

3S Theory for Case Analysis: Tactical Characteristics of Two Talented Young Table Tennis Players

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Abstract

Purpose: This study analyzed the tactical characteristics of two talented young table tennis (TT) players. **Method:** The two TT players analyzed here are Tomokazu Harimoto (14 years old, Japan) and Yun-Ju Lin (16 years old, Taiwan). The scope of the study was to analyze Harimoto's and Lin's tactical characteristics using the 3S (speed, spin and spot) theory. The data was collected from the singles matches which Harimoto and Lin played against Hugo Calderano respectively in 2017 Czech Open and was included from serve to the fifth stroke in the matches. **Results:** In serving, both players served forehand, slow speed, side back spin, and near net. In receiving, Harimoto's return characteristics were backhand twist (33%), medium speed (48%), top spin (57%), and backhand position (33%). Lin's returns were backhand twist (67%), medium speed (48%), top spin (73%), and middle position (45%). In third stroke, Harimoto's return characteristics were drop shot (18%), strong speed (41%), top spin (67%), three main landing spots evenly distribution. Lin's results were backhand twist (37%), medium speed (50%), top spin (80%), and middle position (37%). In fourth stroke, Harimoto's characteristics were fast block (23%), medium speed (65%), top spin (68%), backhand & middle position (32%). Lin's results were block (27%), strong speed (41%), top spin (70%), and backhand position (30%). In fifth stroke, both Harimoto and Lin used drive and block most frequently, but in terms of the speed, Harimoto paired strong speed (42%) with medium speed (38%), while Lin medium speed (54%) paired with strong speed (31%). For the landing spots, Harimoto's spots were distributed among the three areas, while Lin's were mostly at the backhand position (21%).

Keywords: Table tennis, 3S Theory, Talent athletes, Technique and tactics.

1. Introduction

1.1 Research background

The sport of table tennis is characterized by five major technical characteristics, including speed, aggressiveness, accuracy, variation and spin (Chou, & Luo, 2008). Using scientific analysis methods to enhance tactical performance in table tennis has been emphasized and practiced since table tennis has been included as one of the Olympics events in 1988 (Hsu, 2010). It should be noticed that the development of tactical characteristics in table tennis is extremely relevant with the major changes in game rules; as those who could reflect and alter timely and accurately with the changes, whom will be the ones with advantages. The important rule changes since 2000 are summed up by the researchers as followed: (1) the change of ball size into 40mm large ball in 2000, which reduces the speed and spin in stroking but increases the returns in games (Zhang, & Wu, 2000) ; (2) the change of game into 11-scores-per-game in 2001, which reduces the ability and skill differences between players, thus the tendency of fierce tactical choices (Chen, 2004) and requirements for players to engage their optimal performance in shorter time spent (Xu, Liu, & Zhou, 2006) , and the increase of game-point situations (Hsu, 2016); (3) the implementation of no-block service in 2002 leads to the enhancement of receiving skills (Lin, & Cao, 2003); (4) the implementation of the New plastic ball in 2014 results in slower speed, higher loops, weaker spins and emphasizes the first three strokes (Wu, Yang &., Gao, 2016) . The relationships between these changes and the results (such as: the relationships between different tactical choices and the number of returns in games) interest the researchers the most and are believed should be clarified.

Tactical analysis in table tennis needs innovation to reach new highs. For example, the commonly used Three-stage Skill analysis has evolved to Four-stage Skill analysis (Yang, & Zhang, 2014). However, most of the commonly used analysis are result-oriented and are not ideal for examination of the complexity in different strokes. In 2011, Dr. Wu, Sheng-Kuang from Taiwan first applied the “3S Theory” (speed, spin and spot) in the classification system for functional tests and capacity analysis for players in International Table Tennis Federation Para Table Tennis (ITTF-PTT), which received broad recognitions. Dr. Wu indicates that 3S Theory could help us understand the characteristics of different strokes with a more objective and systemic way, which would further help to develop main strategies in competitive table tennis (Wu et al, 2011; Perez & Lucarevic, 2017)¹¹. In short, it is believed that the more

thoroughly the examining of the cause-effect relationships in games in tactical analysis is, the more valuable and relevant the analysis results; which is why the researchers choose to use the 3S theory in this study.

Today, there are numerous talented young table tennis players, each with unique tactical characteristics around the world. For example, the 'Japanese Monster' Tomokazu Harimoto is a potential medalist from Team Japan in the upcoming 2020 Olympics. Lin Yum-Ju, the young player who recently medaled in the 2018 Hungarian Open U-21 Men's singles and known as the successor of Chiang Peng-Lung and Chuang Chih-Yuan, is also well recognized internationally with high expectations. Harimoto and Lin are widely considered noteworthy due to their progressing performance and ranking. This study applies 3S theory in analyzing Harimoto and Lin's performance in respect of technique, speed, spin and landing spot from serving to the fifth stroke in their matches with Hugo Calderano in the 2017 Czech Open. The researchers hope by inducting two players' tactical characteristics with 3S theory, young table tennis players could be inspired and adapt the results into their own training, and also shed light for other tactical analysts in the future.

