

## **A Study on the Technical Analysis and Attack-Defense Performance of Men's Top Four Single Players in 2008 Olympic Games**

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### **Abstract**

The purpose of this study was to examine the three-stage skill, attack-defense performance, zones of scoring points of elite male table tennis players. The study was observed the semi-finalists (Ma Lin, Wang Hau, Wang Li-gin, and Persson, G.) of table tennis men's single in 2008 Beijing Olympic Games. We analyzed all games of the four subjects played using three-stage skill and attack-defense skill analysis table. The results as follows:

1. All subjects were "Pass" in most of three-stage skill evaluative index. The using percentage of rally part was below evaluative index in all players.
2. The main scoring techniques for the top four players were serve-then-attack part (serve point and forehand attack), receive-then-attack part (forehand attack and backhand attack), and rally part (counter-driver and forehand attack) in three-stage skill. Top four players' scoring percentage of three-stage skill was significantly higher than those of their opponents, but no difference in using percentage.
3. There were significant differences in attack-defense performance and zones of scoring points but no difference was found in zones of losing points of four players.
4. The stepwise regression analysis data showed that the scoring percentage of attack-defense in three-stage skill could be effectively to predict the performance.

**Key words: table tennis, skill analysis, scoring techniques, zones of scoring points.**

## **1. Introduction**

### **1.1 Research background**

Professional sports of competitive nature must involve the passion and aggressiveness to win, the breakthrough of one's limitations and the pursuit of enhancement in skills [1], and the development of modern table tennis is an item in sports that places even more emphasis, in the context of skill enhancement, on speed, strength, power, endurance, flexibility, agility and good reflexes [2]. Once equipped with the aforementioned capabilities, these capabilities are mainly reflected in the ample demonstration of techniques and tactics for the purpose of obtaining the best performance in contests. With the incorporation of table tennis as an item of Olympic Games in 1988, countries of the world have been even placing more focus on the

implementation of more scientific analysis to further give aid to methods that enhance the tactical performance of table tennis techniques.

However, amongst all the analytical methods on table tennis techniques, the three-stage skill analysis proposed by Chinese scholars Wu and Li [3] received the widest affirmation with excellent efficacy in its implementation. The content of the analysis is to divide the 24 techniques in a given table tennis match into 3 stages, namely, serve-then-attack part (S.T.A.P), receive-then-attack part (R.T.A.P) and rally part (R.P), the function of which is to record the scoring and using percentages of players in the stages of the match for the evaluation and comparison thereof with established experiential models, in order to provide diagnosis on players' technical and tactical conditions. Due to the fact

that this analytical method has assisted Chinese players in having extraordinary performance in the Olympics and world championships, this method has a pivotal standing in the arena of analysis on table tennis techniques in China. It is with the aforementioned that provides the foundation and motive for the researcher to regard the three-stage skill analysis methodology as the focus in this study.

The three-stage skill analysis methodology, since its debut and development to this day, still remains widely in use, but the analytical model on techniques and tactics are bound to be revised after some major changes to regulations, such as the use of large balls in year 2000, the 11-scores-per-game scheme adopted in 2001, as well as non-blocked service in 2002. For instance, the advantage of S.T.A.P was decreased, the position of R.T.A.P increased, the using percentage of R.P was decreased [4], and rally endurance was the crucial and key factor determining the outcome, victory of the match [5-7]. In particular, the use of falling-zone tactics becomes a vital component winning a match, and the control over the falling zone is more of an important factor when assessing the quality of techniques [8]. Those who are capable of breaking away from the norms and changing the conventional falling zones and routes will ultimately be able to effectively inhibit the changes in opponents' falling zones, hence creating more opportunities to score for themselves [9]. Because of the aforementioned, it is the attempt of this study take the top four players of the singles' table tennis match in 2008 Beijing Olympics as the research subjects, using the three-stage skill analysis as the major research focus to explore the performance of the players' techniques in the three stages, and further exploring the their respective attack-defense performance and main scoring techniques, in collaboration with the analysis of falling-zone tactics and scoring performance. It is the belief of the study that under such a research framework, not only is it able to analyze the technical, tactical performance amongst elite

players and current trends of development; it is also to provide a point of reference for young players in their future training.

