

NOTATIONAL ANALYSIS OF INTERNATIONAL BADMINTON COMPETITIONS

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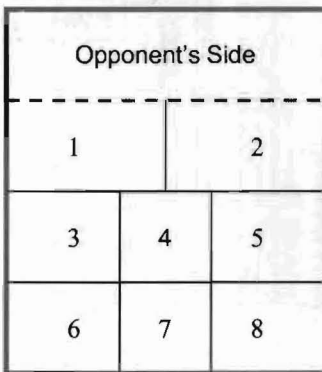
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Notational analysis of competitions is a widely used method for observing the playing patterns of many sports. An experiment was carried out to determine the playing tactics adopted by athletes in international badminton competitions. A total of 10 major competitions were recorded and the data was processed using a generic notational analysis software. The types of techniques used, the success and failure rates of the various shots were computed and compared using statistical methods of analysis. The results showed that the top three most popular shots used were Lift, Net and Clear. It was also found that there were significant differences among the percentage of shots used in the three court areas as well as the type of shots used by males and females.

KEY WORDS: badminton, clear, drop, smash, lob, lift, net, block, push.

INTRODUCTION: Badminton is the fastest racket sport in the world with the shuttlecock reaching speeds over 260 km/h (72m/s). However, unlike ball games, the shuttlecock's flight does not follow a true parabolic curve. Its path is greatly affected by air resistance, which reduces its velocity rapidly in split seconds. With contrasting speed within a short time, badminton players are required to be agile and able to predict the path of the ball by reading the opponent's strokes quickly. Although techniques and skills are important and form the foundation of the game, players at competitive levels win matches based on application of appropriate strategy, which varies depending on their competitors. As such, coaches throughout the world are keen to determine the players' playing pattern through notational analysis. Such data can also be extended to movement analysis, tactical and technical evaluation as well as development of database and modeling (M. Hughes, 1998). This study aims to find out the playing patterns of elite singles players in major competitions.

METHODS: Twenty games, ten each from the men and women's singles of various major competitions in 2004, including the Olympics, were chosen for this study. The subjects were all elite players from the various countries' national squads. In the competition arena, two digital video cameras were used for recording on both ends of the court. The setup for the experiment is displayed in Figure 1. The videos were processed and converted to mpeg video format for notational analysis. The data were then computed using a generic software that helps in keeping a record for various types of techniques. The eight strokes considered here are clear, drop, smash, block, lift, push, net and dab. The success and failure rate were also recorded accordingly with respect to the various court areas. The court is divided into 3 major areas namely the forecourt, mid-court and the rear-court. The eight subdivisions are displayed in Figure 1.



Every stroke is divided into 3 categories namely success, failure and normal. A successful shot (unconditional winner) is considered one that wins either a rally or point as a result of the opponent not being able to return the ball. A failure shot (unforced failure) is one that loses a rally due to a careless mistake, and does not include those shuttles which one fails to reach for and hit at all. A normal shot is one used during the rally that neither belongs to the description of successful nor failure shots. The scope includes the analysis of the matches using t-test and ANOVA.

Figure 1 Court Area Divisions.

RESULTS AND DISCUSSION: Table 1 shows the percentage of shots used from the various court areas. The results showed that most shots were played from the frontcourt followed by the backcourt for males. This is an indication that males hit the shuttle to the net more often. On the other hand, females had a higher percentage of shots played from the backcourt than forecourt. The detailed overall average shows that most shots were played from frontcourt left area 1 and the backcourt right area 8. Analysis of variance (ANOVA) was used to compare shots between the three main areas and results indicate that there are significant differences between the percentage of shots from the front, mid and backcourt as presented in Tables 2 and 3. ($p < .05$).

Table 1 Percentage of shots used from the various court areas (n=20).

Area	Front		Middle			Back		
M	47.80		13.00			39.50		
F	41.80		6.30			51.80		
Average	44.80		9.65			45.65		
Area	1	2	3	4	5	6	7	8
M	24.20	23.40	6.00	2.10	4.70	17.40	2.00	19.90
F	21.90	19.80	3.80	0.20	2.30	25.00	0.40	26.30
Average	23.05	21.60	4.90	1.15	3.50	21.20	1.20	23.10

Table 2 Comparative studies between the Front, Mid and Backcourts for males.