1.2 The purpose of the research

1.2.1 Analyzing two players' average number of strokes

1.2.2 Analyzing two players' tactical characteristics from serving to the fifth stroke

1.3 Definition

1.3.1 3S theory: Dr. Wu, Sheng-Kuang proposed 3S theory in 2011 ITTF PTT grading system. The 3S are: speed, spin and spot. In this research, we mark the stroking speed into 3 catalogs: slow speed, medium speed and strong speed. For spins, we mark 5 catalogs: top spin, back spin, no spin, side top spin, and side back spin. For landing spot, we group them into 2 models: (1) Model one for serving, including forehand position 3 spots [short ball(F-1), half long ball(F-2), and long ball(F-3)], middle position 3 spots [short ball(M-1), half long ball(M-2), and long ball(M-3)] and backhand position 3 spots [short ball(B-1), half long ball(B-2), and long ball(B-3)], in total 9 different landing spots; (2) Model two for second stroke to fifth stroke, including forehand position, middle position and backhand position 3 major spots and 2 receiving errors (touch net and out-side) in total 5 different situations.

1.3.2 Stroke: Only indicates forehand and backhand stroke these two methods.

1.3.3 Technique: Indicates the tactical skills from the second stroke on. Including: drive, counter drive, backhand twist, smash, flip, fast block, block, long push, drop shot, and lob.

1.3.4 Game- Point Situation: indicates the situation when the score of the game is at 9:9.

2. Methods

2.1 Research subjects

This study focuses on the performance of the talented young Japanese player Tomokazu Harimoto (WR:18/2017 August) and 16 years old Taiwanese player Yun-Ju Lin (WR:210/2017 August). With the focus of research area that includes 14 games, which are Harimoto's (semi-final, 7 games) and Lin's (quarter-final, 7 games) matches against 21 years old Brazilian Hugo Calderano in 2017 Czech Open.

2.2 Research tools

2.2.1 A set of Personal Computer (PC): for watching the games and documenting the needed data.

2.2.2 Recording form of 3S theory: the researchers design a recording form according to the 3S theory to recording the player's tactical characteristics of each stroke in game.

2.3 Steps of implementation

2.3.1 The acquisition of data

This study acquires data from the public videos of Harimoto's and Lin's full encounters against Calderano in 2017 Czech Open on YouTube.

2.3.2 Method of record keeping

The researchers document every stroke the research subjects (Harimoto and Lin) made in 2017 Czech Open with the focused tactical characteristics (speed, spin and landing spot) on the recording form. When the characteristic is not clear enough for the researchers to distinguish the tactical situations, the videos would be rewound and replayed until it's clear enough for researchers to determine the tactical characteristics in the strokes.

2.4 Data analysis

After all the data in the recording form was organized and confirmed, the data were counted by descriptive statistics of frequency distribution and percentage analysis. The processed data were then analyzed using 3S theory for the tactical characteristics from serving to the fifth stroke.

3. Results and discussion

3.1 Analysis of the number of stokes for Harimoto and Lin

As shown in table 1, Harimoto defeated Calderano in the semi-final with a 4:3 win.

Game-point situation occurred in game 2, 5, 6 and 7, which reached 57.14% game-point situation rate in the match. Harimoto got 75% winning rate in game-point situation. Harimoto's average number of winning strokes was between 3.5 to 5.25, with the highest number of strokes in game 3 and game 7, and the lowest number of strokes in game 1. The average number of losing strokes was between 3 to 5.45, with the highest number of strokes in game 6, and the lowest number of strokes in game 4. In each game, the number of strokes that occurred most frequently was 3 strokes; which happened in game 1, game 3, game 4 and game 7. The second frequency of the number of strokes was 2 strokes; which happened in game 2, game 3 and game 5. The last one was 4 strokes in game 5 and game 6.

As shown in table 2, Lin was defeated by Calderano in quarter-final with 3:4 lose. Game-point situation occurred in game 2, 4, 6 and 7, which reached 57.14% game-point situation rate in the match, but the winning rate was only counted 25%. Lin's average number of winning strokes was between 3.71 to 6.27, with the highest number of strokes in game 7, and the lowest number of strokes in game 2. His average number of losing strokes was between 3.3 to 6.31, with the highest number of strokes in game 7, and the lowest number of strokes in game 2. In each game, the number of strokes that occurred most frequently was 4 strokes; which happened in game 3, game 4, game 5 and game 7. The second frequency of the number of strokes was 3 strokes; which happened in game 1 and game 2. The last one was 5 strokes in game 6 and 6 strokes in game 3.