## **1.2 The purpose of the research**

**1.2.1** Comparing the differences in the performance of the three-stage skill between the top four players and the opponents they encounter.

**1.2.2** Comparing the differences in attack-defense performance amongst the top four players in the match.

**1.2.3** Comparing the differences in zones of scoring, losing points amongst the top four players in the match.

**1.2.4** Analyzing the impact of attack-defense scoring percentage of three-stage skill in elite male table tennis players.

## **1.3 Definition**

**1.3.1** Serve-then-attack part (S.T.A.P): referring to the serving side serving the ball and serving side hitting the ball again.

**1.3.2** Receive-then-attack part (R.T.A.P): referring to the receiving side hitting the ball the first and second times.

**1.3.3** Rally part (R.P): referring to the serving side hitting the ball after the third time, and receiving side hitting the ball after the third time.

**1.3.4** Scoring percentage = scores won in a part / (scores won in a part + scores lost in a part)  $\times$  100%.

**1.3.5** Using percentage = (scores won in a part + scores lost in a part) / sum of scores won and lost in a game  $\times$  100%.

**1.3.6** Scoring technique: referring to the winning technique in a match for a player, regardless of serving, receiving, rallying, regardless of attacking or defending.

**1.3.7** Attack-defense performance: referring to the scoring victory of the player, divided into attacking and defensive scoring techniques. Attacking techniques are divided into direct serve point, forehand attacks (including drive, smash, flip and fast push), backhand attacks (including drive, smash, flip and fast push) and

counter-drivers (including forehand and backhand counter-driver). In regards to defensive techniques, there

**1.3.8 Zones of scoring points:** referring to the falling zone of the scoring victory of the player in the match, divided into forehand position, center position and backhand position.

**1.3.9 Zones of losing points:** referring to the falling zone for the final missing point of the player in the match,

## 2. Methods

### 2.1 Research subjects

The research subjects were set to the top four table tennis players in 2008 Beijing Olympics (Ma Lin, Wang Hao, Wang Liqin and Persson,G.) and the 12 players they encounter in the individual singles' games (including Wu Shang-eun, Yo Kan, Ko Lai-chark, Cheung Yuk, Tan Rui-wu, Blaszczyk, L., Schlager, W., Karakasevic, A., Samsonov, V., Primorac, Z., Tokic, B., and Kreanga, K.) with a total of 16 players.

### 2.2 Research tools

#### 2.2.1 Personal computer

**2.2.2 Recording tables of table tennis matches:** The three-stage skill analysis table developed by Wu and Li [1] is adopted. The attack-defense skill analysis table developed by Hsu [9] was adopted to record the scoring techniques and zones of scoring points in the respective stage.

### 2.3 Steps of implementation

#### 2.3.1 The acquisition of data

The acquisition of data in this study was conducted by the researcher directly entering the Hichannel for the direct web cast of 2008 Beijing Olympics provided by Hinet, and performing the task of recording on the matches to be analyzed. The web address is as follows: <http://hichannel.hinet.net/2008olympic/film.jsp?dt=6>.

#### 2.3.2 Method of record keeping

First of all, the video was played by Windows Media Player, and the research will immediately hit

are drop shot, long push and block (including lob)

divided into forehand position, center position and backhand position.

**1.3.10 Performance:** the basis is the winning percentage of the player in every game. The winning percentage for each game = scoring points of a game ÷ (scoring points of a game + losing points of a game) × 100%.

