability. In the process of training, I had arranged the increase of the exercise load step by step and rhythmically, according to the Wang Hao's strategy, the tasks of different period, and his physical condition, meanwhile pay attention to the recovery.

5.4 The principle of consistency and differentiation

The table tennis is an individual sport, but nobody can exercise and grow without a team. It is impossible for single training to improve the special skill. My training arrangement is to divide one training unit into two parts: one is the team time, the other is the individual time. In team time, arrange team work, however, according to the individual condition, arrange different contents, method, and demands. For example, arrange a 20 minutes' exercise of sideways attacking after serve in team time, but a 10 minutes' exercise of sideways and backhand cross sweeping attacking respectively for Wang Hao; or arrange all court forehand attacking in team time, but both – sided attacking for Wang Hao.

5.5 The principle of the coalescence of the general and special skill training

From the angle of the development of the modern table tennis, it is necessary for an athlete to gain excellent scores not only to grasp the general skills of ones strategy, but also to have ones own specialty. Full – scale, mainly means that there must not be any leaks in skill, and be able to deal with any kind of players, and use appropriate skill according to different ball. The demand of the full – scale does not remain unchanged, but keeps changing with the situation. For instance, Chinese penhold fast attacking players grasp not only the defensive skill, but also the skills of the alternation of offense and defense, and can loop topspin balls as well as backspin ones.

The most advanced developed part of the athlete's whole construction of his sport skills is called specialty. The most successful score skill or tactic of one athlete is called one's unique skill. An excellent player should pay attention to the full scale of the skill, as well as the individual specialty and unique skill.

6 The content and method of the chief skill training

6.1 The training of attack VS attack, attack vs chop

6.1.1 The purpose is to grasp and improve the action and skill

(1) The training of penhold backside at backhand fast flip (attack, loop) skill vs attacking.

(2) Loop vs chop in the two basic backhand routes, short court, medium court, or the combination of the short and medium court.

6.1.2 The purpose is to enhance the velocity and the ability to control the falling placements

(1) The exercise of penhold backhand fast flip (attack, loop) vs forehand attack and loop, from orderly to orderless.

(2) The exercise of penhold backhand fast flip (loop, attack) the rival's two points, from orderly to orderless.

6.1.3 The purpose is to improve the pace speed and the physical agility

(1) Left half court penhold backhand backside attack or loop, from orderly to orderless.

(2) Penhold backside at backhand fast flip (attack, loop) + sideways attacking (loop) + right rush.

6.1.4 The purpose is to fast change the ball route, and improve the ability of the variation of the falling placements

(1) Two straights vs two crosscourts,

(2) Changing straight to cross court and changing crosscourt to straight,

(3) The coalescence of the backhand backside and drop shot.

6.1.5 The purpose is to enhance the defensive ability

(1) The exercise of the ability to counter the consecutive attack or loop,

(2) The exercise of countering the consecutive attack or loop and variation of the falling placements.

6.2 The training of serve, attacking after serve, and receive

6.2.1 To grasp and improve the action and quality of serve

(1) The serve exercise of single spin and falling placement.

(2) The serve exercise of all kinds of spin and falling placements.

6.2.2 To adapt the variation of the characters and falling placements of the returned ball, and enhance the ability to attack (loop)

(1) The attacking after serve of the rival's single spin and falling point ball,

(2) The attacking after serve of the rival's, varied spin and falling point balls,

(3) The unique serve and route attacking of the rival's single spin and falling point ball,

(4) The unique serve and route attacking of the rival's varied spin and falling point balls.

6.2.3 To establish individual special skill and train the unique skill of attacking after serve

6.2.4 To adapt to the rival's attacking receives, and enhance the defensive and reactive ability

(1) Receive of the rival's single spin and falling point serve and attacking.

(2) Receive of the rival's varied spin and falling points serve and attacking.

(3) The unique serve and route attacking of the rival's single spin and falling point ball,

(4) The unique serve and route attacking of the rival's varied spin and falling point balls.

6.3 The training of the attacking (loop) and defense

6.3.1 To enhance the coalescence of the push and attack, and the active offensive ability

(1) The exercise of backhand penhold backside attacking or loop in push at the two basic backhand route, or loop the rival's single right, left or middle route.

(2) The exercise of penhold backhand cross sweeping attacking or loop in push at the two basic backhand routes, or loop the rival's varied right, left or middle route.

(3) The coalescence of the backhand cross loop, smash and route variation.

6.3.2 To adapt to the rival's variation of push, and enhance the defensive ability

(1) The training of the adaptation of the rival's fast and slow, spin or dead push and attacking in push.

(2) The training of the adaptation of all kinds of rackets.

7 Notice

(1) To deal well with the relationship between the penhold backhand cross sweeping skill and other skills, and arrange a wise ratio of the training of the penhold backhand cross sweeping to that of other skills.

(2) The well management of the quality and quantity.

(3) The good disposal of the pace and hand.

(4) The appropriate treat of order and orderless.

(5) The proper transaction of single and multiple balls.

61 About the physical quality training of speciality of table tennis

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1 Introduction

The competition of table tennis is more and more intense, so the demands for the physical quality of specialty are higher. This article studies by information the basis of physical quality training of specialty of table tennis and the special degree of training method. It also studies the control for the sport load.