Both Harimoto and Lin had a close match against Calderano. Both matches were won in the deciding game. We argue that players' performances in game-point situations are critical for winning the match. Both Harimoto and Lin's match against Calderano reached 57.14% game-point situation rate. Harimoto had 75% winning rate, however, Lin only had 25%. This result showed a much higher game-point situation rate than Hsu, Lin, and Wu's (2015) study on all the table tennis matches in 2012 London Olympics Men's singles; which they calculated 40% game-point situation rate when the matches were at 4:3. This result reflects how the change of rules affects the game and increases the frequency of game-point situation; which also reflects the importance of how players deal with the game-point situation is crucial for winning the match when they have similar tactical level. Also, we can say that Harimoto and Lin both adapt the "fast attack combine with looping" style from their number of average strokes in games, with the emphasis on: standing close to the table, and attacking aggressively and viciously. Harimoto's plays more powerful especially, with only 3 strokes as the most frequently occurred number of strokes (Lin had 4 strokes). This result

resonates Xu's (2018) study, which concluded that in the New plastic ball era most of the top players play 3 strokes (19.2%) in each game, and secondly 4 strokes (18.9%). Also, just like Xu's concluded, the first 4 strokes are crucial for winning in the first few games, because players were still unfamiliar with each other; however, after the first 4 games, the number of returns increases, thus shift towards the importance of players' rally abilities.

Table 1.

Results of Harimoto against Calderano (semi-final)

| Games | Game 1 | Game 2 | Game 3 | Game 4 | Game 5 | Game 6 | Game 7 |
|------------------------------|--------|--------|---------|--------|-----------|--------|--------|
| Game points | 06:11 | 11:09* | 04:11 | 11:04 | 11:09* | 09:11* | 16:14* |
| Win/Lose | Lose | Win | Lose | Win | Win | Lose | Win |
| Average winning stroke | 3.5 | 3.91 | 5.25 | 3.55 | 4.18 | 4.11 | 5.25 |
| Average losing stroke | 3.36 | 3.78 | 3.82 | 3 | 5.44 | 5.45 | 5.29 |
| Average stroke | 3.41 | 3.85 | 4.54 | 3.28 | 4.75 | 4.85 | 5.27 |
| Most frequent/stroke (times) | 3/(6) | 2/(6) | 2&3/(4) | 3/(5) | 2 & 4/(5) | 4/(6) | 3/(8) |

P.S. *: the win was decided in the game-point situation

Table 2.

Results of Lin against Calderano (quarter-final)

| Games | Game1 | Game2 | Game3 | Game4 | Game5 | Game6 | Game7 |
|------------------------------|-------|--------|--------------|--------|-------|--------|--------|
| Score | 11:03 | 12:10* | 07:11 | 12:14* | 11:08 | 09:11* | 11:13* |
| Win/Lose | Win | Win | Lose | Lose | Win | Lose | Lose |
| Average winning stroke | 4.4 | 5.55 | 3.71 | 5 | 4.64 | 4 | 6.27 |
| Average losing stroke | 3.5 | 3.33 | 4.36 | 5.07 | 4.88 | 4.64 | 6.31 |
| Average stroke | 3.95 | 4.44 | 4.04 | 5.04 | 4.76 | 4.32 | 6.29 |
| Most frequent/stroke (times) | 3/(5) | 3/(8) | 3, 4 & 6/(4) | 4/(7) | 4/(7) | 5/(6) | 4/(7) |

P.S. *: the win was decided in the game-point situation

3.2 Tactical characteristics analysis in the first stroke (serving)

As shown in table 3, both players served only with forehand. Harimoto served 68 balls in total, and Lin served 67 balls in total. In respect of speed, Harimoto served mainly in slow speed (48.53%), with medium speed (30.88%) in second. Lin, on the other hand, served in both slow (47.76%) and medium speed (46.27%) almost as much. In respect of spins, two players both served mainly in side back spin and side top spin in second. Harimoto served 51.47% side back spin and 25% side top spin. Lin served 67.16% side back spin and 19.40% side top spin. In respect of the landing spots, Harimoto's landing spots were mainly in forehand short ball (36.76%), middle long ball (11.76%) and backhand long ball (11.76%). Lin's servings were mainly short ball in middle position (46.27%) and long ball middle position (20.90%).

In short, both Hiramoto and Lin chose similar serving strategies in this phase. In respect of serving, they both chose forehand serving with slow speed and medium speed; as for spins, they both chose a mix of side back spin and side top spin. Studies have shown that most of players tend to serve with back spin short ball due to controlling reason, which could help create better attacking opportunities for themselves and depress opponents' attacking

opportunities (Tang, 2010). We also found out that Harimoto was more adventurous regarding to serving with different directions and length, which resulted to diverse landing spots in his play. On the other hand, Lin served mainly in middle position with long and short balls differences, which seemed more conservative. We thus assume that Harimoto plays a bold and aggressive style, and Lin plays a conservative and steady style.

