

THE VARIATION IN SPINS PRODUCED BY SINGAPORE ELITE TABLE TENNIS PLAYERS ON DIFFERENT TYPES OF SERVICE

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An experiment was carried out to measure the topspin and sidespin produced by five elite players of Singapore after the change in service rules by the ITTF so as to ascertain their variation in ball spin on different techniques. The balls were painted half black to facilitate the calculation of spin from high speed (200Hz) video playback. The percentage reduction on ball spin after hitting the table twice was also considered in order to find out the spin that could be delivered to the opponent. The results showed that different players excel in different techniques and the ball spin increases after ball contact with the table for long distance side topspin balls. Lastly, using data for certain service techniques done in 2000 (Xie & Qin 2001), an experimental comparison was carried out to examine the possible influence of the new rules on player performance.

KEY WORDS: table tennis, topspin, backspin.

INTRODUCTION: Table Tennis ball spin plays an important part in competitions as nearly every stroke imparts some form of spin to the ball. A high spin ball delivered at an appropriate time can raise the difficulty level in handling the ball for the opponent. Topspin balls are forced downwards to the table sooner while backspin balls have slightly prolonged flight due to Magnus forces principles. Sidespins and combination spins bounce sideways when it hits the table and can throw an opponent's timing off. Unlike ball speed, the effect of air resistance on spin is minimal (Xie & Qin, 2001). The objective of this experiment was to find out the variations in ball spins delivered by the five elite players from Singapore after the implementation of new rules by the International Table Tennis Federation, ITTF which disallow players to conceal their serves. The scope includes the six common techniques namely forehand and backhand side backspin, forehand and backhand side topspin, high spin and minimal spin balls. The amount of spin immediately after ball impact with the bat as well as its percentage reduction after bouncing twice on the table were both considered.

METHOD: Five elite players from the Singapore national team were chosen for this study. The subjects were 24 ± 6 years of age, 1.69 ± 0.07 m in height and 58.3 ± 5.1 kg in weight. In the laboratory arena, a PEAK HSC-200 high-speed video camera and VCR were used to record videos of the players' service, at a rate of 200 fields/sec and shutter speed of 1/2000 sec. The setup for the experiment is displayed in Figure 1. The equipment used consists of the following:

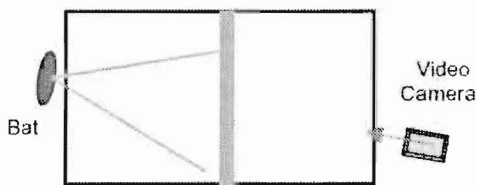


Figure 1: Experimental Setup

(1) Nittaku 40mm (average weight 2.67g) yellow balls (three stars) painted half black. These balls were used for all experiments since Nittaku three star balls is ITTF approved standard for competition.

(2) Nittaku blue table tennis table.

(3) One PEAK HSC-200 camera was set up to capture video at a rate of 200 frames/sec and shutter speed of 1/2000sec.

The camera's video recording, which is the close-up view on the ball, was used for data processing. The videotape recordings of the elite players were obtained and converted from Analog to Digital format via the software Peak Motus. The balls were painted half black using markers so that the number of spins can be calculated during video playback by observing the rotation of the ball frame by frame. Figure 2 shows a series of five video frames of a ball

going through a complete 360° revolution from video frame 101 to 105, hereby referred to as the initial and final video frame respectively.



Although this illustration is only for one revolution, effort has been made to take into account up to 10 revolutions per trial for improved accuracy. About 7 to 10 clear trials were chosen out of the 20 repetitions per technique per player. Figure 3 shows a trial, which is unclear for analysis as the axis of spin is perpendicular to the dividing line between the painted and unpainted half portion of the ball. In such an extreme case, it would look as if the ball is not spinning at all from the video.

The formula below was applied for calculation of N, the number of spins per second.

$$N = \frac{n}{(VF2 - VF1) \times 0.005}$$

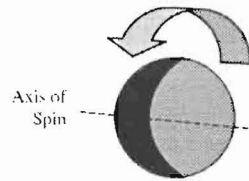


Figure 3: Ball Spin.

where n is the number of spin while VF1 and VF2 are the initial and final video frame respectively. Next, a calculation on Coefficient of Variation (COV) on the players' serves was also computed to find out the consistency of the players. It measures the variability as a proportion of the average (COV = Standard Deviation ÷ Mean).