2 To decide what the content of physical quality of table tennis specialty depends on

2.1 According to the features of table tennis players' energetic supersession

A German expert pointed out in a research of energetic supersession of table tennis players: the sports of table tennis are a kind of enduring load in which the strength is relatively low on average. As the increase of continuing time of load, the proportion of fat – supplying energy on which players depend is higher. That the total strength of loading in the sport of table tennis is relatively low is nor because of the short rime of loading, but because constant change of high – intensity load. Japanese expert's research on the characteristics of competing time and space and the body's physiological burden of excellent players shows the physiological burden equal to 71 ~ 68 maximum from the perspective of the rhythm of the heart. And we predict that the physiological burden can be higher against each other, we can see the performance of male players is an oxygen – free supersession of energy of intensive movement which happens in a matter of seconds. This also includes the long – time repetitive movements of endurance involving transient breaks like picking up the balls. A research on some skillful movements and the energy consumed in one round shows that table tennis is mainly a with – oxygen supersession sports of middle intensity. According to the features of energy supersession of table tennis games, lower or middle intensity exercises and short – time high – intensity exercises should be chosen as training content. Moreover, these contents should be displayed in the arrangements of the intensity and quantity

of exercises and the combination of different exercises.

2.2 From the perspective of the features of table tennis games

One research carried out by Beijing institute on physics research reveals that a table tennis player should develop his quality of speed and quickness in the first place. The reason is that during the game, judgment – reaction – start – moves – swing the arm all demand high speed. This in turn requires excellent special quality of speed and quickness. Special exercises on strength help improve the intensity of exciting and restraining of the nerve system which can help develop special quality of speed. Next, develop corresponding special quality of endurance. It has both practical and theoretical reasons. In practice, the game formally last 7 ~ 8 days, and as the end of the game approaches, it grows more intensive, demanding high quality of endurance. In theory, the quality of endurance required in the game of table tennis is a specialized endurance that involves frequent conversion of intensity that is closely related to speed and quickness.

2.3 The characteristics of table tennis's main technical movements

Technical movements mainly include: forehanded technical movements—pull, drive, raise, etc; backhanded technical movements—pull, drive, dash, push, and various methods of moving steps, which fit in the technical movements. To well accomplish these technical movements, one must process considerable specialized speed, sensitivity, strength, and stamina. One must make a point of selecting the specialized training which has similar movements structure and form of muscle's using force so that specialized speed and strength can truly meet with each technical movement's requirements. Muscle's using force begins with a near point of human body's centre of gravity and end with a distant one. Only in this way can the specialized quality exercise develop its full effect and at the same time efficiently force the technical improvements.

3 Methods of table tennis's specialized physical quality training

During the process of applying these methods, the first problem should be solved is that how to make so many complex methods into an ordered, clearly pertinent exercise system which both conforms to principles of table tennis's specialized physical quality training and table tennis's practical case. Under the precondition of defining the three aspects of specialized physical training, former practice methods can be classified according to technical movements' anatomy, physiology and technical movements themselves. Meanwhile, specialized degrees of different contents of the same quality practice method can

be distinguished. When distinguishing specialized training degrees, concepts of specialized basic physical quality and specialized physical quality are applied. Specialized basic physical quality training refers to that it can closely connected with special needs of specialized physical quality and offer direct help to improve training level. While specialized physical quality is a professional quality practice composed by table tennis's technical movements strategic requirements. Specialized physical quality training methods can be divided according to the two different concepts.

4 Control of exercise load

4.1 Exercise load specialization

It means that the load must correspond with requirements of the game which is suitable for the player with regard to his level. Research results and experience of table tennis's specialized physical quality training show us that during the training process, the method of alternating with rest – medium load – transient intensified load can be adopted.

4.2 Exercise intensity

Exercise intensity determines the nature of energy supply. By means of changing exercise intensity, ways of supplying energy would be changed. In table tennis's specialized physical training, heart rates can decide which system of supplying energy would be affected.

4.3 Lasting period

In order to improve ability, players can adopt limit intensity practice method. To improve it, time for practicing can last for ever several hours. That is to say, during the training of table tennis's specialized physical quality, some technical practice methods or whole training classes themselves in fact can be arranged as specialized physical quality in the light of exercise load.

4.4 Time for rest

In table tennis's specialized physical training, usually, the time for rest is decided by heart rates. Heart rate rises to the highest when work ability is the lowest. As a rule, recovery of work ability goes hand in hand with the recovery of heart rate. By changing the time for rest, players can develop specialized physical quality of different tasks.

Influence to training effect producing by different time for rest within 45 seconds (Table 1).

Table 1. Time for rest

Time for rest	Heart rate	Training effect
Shortened	80 ~ 96	mainly develop specialized stamina
Insufficient	88 ~ 96	develop specialized stamina as well as speed
Sufficient	88 ~ 96	mainly develop speed
Prolonged	92 ~ 96	mainly develop speed

5 Conclusions

(1) Defining the content of table tennis's specialized physical quality training involves three aspects of specialized quality, including the characteristics of energy supply, the role or position each quality takes and specialized methods of quality exercise. They work as theoretical guidance for distinguishing and controlling degrees of specialization of training methods.

(2) The purpose of distinguishing degrees of exercise methods' specialization lies in clarifying types of exercise methods and classifying by both the concept of specialized basic physical quality training and specialized physical training so that players can efficiently select in practice.

(3) To control load of exercise methods is to master them scientifically and effectively during training process. Only by correctly controlling exercise load can different specialized physical quality training function well.