Table 3.

Harimoto & Lin's serving performance

| Serving | Forehand (%) | | | Backhand (%) | | | | | | |
|----------|--------------|--------------|--------------|--------------|--------------|-------------|---------------|-------------|----------------|--|
| Harimoto | 68(100%) | | | 0(0%) | | | | | | |
| Lin | 67(100%) | | | 0(0%) | | | | | | |
| Speed | Slow speed | | Medium speed | | Strong speed | | | | | |
| Harimoto | 33(48.53%) | | 21(30.88%) | | 14(20.59%) | | | | | |
| Lin | 32(47.76%) | | 31(46.27%) | | 4(5.97%) | | | | | |
| Spin | Top spin | | Back spin | | No spin | | Side top spin | | Side back spin | |
| Harimoto | 1(1.47%) | | 13(19.12%) | | 2(2.94%) | | 17(25%) | | 35(51.47%) | |
| Lin | 0(0%) | | 8(11.94%) | | 1(1.49%) | | 13(19.40%) | | 45(67.16%) | |
| Spot | F-1 | M-1 | B-1 | F-2 | M-2 | B-2 | F-3 | M-3 | B-3 | |
| Harimoto | 25 36.76% | 5 7.35% | 4 5.88% | 5 7.35% | 5 7.35% | 7 10.29% | 1 1.47% | 8 11.76% | 8 11.76% | |
| Lin | 7 10.45% | 31 46.27% | 2 2.99% | 6 8.96% | 14 20.90% | 1 1.49% | 1 1.49% | 4 5.97% | 1 1.49% | |

3.3 Tactical characteristics analysis in the second stroke (receiving)

As shown in table 4, Harimoto received in backhand with 72.46% rate and forehand with 27.54% rate; Lin received in backhand with 87.67% rate and forehand with 12.33% rate. In respect of the techniques used in the matches, Harimoto used 6 different techniques in the match, the top three ones were backhand twist (33.33%), long push (26.09%), and drop shot (20.29%); Lin used 4 different techniques, top three ones were backhand twist (67.12%),

drop shot (21.92%), and long push (6.85%). In respect of speed, Harimoto's choices were: medium speed (47.83%), strong speed (33.33%), and slow speed (18.84%); Lin's choices were: medium speed (47.95%), strong speed (31.51%), and slow speed (20.55%). In respect of spins, Harimoto used different types of spins in the following order: top spin (56.52%), back spin (40.58%), and without spin (2.90%); Lin used them in the following order: top spin (72.60%), back spin (24.66%), and without spin (2.74%). In respect of landing spots, Harimoto's performances were: backhand position (33.34%), forehand position (26.09%), middle position (21.75%), out-side (13.04%), and touch net (5.80%); Lin's performances were: middle position (45.21%), forehand position (24.66%), backhand position (19.18%), out-side (5.48%), and touch net (5.48%).

It is clear that Harimoto and Lin both relied heavily on backhand skills. Especially for Lin, who was calculated with 87% rate in receiving with backhand. This might be caused by the trend which high ranking players often choose to receive with backhand twist in full table. Both players mainly chose to receive with backhand twist and long push or drop shot. However, Harimoto had more diverse choices that included 6 different techniques, and Lin with only 4 of them. Lin's choices are especially focused with backhand twist and drop shot, which calculated 90% usage rate. We can thus assume that backhand twist is one of the most important techniques in Lin's receiving choices. Both players mostly chose to receive with medium and strong speed. Harimoto chose to do top spin and back spin with a fair frequency; but Lin chose to do top spin (more than 72%), which was much more often than back spin. In respect of landing spots, Harimoto mainly chose opponent's backhand position as his break through point; Lin mainly chose to break through with the middle position. It is also worth noticed that Harimoto's direct error rate in receiving reached almost 20%; Lin's direct error rate was around 11%. With these results we would argue that Harimoto's strategy in receiving was fierce with attacking, and Lin's strategy was leaning toward steady with attacking.

Table 4.