The Table Tennis table was divided into 3 zones (Figure 4) to calculate the initial and final ball spin. Only Zones 1 (initial spin) and 3 (final spin) were considered, as they were the critical requirement for this experiment. Final spin was calculated to find out how much quantitatively the change in ball spin upon bouncing twice on the table was. It can also serve as a gauge on how much spin does the opponent experience. All techniques considered were for short distance balls unless otherwise stated. Short distance service is defined as balls that reached the area around Point A while long distance balls are those that reach Point B further away from the net as shown in Figure 4.

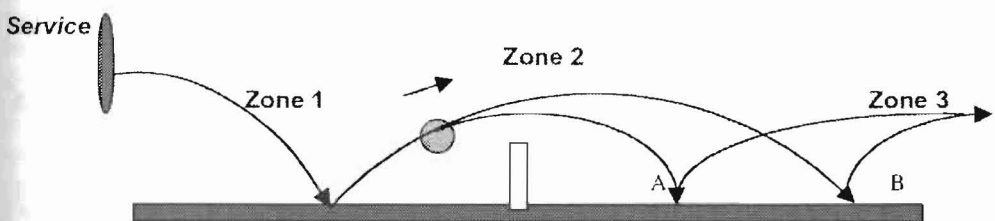


Figure 4: Data Analysis Zones.

RESULTS AND DISCUSSION: Table 1 shows the results of the spins of the five players according to techniques and zones. The techniques tested include the six common service namely Forehand (FH) and Backhand (BH) side backspin, FH and BH side topspin, high-spin and low-spin balls. The percentage change in ball spin is indicated by the symbol %? while Zone 1 and 3 are represented by Z1 and Z3 respectively. The COV in Table 1 are all for Zone 1 and techniques were tested according to those in which the players frequently use in actual competitions.

Table 1 Number of spins per second according to combination spins service techniques.

Name	Backspin Balls							
	High Spin				Low/Minimal Spin			
	Z1	Z3	%	COV	Z1	Z3	%	COV
A	48.2	29.7	-38.4	10.9	28.9	16.6	-42.6	9.8
B	50.7	32.9	-35.1	6.7	23.3	8.0	-62.2	11.7
C	-	-	-	-	-	-	-	-
D	-	-	-	-	-	-	-	-
E	44.3	24.7	-44.2	5.8	31.3	12.8	-59.1	12.4
Mean	47.7	29.1	-39.2	-	28.8	12.5	-54.6	-

Name	FH Sidespin							
	Topspin				Backspin			
	Z1	Z3	%	COV	Z1	Z3	%	COV
A	-	-	-	-	-	-	-	-
B	-	-	-	-	-	-	-	-
C	53.6	46.0	-14.2	6.7	51.3	39.3	-23.4	4.9
D	50.2	43.8	-12.7	3.3	56.5	42.0	-25.7	4.7
E	57.9	49.2	-15.0	5.4	59.4	48.2	-18.9	7.1
Mean	53.9	46.3	-14.1	-	55.7	43.2	-28.9	-

Name	BH Sidespin							
	Topspin				Backspin			
	Z1	Z3	%	COV	Z1	Z3	%	COV
A	55.1	46.5	-15.6	5.4	53.6	39.7	-25.9	4.5
B	-	-	-	-	-	-	-	-
C	-	-	-	-	42.6	27.7	-35.0	3.5
D	46.4	40.0	-13.8	3.9	44.8	34.4	-23.2	6.2
E	-	-	-	-	-	-	-	-
Mean	50.8	43.3	-14.8	-	47.0	33.9	-27.9	-

Name	*Long distance service sidespin							
	TopSpin				BackSpin			
	Z1	Z3	%	COV	Z1	Z3	%	COV
A	68.6	72.7	+6.0	3.8	72.3	66.2	-8.4	5.5
B	44.4	52.5	+18.2	19.5	67.7	59.4	-12.3	7.0
C	59.6	62.7	+5.2	7.2	68	59.4	-12.6	12.1
D	-	-	-	-	-	-	-	-
E	-	-	-	-	-	-	-	-
Mean	57.5	62.6	+9.8	-	69.3	61.6	-10.3	-

*Except for player A, both other players used forehand in long distance service.