“Pause” whenever players of both sides hit the ball, to analyze and recorded the technical term and falling zone in the attack-defense skill analysis table, and every stroke was recorded in detail according to the aforementioned manner. Next, the total hits of every point were used to ascertain to which winning player the point belonged in terms of the technical attribute of the stage, and the result was recorded in the three-stage skill analysis table. If the difficulty of determining the route of the ball was encountered during the analyzing and recording process, then the video was rewound for repeated viewing till appropriate analysis could be conducted. Because the manner of analysis was such that each stroke was analyzed and recorded, the time spent on each point was fairly extensive; thus, each analysis was conducted for one game only in order to avoid possible errors when recording due to tiredness and fatigue.

### 2.4 Data analysis

After the confirmation that the acquired data was without any error, the statistics software SPSS for Windows 12.0 was subsequently employed for the task of statistical analysis. The acquired data was analyzed using the following methods: descriptive analysis, independent *t* test,  $\chi^2$  test and stepwise regression

### 3. Results and discussion

#### 3.1 The analysis of difference on the three-stage skills performance between the top four players and their opponents

##### 3.1.1 The analysis of Top four player three-stage skill evaluative index

It was obtained from Table 1 that all subjects were “Pass” in most of three-stage skill evaluative index. The using percentage of R.P was below evaluative index in all players. In particular, the scoring percentage for S.T.A.P (59.11%/Excellent) and the using percentage (33.06%/Pass) for S.T.A.P demonstrated the most extraordinary performance.

On an individual level, player Ma Lin had 4 indexes out of 6 reaching “pass” and above, amongst which the scoring percentage for S.T.A.P (77.15%/Excellent) and R.T.A.P (62.60%/Excellent) were the highest of all 4 players; regarding the scoring percentage (42.73%/No pass) or using percentage (39.61%/No pass) in R.P were somewhat unsatisfactory. Wang Hao showed better performance in the scoring percentage (60.41%/Excellent), using percentage (33.70%/Pass) in R.T.A.P, as well as the scoring percentage in R.P (42.27%/ No pass), but the other 3 indexes did not reach “Pass” and above. In the case of Wang Li-qin, only the using percentage in S.T.A.P (22.83%) and R.P (42.45%) were at “No pass” level, and the other 4 items demonstrated fair performance, especially the scoring percentage for the skills of 3 stages all reach “Excellent” level. Persson’s performance was the same as Ma Lin, in that only the scoring percentage (40.50%/Fail) and using

percentage (42.33%) for R.P demonstrated unsatisfactory performance, and the other 4 indexes all reached “Pass” level. Such results were identical with those conducted by Li, Zhao, and Zhang [10], and Zhang [4]. According to the findings of Li et al. [10] and Zhang [4] with the implementation of new regulations, extraordinary world-class players compete more fiercely during the first three strokes, in particular, there existed a clear trend of “regression towards mean-value” when it came to using percentage of the three-stages. In comparison with the times before the implementation of the new regulations, the using percentage for R.T.A.P showed a tremendous increase, whereas the using percentage for R.P showed an apparent decrease. According to the findings of Zhang [4], since the change of regulations, the main performance of technical and tactical characteristics for elite players was the decreased advantage of S.T.A.P, the position of R.T.A.P was increased, and the using percentage of R.P showed decrease. Such findings apparently differentiate themselves from the perspective shared by many most scholars after the change to the use of large balls, i.e., the number of rounds will increase. The causes for the aforementioned may be due to the renovation on equipment the creation of new techniques that, once again, make rotation and speed return to their original state, or relating to faster rotation [11].

Table 1 Top four player three-stage skill evaluative index

Three-stage skills	Players	Scoring percentage/ index	Using percentage/ index
S.T.A.P	Ma Lin	77.15% / Excellent	26.28% / Pass
	Wang Hao	57.26% / No pass	23.55% / No pass
	Wang Li-gin	72.58% / Excellent	22.83% / No pass
	Persson, G.	63.15% / Good	26.95% / Pass

	Total	67.49% / Good	25.17% / Pass
R.T.A.P	Ma Lin	62.60% / Excellent	34.11% / Pass
	Wang Hao	60.41% / Excellent	33.70% / Pass
	Wang Li-gin	57.93% / Excellent	34.72% / Pass
	Persson, G.	56.48% / Excellent	30.73% / Pass
	Total	59.11% / Excellent	33.06% / Pass
R.P	Ma Lin	42.73% / No pass	39.61% / No pass
	Wang Hao	47.27% / Good	42.75% / No pass
	Wang Li-gin	55.90% / Excellent	42.45% / No pass
	Persson, G.	40.50% / No pass	42.33% / No pass
	Total	45.88% / Pass	41.77% / No pass

### 3.1.2 The analysis of difference on the three-stage skills performance between the top four players and their opponents.