Harimoto & Lin's second stroke performance

| FH & BH | Forehand Strike (%) | | Backhand Strike (%) | | | |
|-----------|---------------------|----------------|---------------------|------------|------------|------------|
| Harimoto | 19(27.54%) | | 50(72.46%) | | | |
| Lin | 9(12.33%) | | 64(87.67%) | | | |
| Technique | Drive | Backhand twist | Flip | Fast block | Long push | Drop shot |
| Harimoto | 7(10.14%) | 23(33.33%) | 5(7.25%) | 2(2.90%) | 18(26.09%) | 14(20.29%) |

| | | | | | | |
|----------|------------|------------|------------|-----------|--------------|------------|
| Lin | 3(4.11%) | 49(67.12%) | 0 | 0 | 5(6.85%) | 16(21.92%) |
| Speed | Slow | | Medium | | Strong | |
| Harimoto | 13(18.84%) | | 33(47.83%) | | 23(33.33%) | |
| Lin | 15(20.55%) | | 35(47.95%) | | 23(31.51%) | |
| Spin | Top spin | | Back spin | | Without spin | |
| Harimoto | 39(56.52%) | | 28(40.58%) | | 2(2.90%) | |
| Lin | 53(72.60%) | | 18(24.66%) | | 2(2.74%) | |
| Spot | FH-P | Middle | BH-P | Touch net | Out side | |
| Harimoto | 18(26.09%) | 15(21.75%) | 23(33.34%) | 4(5.80%) | 9(13.04%) | |
| Lin | 18(24.66%) | 33(45.21%) | 14(19.18%) | 4(5.48%) | 4(5.48%) | |

P.S.: FH-P: Forehand Position, BH-P: Backhand Position

3.4 Tactical characteristics analysis in the third stroke

It is widely recognized that top players around the world today tend to choose to adapt strategies with strong speed, strong spins, and unpredictable landing spots. In this study we also examined the error rate of no-touched ball to understand the quality of players' performance in the competition. As shown in table 5, Harimoto's backhand hitting reached 49.06% rate, forehand hitting rate reached 47.17%, and the no-touched error reached 3.77%. Lin's backhand hitting rate reached 54.10%, forehand hitting rate reached 44.26%, and the no-touched error reached 1.64%. In respect of techniques, Harimoto used in total of 8 different ones, the top three most used ones were drop shot (17.66%), Fast block (15.69%), and counter drive (13.73%). Lin also used 8 different techniques, the top three of them were: backhand twist (36.67%), counter drive (25%), and drop shot (13.33%). In respect of speed, Harimoto's choices were: strong speed (41.18%), medium speed (31.37%), and slow speed (27.45). Lin's choices were: medium speed (50%), strong speed (35%), and slow speed (15%). In respect of spins, Harimoto's choices were: top spin (66.67%), back spin (23.53%), and without spin (9.80%). Lin's choice were: top spin (80%), back spin (16.67%), and without spin (3.33%). In respect of landing spots, Harimoto's performances were: forehand position (29.41%), backhand position (25.49%), middle position (23.53%), out-side (11.76%), and touch net (9.80%). Lin's performances were: middle position (36.67%), backhand position (25%), forehand position (20%), out-side (13.33%), and touch net (5%).

In short, Harimoto and Lin both chose to use forehand and backhand with a more equal frequency in the third stroke. However, it seemed like they relied on backhand choices more; with which we would assume that backhand skills are still the main focus in the second stroke and the third stroke for shake-hand grip players. Also, both players' performances in no-touch error in the third stroke were not high, which we would assume that their choices of spins and landing spots in serving could effectively depress their opponent from attacking. In

respect of techniques, both Harimoto and Lin chose 8 different techniques in the third stroke. However, Harimoto's usage rate in them were in the range of 7.84% to 15.69%, which implied the diversity of his play. On the other hand, Lin's choices in backhand twist, counter drive, and drop shot were summed up to 75% in total. Lin especially focused on backhand twist, which is also recognized as his signature characteristic. In short, we argue that Harimoto and Lin chose different approaches in the third stroke. In respect of speed, Harimoto chose to play strong speed with medium speed; Lin chose to play medium speed with strong speed. In respect of spins, both players chose mainly in top spin; Lin's choices in top spin specially reached 80%. In respect of landing spots, both players chose to break through from opponent's backhand and middle position. It is worth noticed that Harimoto's direct error rate in the third stroke was higher than 20%, with Lin who also reached 18.33%; which were higher than the error rate in their receiving stroke. With this result we would argue that the opponent's receiving still created pressure for both Harimoto and Lin; which also implied that both players might need further stability improvements for attacking in the third stroke.

Table 5.