For backspin balls category, players are to execute balls that contain the highest spin possible and also those with minimal spin. Subjects who are able to produce a high spin have a good grasp of the technique, high loop, which is characterized by high ball spin but slower speed than forward driving loop which emphasize more on speed (Wu & Qin, 1992). The results showed that the percentage reduction in ball spins for minimal spin balls are generally higher than those with high spin for all tested players. It can also be inferred from the numerical data that player B has better skills compared to players A and E. She is able to produce the highest spin at 50.7 spins per second and also managed to maintain the spin by limiting it to only a percentage reduction of 35.1% compared to a relatively higher percentage reduction for other players. On the other hand, low/minimal spin balls are suppose to spin as slow as possible; Player B is also able to produce the least spin and yet the highest percentage reduction in spin at 62.2% making the final spin an average of only 8 spins per second. As for the other two players, it is recommended for them to increase their spin for high spin balls and reduce that for minimal spin balls. Player E also needs to work more on his consistency for low/minimal spin balls.

Considering the categories of FH and BH Sidespin, it is desirable for players to obtain a high spin and have a low percentage reduction in spin after contact with the table. Player A performed the best for both BH side topspin and backspin. Although her percentage reduction in ball spins after hitting the table was not the least, her Zone 3 ball spin is considered the highest compared to the other two players. As for FH side topspin and backspin, player D is the most consistent with the least COV while player E produced the highest ball spin. Next, it can be seen that the reduction in ball spins is higher for backspin than topspin for all players. This gives them an indication whether to use topspin or backspin balls depending on how much spin they want their opponents to tackle. Players are also able to make use of this knowledge to manipulate their spins throughout the match and place an opponent off guard. Previous research by Xie & Qin (2001) showed that upon ball contact with the table, the reduction in spin is higher for backspin than sidespin. According to them, the influence of air resistance on spin is minimal at about 3-4% from the time it leaves the bat till moments prior to contact with table in Zone 1 whereas the reduction in speed is about 29%. Thus air resistance can be considered negligible when considering the number of ball spins. Assuming air resistance is negligible, it

can be observed here that friction from the table has a higher effect on backspin than topspin. Therefore by changing the ball speed and angle of spins, the effects of friction on both ball speed and spin will vary accordingly. Lastly, for long distance service, it was found that the topspin balls actually increase in spin after the balls come in contact with the table. The increase in spins range from 5.2% to 18.2% and averaged up to 9.8% for the three players tested.

With the new rules set by ITTF to disallow players in concealing their serves, coaches are also keen to find out how this affects the players psychologically which in turn might influence their performance. Table 2 compares the service spin for four of the above athletes before and after the change in service rules by the ITTF for the same service techniques that each individual used then and now. All the players use a forehand combination of side and backspin except for player A, who uses the backhand. Around eight trials were selected for each athlete and the average data was taken. The data shown here are all for Zone 3 since coaches are concerned with the actual spin experienced by the opponents.

Table 2 Long Distance Side-Backspin Service techniques before and after new ITTF rules.

Player	2000-Before new rules (Z3)			2002-After new rules (Z3)			% _ in spin
	Spin	SD	COV	Spin	SD	COV	
A	40.0	3.4	8.5	39.7	2.1	5.3	-0.8
B	56.3	4.0	7.1	59.4	3.1	5.2	+5.5
C	64.1	3.0	4.7	59.6	4.3	7.2	-7.0
D	37.9	1.9	5.0	42.0	2.0	4.8	+10.8

The results showed that the new rules have considerable effects on all players except for player A, who is not much affected by the change. This is because she has been using backhand service and this technique originally does not conceal a player's serve. Thus it does not matter much for her whether the new rule was implemented. In terms of consistency, she has improved the most among all players. This can be inferred from the higher reduction in both her Standard Deviation (SD) and COV compared to year 2000. Player B, who performed the best for high spin and minimal spin balls as mentioned earlier, actually performed better without concealing her service. There is an increment of 5.5% for her average ball spin. The increment in spin also applies for player D who plays better with the new rules and is also able to maintain his regularity. On the other hand, player C's ball spin reduced by 7% and her consistency was much affected by the new rules. It is recommended for her to practice more on her service for improvement.

CONCLUSION: Ball spins in Table Tennis can be useful in making it a difficult for the opponent to return serve. The results showed that friction from the table has a higher effect on backspin balls as compared to those with topspin. Perhaps by varying the direction of spins, players can predict the resultant spin that is being delivered to the competitor. Finally, the change in new rules by the ITTF has some effects on ball spins mainly for players using forehand service. It is recommended for those affected ones to practice more often to improve. Future research may include the study on the relationship of angles of spin to the speed and spin of balls upon contact with the table.

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