It could be obtained from Table 2 that the S.T.A.P scoring percentage ( $t=5.50$ ,  $p<.05$ ), R.T.A.P scoring percentage ( $t=4.06$ ,  $p<.05$ ) and R.P scoring percentage ( $t=4.06$ ,  $p<.05$ ) in the three-stage skill scoring percentage for the top four players, as well as their opponents' scoring percentage. It reached significant difference. There was no difference in regards to the 3 variables in using percentage. It could be discovered from the analysis on the average scores amongst the variables that the average scores of the 3 variables in scoring percentage for the top four players were significant higher than those of their opponents, demonstrated that the scoring performance in S.T.A.P, R.T.A.P and R.P were better than their opponents, and their techniques were more comprehensive.

According to the three-stage skill theory proposed by Wu and Li [1], scoring percentage and using percentage were proportionate to performance; that was, the scoring percentage and using percentage in the stages was higher,

then performance was higher accordingly. The possible caused for no difference in using percentage was that most players demonstrated a similar pattern in their use of tactics. In addition, according to the studies of Chu [7] and Zhang [4] shown, players with different competitive capabilities demonstrated their differences primarily in the area of scoring percentage. It could be known from the aforementioned that the technical and tactical foundation for the sport of table tennis lies in outstanding specialties and no visible technical weakness. Under identical technical and tactical usage conditions, the competition amongst players are directly reflected in scoring percentage, in that the probability of victory is greater when the scoring percentage is higher. Therefore, if a coach implements the analysis on the scoring percentage based on three-stage skills when conducting routine trainings, such analysis can be used as an important reference when evaluating the player's improvement on technical and tactical capability.

Table 2 The difference on the three-stage skills performance between the top four players and their opponents

Three-stage skills	Players	N	M	SD	t	Sig.
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S.T.A.P Scoring percentage	Top four	98	67.49	24.19	3.70 *	.000
	Opponents	58	52.36	25.49		
R.T.A.P Scoring percentage	Top four	98	59.11	20.93	5.50 *	.000
	Opponents	58	39.50	22.40		
R.P Scoring percentage	Top four	98	45.88	19.77	4.06 *	.000
	Opponents	58	33.30	16.72		
S.T.A.P Using percentage	Top four	98	25.16	8.63	-.38	.705
	Opponents	58	25.76	10.46		
R.T.A.P Using percentage	Top four	98	33.06	9.20	.40	.684
	Opponents	58	32.46	8.23		
R.P Using percentage	Top four	98	41.77	12.37	-.00	.996
	Opponents	58	41.78	13.03		

\* P < .05

### 3.2 The analysis on the difference in attack-defense performance amongst the top four players in the match.

#### 3.2.1 The analysis on the top four players' performance on scores won of attack-defense techniques

The performance on scores won and scores lost of the four players in their techniques in each stage were shown in Table 3. Also, it could be known from Table 4 that the four players' performance on scores won of attack-defense reach significant difference ( $\chi^2 = 89.90$ ,  $p < .05$ ). From the total, the attack-defense scoring performance of the top four players were mainly on attack scoring, in which forehand attack (29.7%) and counter-driver (26.1%) had the highest scoring percentage. If technical characteristics were evaluated based on personal performance, players with the best performance were: Ma Lin (forehand attack, 31.6%); Wang Hao (backhand attack, 29.4%); Wang Li-qin (forehand attack, 29.6%); and Persson (forehand attack, 30.3%). If the players' performance was analyzed based on individual techniques, it was as follows: serve point (Wang Li-qin, 10.6%), forehand attack (Ma Lin, 31.6%), backhand attack (Wang Hao, 29.4%), counter-driver