Harimoto & Lin's third stroke performance

| FH & BH | Forehand Strike (%) | | | Backhand Strike (%) | | | No touch(%) | |
|-----------|---------------------|---------------|----------------|---------------------|-------------|------------|--------------|-------------|
| Harimoto | 25(47.17%) | | | 26(49.06%) | | | 2(3.77%) | |
| Lin | 27(44.26%) | | | 33(54.10%) | | | 1(1.64%) | |
| Technique | Drive | Counter drive | Backhand twist | Flip | Fast block | Long push | Block | Drop shot |
| Harimoto | 6 11.76% | 7 13.73% | 4 7.84% | 6 11.76% | 8 15.69% | 4 7.84% | 7 13.73% | 9 17.66% |
| Lin | 3 5% | 15 25% | 22 36.67% | 3 5% | 3 5% | 3 5% | 3 5% | 8 13.33% |
| Speed | Slow | | | Medium | | | Strong | |
| Harimoto | 14(27.45%) | | | 16(31.37%) | | | 21(41.18%) | |
| Lin | 9(15%) | | | 30(50%) | | | 21(35%) | |
| Spin | Top spin | | | Back spin | | | Without spin | |
| Harimoto | 34(66.67%) | | | 12(23.53%) | | | 5(9.80%) | |
| Lin | 48(80%) | | | 10(16.67%) | | | 2(3.33%) | |
| Spot | FH-P | Middle | BH-P | Touch net | Out side | | | |
| Harimoto | 15(29.41%) | 12(23.53%) | 13(25.49%) | 5(9.80%) | 6(11.76%) | | | |
| Lin | 12(20%) | 22(36.67%) | 15(25%) | 3(5%) | 8(13.33%) | | | |

P.S.: FH-P: Forehand Position, BH-P: Backhand Position

3.5 Tactical characteristics analysis in the fourth stroke

As shown in table 6, Harimoto's performance in the fourth stroke were: backhand (42.11%), forehand (39.47%), and no-touched error (18.42%). Lin's performances were: backhand (68.83%), forehand (29.79%), and no-touch (6.38%). In respect of techniques, Harimoto used 8 different ones, the most used top three were: fast block (22.58%), counter drive (19.35%), and block (16.13%). Lin used 9 different techniques, the top three of them were: block (27.27%), fast block (20.45%), and counter drive (15.91%). In respect of speed, Harimoto's choices were: medium speed (64.52%), strong speed (22.58%), and slow speed (12.9%). Lin's choices were: strong speed (40.91%), medium speed (38.64%), and slow speed (20.45%). In respect of spins, Harimoto's performances were: top spin (67.74%), back spin (19.35%), and without spin (12.90%). Lin's performances were: top spin (70.45%), without spin (18.18%), and back spin (11.36%). In respect of landing spots, Harimoto's performances were: middle position (32.64%), backhand side (32.26%), forehand side (12.91%), net (12.90%), and out-side (9.68%). Lin's performances were: backhand position (29.54%), out-side (25%), middle position (22.73%), forehand position (15.90%), and touch net (6.82%).

According to the data from table 6, Harimoto chose to stroke with forehand more in the fourth stroke, which implied a change of strategy. Lin, however, still played mainly with backhand (63.83%), which implied Lin's confidence in his backhand skills. It is worth noticed that Harimoto's no-touch error rate reached 18.42% in the fourth stroke seemed to be strangely high, which might need further examination. In respect of techniques, both players chose mainly with fast block, counter drive, and block. Fast block is a backhand fast counterattack skill, and counter drive is a forehand powerful attacking skill. Both skills are considered highly demanding, which implied that Harimoto and Lin both played aggressively. In respect of speed, although Harimoto tended to play aggressively, he still adapted to his opponent's serving strategies and mainly responded with moderate speed. Lin chose to play more equally in medium speed and strong speed, but he played a bit more aggressively in speed than Harimoto. In respect of spins, both players mainly chose top spin. Lin especially, had a higher top spin rate. No wonder Lin has a reputation in creating pressure with top spin to his opponents in Taiwan. In respect of landing spots, both players chose to create break through points from opponent's backhand and middle position instead of opponent's forehand position. It is worth noticed that both Harimoto and Lin's performances in out-side, touch net, and no-touch caused by opponent's well returns in the

fourth stroke were both higher than 36%. This result not only implied both Harimoto and Lin had the weakness in returning after receiving, but also that having the serving right helped reassuring player's advantages.

Table 6.

Harimoto & Lin's forth stroke performance

| FH & BH | Forehand Strike (%) | | Backhand Strike (%) | | | | No touch (%) | | |
|-----------|---------------------|-----------------|---------------------|----------------|-----------------|-----------------|------------------|----------------|----------------|
| Harimoto | 16(42.11%) | | 15(39.47%) | | | | 7(18.42%) | | |
| Lin | 14(29.79%) | | 30(63.83%) | | | | 3(6.38%) | | |
| Technique | Drive | Counter drive | Backhand twist | Flip | Fast block | Long push | Block | Lob | Drop shot |
| Harimoto | 4 12.90 % | 6 19.35 % | 1 3.23% | 1 3.23 % | 7 22.58 % | 4 12.90 % | 7 16.13 % | 0 0% | 9 9.68 % |
| Lin | 6 13.64 % | 7 15.91 % | 2 4.55% | 1 2.27 % | 9 20.45 % | 3 6.82% | 12 27.27 % | 1 2.27 % | 3 6.82 % |
| Speed | Slow | | Medium | | | Strong | | | |
| Harimoto | 4(12.90%) | | 20(64.52%) | | | 7(22.58%) | | | |
| Lin | 9(20.45%) | | 17(38.64%) | | | 18(40.91%) | | | |
| Spin | Top spin | | Back spin | | | Without spin | | | |
| Harimoto | 21(67.74%) | | 6(19.35%) | | | 4(12.90%) | | | |
| Lin | 31(70.45%) | | 5(11.36%) | | | 8(18.18%) | | | |
| Spot | FH-P | Middle | BH-P | Touch net | Out side | | | | |
| Harimoto | 4(12.91%) | 10(32.26%) | 10(32.26%) | 4(12.90%) | 3(9.68%) | | | | |
| Lin | 7(15.90%) | 10(22.73%) | 13(29.54%) | 3(6.82%) | 11(25%) | | | | |

P.S.: FH-P: Forehand Position, BH-P: Backhand Position

3.6 Tactical characteristics analysis in the fifth stroke

As shown in table 7, Harimoto's performances in the fifth stroke were: forehand (62.5%), backhand (37.5%), and no-touched (0%). Lin's performances were: backhand (55.56%), forehand (40.74%), and no-touched (3.70%). In respect of techniques, Harimoto chose 7 different ones, the most used of them were: drive (29.17%), block (20.83%), fast block (16.67%) and counter drive (16.67%). Lin used 8 different ones, the top three of them were: drive (26.92%) and block (26.92%), fast block (15.38%), and counter drive (11.54%). In respect of speed, Harimoto's choices were: strong speed (41.67%), medium speed

(37.50%), and slow speed (20.83%). Lin's choices were: medium speed (53.85%), strong speed (30.77%), and slow speed (15.38%). In respect of spins, Harimoto's choices were: top spin (66.67%), non-spin (25%), and back spin (8.33%). Lin's choices were: top spin (65.38%), non-spin (26.92%), and back spin (7.69%). In respect of landing spots, Harimoto's performances were: out-side (25%), middle position (20.83%) and backhand position (20.83%), forehand position (16.67%) and touch net (16.67%). Lin's performances were: backhand position (30.77%), out-side (26.92%), touch net (23.08%), middle position (11.54%), and forehand position (7.69%).

As shown above, Harimoto chose to stroke with forehand in the fourth and the fifth stroke more than stroke with backhand; which implied a change of strategy after the first three strokes. Lin, on the other hand, chose to stroke mainly with backhand from the second to the fifth strokes; which again reflected Lin's strong style with backhand skills. Both Harimoto and Lin's no-touch error rate in the fifth stroke were lower than their no-touch error rate in the fourth stroke. According to Wu and Li's (1990) study in Three-stage Skill analysis, the fifth stroke is the beginning of rally stage; which might imply the advantages from serving were no longer effective in rally stage. In respect of techniques choices, both players chose to attack more than defense. However, Harimoto played more aggressively than Lin according to their blocking rates. In respect of speed, Harimoto was more aggressive with his main choices of strong speed with medium speed. Lin mainly chose medium speed with strong speed. In respect of spins, both players chose mostly top spin; which could be related to their choices in high rating attacking strategies. In respect of landing spots, Harimoto's performances in the three main areas were considered equal. Lin, on the other hand, still chose backhand and middle position in general. It is worth noticed that both Harimoto and Lin's error rates were higher in the fifth stroke; with Harimoto reached more than 41% and Lin more than 50%. Since the fifth stroke is in the players' own serving game, the relationships between the high error rates and opponent's return abilities in the fourth stroke are important for researchers to further explore.

Table 7.

Harimoto & Lin's fifth stroke performance

| FH & BH | Forehand Strike (%) | Backhand Strike (%) | No touch |
|----------|---------------------|---------------------|----------|
| Harimoto | 15(62.5%) | 9(37.5%) | 0(0%) |
| Lin | 11(40.74%) | 15(55.56%) | 1(3.70%) |