(Persson, 29.0%), drop shot (Ma Lin, 17.0%), long push (Wang Li-qin, 4.0%) and block (Persson, 13.7%), showing that the top four players all had their exclusive techniques in terms of skill demonstration. It could be known from a further comparison (Table 3) that the technical characteristic for Ma Lin was forehand attack and drop shot, and forehand attack is mainly demonstrated in higher scoring points in S.T.A.P, whereas drop shot technique was demonstrated in R.T.A.P. It was discovered from above and the findings on Ma Lin by Cui and Qu [12], that characteristics for Ma Lin such as the high serve then attacking percentage, great execution, stronger transitioning skill of forehand topspin loop and the ability of counter-drive far away from the table were similar. With regards to Wang Hao, his technical characteristics were reflected on the backhand attacks in R.T.A.P, demonstrated that he was fairly aggressive when receiving and attacking that fully brings out the technical characteristics of "pen-held grip backside hit". Wang Li-qin's technical characteristics were forehand attack scoring in R.T.A.P, and counter-driver in R.P. The study conducted by Li [13] on Wang Li-qin also showed the same results, in which the using percentage of serving then forehand counter-driver

was lower, whereas the ability of forehand counter-driver after receiving then attack was stronger; the forehand counter-driver in R.P was the most extraordinary part of Wang Liqin's tactical system. The main technical characteristics of Persson were forehand attack and counter-driver scoring, the former being reflected in R.T.A.P, and counter-driver in R.P. This showed that Persson's performance in attack techniques was quite outstanding.

From the above discussion, the main scoring techniques for the top four players were S.T.A.P (serve

point and forehand attack), R.T.A.P (forehand attack and backhand attack), and R.P (counter-drive and forehand attack) in the three-stage skill. Amongst all the table tennis techniques, pen-hold-grip or shake-hands grip players still opt for forehand attack as the main scoring tactic, and this result was consistent with the findings of Otchevac and Drianovski [14], Zhang [4] and Hao et al. [15]. The primary reason for such results is because forehand attack is more powerful and smoother coordination of footsteps.

Table 3 The performance on scores won and scores lost of top four players in three-stage skills

Three-stage skills	Players			
	Ma Lin	Wang Hao	Wang Li-gin	Persson, G.
S-T-A-P scores won ( % )	Forehand attack ( 11.3% )	Serve point ( 7.7% )	Serve point ( 10.6% )	Forehand attack ( 11.7% )
S-T-A-P scores lost ( % )	Counter-driver ( 4.5% )	Block ( 6.5% )	Forehand attack ( 6.5% )	Counter-driver ( 8.3% )
R-T-A-P scores won ( % )	Drop shot ( 12.6% )	Backhand attack ( 14.9% )	Forehand attack ( 8.8% )	Forehand attack ( 13.0% )
R-T-A-P scores lost ( % )	Block ( 16.3% )	Block ( 12.45 )	Block ( 14.4% )	Block ( 9.6% )
R-P scores won ( % )	Counter-driver ( 15.8% )	Forehand attack ( 13.4% )	Counter-driver ( 16.4% )	counter-driver ( 16.0% )
R-P scores lost ( % )	Block ( 29.2% )	Counter-driver ( 19.5% )	Counter-driver ( 22.2% )	Block ( 29.2% )

Table 4 The analysis on the top four players' performance on scores won of attack-defense techniques

Attack and defense techniques		Players				Total ( % )	$\chi^2$	Sig.
		Ma Lin	Wang Hao	Wang Li-gin	Persson, G.			
Attack	Serve point ( % )	9.3%	7.7%	10.6%	9.8%	9.4%	89.90*	.000
	Forehand attack ( % )	31.6%	26.3%	29.6%	30.3%	29.7%		
	Backhand attack ( % )	9.3%	29.4%	13.7%	10.4%	14.7%		
	Counter-drivers ( % )	25.9%	22.7%	25.2%	29.0%	26.1%		
Defense	Drop shot ( % )	17.0%	4.1%	6.6%	5.2%	8.3%		
	Long push ( % )	2.0%	3.6%	4.0%	1.6%	2.7%		
	Block ( % )	4.9%	6.2%	10.2%	13.7%	9.1%		
Total ( % )		100.0%	100.0%	100.0%	100.0%	100.0%		

\*p < .05

**3.2.2 The analysis of the top four players' performance on scores lost of attack-defense techniques.**

It could be known from Table 5 that the performance of scores lost of attack-defense for the top four players reached significant difference ( $\chi^2=51.41, p<.05$ ). Overall, the top four players had the highest percentage of scores lost of attack-defense in block (42.7%) and counter-drive (29.7%). If the analysis on the techniques with the highest percentage of scores lost was conducted according to individual performance, it could be known that the main scores lost technique for all four players was block technique; secondly was counter-driver technique. If a comparison was conducted with Table 3, it could be known that the four players' block and counter-drive were mainly reflected in the percentage of scores lost in R.P, especially Ma Lin's block in R.P, and Persson's counter-drive in R.P, were relatively weaker in comparison with other two players. This demonstrated that those who had a better handle in R.P had a better chance of winning.

In addition, it was known from the analysis on other players' major techniques regarding scores lost that

Wang Liqin's forehand attack scoring was his main scoring technique, but he also had the highest percentage of scores lost amongst the four players, showing that he quite frequently uses forehand attack. Wang Hao also demonstrated the same result, in that his backhand attack was his main scoring technique, but he also had the highest percentage of scores lost amongst the four players, showing his confidence and dependence on backhand attack technique. As such, the current development of table tennis skills all require being more proactive, aggressive, speedy, more in speed, as well require better quality in hitting balls, and in terms of tactics, the requirement is comprehensive tactics in both defense and attack [6, 16] . That is, players must seek every opportunity to launch powerful attack in a match, such that their opponents are unable to mount up counterattack resulting in missing, or they use counter-driver to attack back whenever there is an opportunity in order to seek more chance for scores won. Such a proactive tactic inevitably will place psychological pressure on opponents, but the training requirement on players' muscle strength and endurance will be higher than before.

Table 5 The analysis of the top four players' performance on scores lost of attack-defense techniques

Attack and defense techniques		P l a y e r s				Total ( % )	$\chi^2$	Sig.
		Ma Lin	Wang Hao	Wang Li-gin	Persson, G.			
Attack	Forehand attack ( % )	10.2%	11.2%	18.3%	13.7%	13.3%	51.41*	.000
	Backhand attack ( % )	4.0%	20.1%	9.2%	4.3%	8.5%		
	Counter-driver ( % )	30.7%	27.2%	28.8%	31.0%	29.7%		
Defense	Drop shot ( % )	4.0%	4.7%	4.6%	4.0%	4.3%		
	Long push ( % )	1.1%	1.8%	2.6%	1.0%	1.5%		
	Block ( % )	50.0%	34.9%	36.6%	46.0%	42.7%		
Total ( % )		100.0%	100.0%	100.0%	100.0%	100.0%		

\*p < .05

**3.3 The analysis on the difference zones of scoring**

**and losing points amongst the top four players**



**3.3.1 The analysis on the difference zones of scoring points for the top four players**

It was known from Table 6 that the zones of scoring points for the four players reached significant difference ( $\chi^2 = 23.79, p < .05$ ). Overall, the performance of scoring points for the four players was the best when attacking their opponents' backhand positions. It was known from an analysis on the distribution of zones from individual characteristics that Ma Lin preferred attacking opponent's center position for scoring; Wang Hao was good at attacking opponents' left and right large angles; Wang Li-gin mainly attacked opponents' backhand position; Persson was accustomed to attacking opponents' the center position of backhand position.