| Technique | Drive | Counter drive | Backhand twist | Smash | Flip | Fast block | Long push | Block | Drop shot |
|-----------|-----------------|-----------------|----------------|------------|------------|-----------------|----------------|-----------------|----------------|
| Harimoto | 7 29.17 % | 4 16.67 % | 0 0% | 1 4.17% | 1 4.17% | 4 16.67 % | 0 0% | 5 20.83 % | 2 8.33 % |
| Lin | 7 26.92 % | 3 11.54 % | 2 7.69% | 1 3.85% | 0 0% | 4 15.38 % | 1 3.85 % | 7 26.92 % | 1 3.85 % |
| Speed | Slow | | | Medium | | | Strong | | |
| Harimoto | 5(20.83%) | | | 9(37.50%) | | | 10(41.67%) | | |
| Lin | 4(15.38%) | | | 14(53.85%) | | | 8(30.77%) | | |
| Spin | Top spin | | | Back spin | | | Without spin | | |
| Harimoto | 16(66.67%) | | | 2(8.33%) | | | 6(25%) | | |
| Lin | 17(65.38%) | | | 2(7.69%) | | | 7(26.92%) | | |
| Spot | FH-P | | Middle | | BH-P | | Touch net | | Out side |
| Harimoto | 4(16.67%) | | 5(20.83%) | | 5(20.83%) | | 4(16.67%) | | 6(25%) |
| Lin | 2(7.69%) | | 3(11.54%) | | 8(30.77%) | | 6(23.08%) | | 7(26.92%) |

P.S.: FH-P: Forehand Position, BH-P: Backhand Position

4. Conclusions and Suggestions

4.1 Conclusions

4.1.1 Game-point situation: When two players share a similar level of tactical skills, how the player handle the game-point situation is critical for winning the game.

4.1.2 Average number of strokes: It is assumed that because both player chose to stand close to the table, and attacking aggressively and viciously, so the number of strokes in rallies are not high. In the beginning of the match it seemed like both players chose to focus in tactical performance during the first four games; from the fifth game on, the ability in rally is the key for winning.

4.1.3 Serving: Both players serve mainly with forehand slow side back spin. However, Harimoto had richer diversity in landing spots after serving than Lin.

4.1.4 From the second to the fifth stroke: Both players played more aggressively than defensively with different tactical characteristics. Harimoto chose backhand twist with push in the second stroke. In the third to the fifth stroke, he chose drive, counter drive, fast block and block as his tactical focus. As for Lin, he mainly chose backhand twist with a few drop shot in the second and the third stroke, and he also chose drive, counter drive, fast block and

block as his tactical focus during the third to the fifth stroke. In respect of speed, Harimoto had stronger speed in the third and the fifth stroke in his serving game. Lin, on the other hand, played mostly medium speed. In respect of spins, both players chose top spin due to their aggressive style. However, Harimoto played a wider range of different top spin and back spin than Lin. In respect of spots, Harimoto chose to play at the opponent's backhand side as break through point in the second and forth stroke and attacked opponent's three main spots in the third and fifth stroke. Lin played more conservatively as he chose the middle position as majority in the second and third stroke. Lin used the forth and the fifth stroke with opponent's backhand position as break through point.

4.2 Suggestions

- 4.2.1 It is still not clear whether “standing close to the table and fast attack” style players have similar tactical characteristics in respect of the average strokes per game, which appears to be less in this study. Further follow-ups and studies thus are recommended.
- 4.2.2 This study examines Harimoto's and Lin's performances from serving to the fifth stroke in an over-all way. It is recommended to further separate and explore the winning and losing games and the tactical characteristics in those games to distinguish the potential winning strategies and to help improve 3S theory in practice.
- 4.2.3 Young Harimoto and Lin are two talented players who have great potential and are continuously in progress; their future tactical developments and game performances are highly expected.

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3S 理論之個案分析—二位年輕天才桌球選手之技戰術特性

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摘要

目的:在分析二位年輕的天才桌球選手在比賽中技戰術發揮之特性。方法:以日本 14 歲的天才選手張本智和和台灣 16 歲的桌球神童林昀儒為研究對象，二位選手在 2017 捷克公開賽分別對抗 21 歲巴西選手 Hugo CALDERANO 之二場賽事為研究範圍，以 3S 理論(speed, spin, spot)為研究架構，分別分析二位選手在比賽時，從發球到第五板擊球過程中在技術、速度、旋轉和落點之發揮情形，藉以歸納出擊球特性。結果:1.在發球，二位選手都以正手發慢速側下旋短球為主，但張本的發球落點在正手位，而林則在中間位置。2.在接發球，張本主要回擊特徵為擰球搭配搓長、中等速度搭配強速、上旋，落點在反手位；林則為擰球搭配擺短、中等速度、上旋，落點在中間位置。3.在第三板，張本的特徵是擺短結合快帶與反拉、強速搭配中速、上旋，落點均分在三大區；林則為擰球搭配擺短、中速搭配強速、上旋，落點在中間位置。4.第四板，張本的特徵是快帶結合反拉、中等速度搭配強速、上旋，落點大多在反手和中間位置；林的主要以擋球結合快帶、強速搭配中速、上旋，落點在反手位。5.第五板，二位選手以拉和擋球的使用率最高，但速度上，張本以強速搭配中速，林為中速搭配強速。落點方面，張本均分在三大區；林則以反手位居多。

關鍵詞:桌球、3s 理論、天才運動員、技戰術