Major factors to victory in a table tennis match are speed, rotation, power, zones, and curve, but the players in previous matches placed more emphasis on speed, rotation and power till the 3 major changes to rules resulting in the control of zones as the important factor of evaluating the quality of skills [8]. Also, based on the

Table 6 The analysis on the difference zones of scoring points for the top four players

Zones of scoring points	Players				Total ( % )	$\chi^2$	sig.
	Ma Lin	Wang Hao	Wang Li-gin	Persson, G.			
Forehand position ( % )	22.3%	34.0%	29.2%	23.5%	26.6%	23.79*	.000
Center position ( % )	43.3%	23.7%	29.6%	36.5%	34.1%		
Backhand position ( % )	34.4%	42.3%	41.2%	40.1%	39.3%		
Total ( % )	100.0%	100.0%	100.0%	100.0%	100.0%		

\*p < .05

**3.3.2 The analysis on the difference zones of losing points for the top four players**

Based on Table 7, it was known that the four players' performance on zones of losing points did not reach significant difference ( $\chi^2 = 8.35, p > .05$ ). It could be seen from the Table 7 that the result was due to the fact that the top four players' main zones of losing points all were

results of analysis, only Wang Hao's zones of scoring points were more evenly distributed in left and right positions, fully expanding the range of movement of opponents, increasing the difficulty for opponents' ability to confirm the effective zones and thus making good use of the tactic of zones, the other three players all were good at attacking opponents' backhand position of left half of the table for scoring points. This apparently ran contrary to the viewpoints of Zhang [4] who believed that the change to new regulations should enable players to break the status quo and switch the focus from the left half of the table to the right half in order to confuse opponents' habits and focus. It showed that players, when in a match, are still accustomed to primarily using backhand against backhand, and will not hastily change routes under uncertain situations.

at backhand position, showed that their opponents were also accustomed to using backhand against backhand during contest, and were not willing to attempt changing hitting position without absolute certainty. This also means that the four players were weaker in the handling of backhand position than forehand

position and center position balls. It could also be inferred from the result, regarding the zone tactics used by top players of the world. That it is still as what experts believed; that the game tactics of world

top players were to reduce the opponent's return quality, to keep press on the weakness and to suppress opponent's strong techniques.

Table 7 The analysis on the difference zones of losing points for the top four players

Zones of losing points	P l a y e r s				Total ( % )	$\chi^2$	sig.
	Ma Lin	Wang Hao	Wang Li-gin	Persson, G.			
Forehand position ( % )	37.5%	26.0%	26.8%	33.3%	31.5%	8.35	.214
Center position ( % )	24.4%	30.8%	30.7%	30.0%	29.1%		
Backhand position( % )	38.1%	43.2%	42.5%	36.7%	39.5%		
Total ( % )	100.0%	100.0%	100.0%	100.0%	100.0%		

\*p < .05

### 3.4 The analysis on attack-defense scoring percentage of three-stage skills to the elite male players' performance

Through a stepwise regression conducted in this study, it was known (Table 8) the F value of the overall model was 160.86, reaching a significant standard (p<.05), and the  $R^2_{(adj)} = 0.908$ , showed that the variables could be interpreted holistically to be the 90.8% of the total variance of performance. In addition, it was known from the analysis results that the 6 independent variables in this study could be effectively to predict players' performance, and they showed positively significant influence; according to the degree of influence: R.P attack scoring percentage ( $\beta=0.607$ ), R.T.A.P attack scoring percentage ( $\beta=0.519$ ), R.T.A.P defense scoring percentage ( $\beta=0.464$ ), S.T.A.P attack scoring percentage ( $\beta=0.455$ ), R.P defense scoring percentage ( $\beta=0.244$ ), and S.T.A.P defense scoring percentage ( $\beta=0.176$ ).

It could be known from the aforementioned that the scoring percentage of attack-defense in three-stage skill could be effectively to predict the performance, and when the attack-defense scoring percentage was higher, the player's performance was better. It is revealed from the study that R.P attack scoring percentage had the most significant influence on performance; secondly was the R.T.A.P attack scoring percentage; thirdly was the R.T.A.P defense scoring percentage. Hence, it was known that the change to the 3 regulations indeed causes significant change to the tactical characteristics of excellent players, in that the advantage of S.T.A.P previously now is decreased, and the scoring position of R.T.A.P and R.P is increased. Therefore, players should be made more conscious to strength receive-then-attack skills, and especially as they enter rally situation, the key factor to victory is to effective use tactical change to create scoring opportunities for themselves.

Table 8 The analysis on attack-defense scoring percentage of three-stage skills to the elite male players' performance

Variables	R <sup>2</sup>	F	B	Beta	t	VIF
(Constant)			5.707		3.277 *	
R.P attack scoring percentage	.312	44.90 *	.361	.607	17.484 *	1.273

S.T.A.P attack scoring percentage	.554	61.26 *	.234	.455	14.231 *	1.082
R.T.A.P defense scoring percentage	.628	55.48 *	.328	.464	12.544 *	1.443
R.T.A.P attack scoring percentage	.834	122.86 *	.296	.519	14.522 *	1.350
R.P defense scoring percentage	.879	142.58 *	.339	.244	7.058 *	1.263
S.T.A.P defense scoring percentage	.908	160.86 *	.175	.176	5.454 *	1.099

\*p < .05

#### 4. Conclusions and suggestions

##### 4.1 Conclusions

**4.1.1** From without significant difference in the 3 indicators of three-stage skills such as using percentage, it was known that the overall used of techniques and tactics amongst the elite male table tennis players of the world were generally identical, and the competition amongst players are directly reflected in scoring percentage, namely, players who were equipped with all the scoring capabilities of the three-stage skills would have better chance of victory.

**4.1.2** The main scoring techniques for the top four players were S.T.A.P (serve point and forehand attack), R.T.A.P (forehand attack and backhand attack), and R.P (counter-driver and forehand attack) in three-stage skill.

**4.1.3** Since the four players' performance on attack-defense scores won and lost all reached significant difference, each player had his own unique techniques to victory regarding the demonstration of their skills, and in the same manner, they also had corresponding technical shortcomings. Especially, whoever could reduce the errors in R.P in future matches could have a higher chance of victory.

**4.1.4** Currently, top players of the world are still accustomed to using backhand position against backhand position, and will not opt for changing zones when they are not certain. This showed that the game tactics of world top players were to reduce the opponent's return quality, to keep press on the weakness and to suppress opponent's strong techniques.

**4.1.5** The stepwise regression analysis data showed that

the scoring percentage of attack-defense in three-stage skill could be effectively to predict the performance, and when players' scoring percentage was higher, their performance was better. In addition, "R.P attack scoring percentage" had the greatest influence on performance, demonstrating that the implementation of the new system for matches present a significant change in elite players' technical and tactical characteristics, in that the advantage of S.T.A.P was decreased, and the position of R.T.A.P and R.P was increased.

##### 4.2 Suggestions

**4.2.1** In addition to solid basic techniques as the foundation, when trainers train young players, they need to strengthen players to be more aggressive, more proactive, faster attack-defense switching, as well as to improve on technical and tactical combination when strengthening players' tactical training. When the mutual contention amongst them is stronger, then these players are required to be equipped with three-stage scoring capability such that they can contend with world-class players.

**4.2.2** It is beyond doubt that each player should hold his unique technique style; such is not to be ignored. Therefore, it is desirable to establish own styles in the skill-learning stage, and promote at least one or two scoring techniques according to one's own style, or strengthen weak techniques.

**4.2.3** Players should be strengthened with the concept of falling zone tactics during routine training; meanwhile strengthening backhand position attack-defense

capability; especially the proportion dedicated to training time should significantly be increased.

4.2.4 During routine training, in addition to strengthening the ability of R.T.A.P, a key factor to

victory is the effective use of tactical changes when entering R.P should also be emphasized in order to creative scoring opportunities.

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