Male	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6607.267	2	3303.633	110.380	.000
Within Groups	808.100	27	29.930		
Total	7415.367	29			

Table 3 Comparative studies between the Front, Mid and Backcourts for females.

Female	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	11435.000	2	5717.500	135.498	.000
Within Groups	1139.300	27	42.196		
Total	12574.300	29			

In terms of the percentage of shots used based on technique, it was found that the top three most frequently used shots are Net, Lift and Smash for males and Clear followed by Lift and Drop for females. It can be observed from Figure 2 and Table 4 that females were using only quite a small percentage of the smash technique (8.4%). They used more clear shots and drop shots while males used more of Net and Smash. The technique of lift however was being used very often by

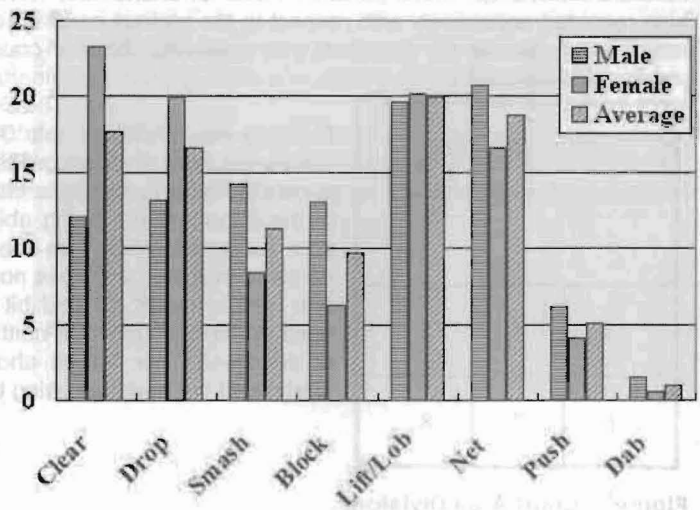


Figure 2 Percentage of shots

both genders. It constitutes about one-fifth of all shots played on the average. This result is consistent with the research by Y. Hong (1998) whereby Lift comprised of the highest percentage of all shots used (23%). Next, it is also noticed that males had a relatively higher percentage of blocks (13.0%) compared to females (6.3%) since males used more smash and thus the technique of block was needed to return the shuttle. However the mid court block technique was usually ineffective as shown in Tables 5 and 6.

Table 4 Percentage of shots used based on techniques.

Technique	Clear	Drop	Smash	Block	Lift/Lob	Net	Push	Dab
Male	12.10	13.20	14.20	13.00	19.60	20.70	6.10	1.50
Female	23.30	19.90	8.40	6.30	20.20	16.60	4.10	0.50
Average	17.70	16.60	11.30	9.70	19.90	18.70	5.10	1.00

Table 5 summarizes the effectiveness of shots hit from the three main court areas while Table 6 categorizes the shots effectiveness based on techniques. Highest ineffective rate was from mid court due to mistakes committed when returning a smash using the block technique. It can also be observed that the standard deviation for ineffective rate in mid court was higher than the rest for both genders. This is because returning a smash is one of the harder techniques to master where consistency is a great challenge and thus the high variability in its effectiveness. It can be seen that the overall highest effective rate is from the backcourt and this is likely to be due to the technique of smash used from backcourt for winning points. As affirmed in Table 6, the Smash technique had the highest effective rates for both genders. However, the ineffective rate of smash for females was relatively high too. This shows that although most points can be won from the smash technique, most mistakes were often committed here for females (10.4%). On the other hand, males had a relatively lower ineffective rate for smash (6.4%) and that explains why males use this technique more often than females as found out from Table 4 earlier. This could also be attributed to the higher strength of males in general, even among older children. From previous research by M. Blomqvist in 1998 on game analysis for boys and girls, it was found that boys as young as 12-13 years old were able to hit the shuttle harder than girls due to better technical skills and strength level. Ellen K. (1996) also demonstrated the likelihood of committing errors due to the lack of strength or power, which might be the reason for females having a higher ineffective rate for the Smash technique.

Table 5 Effectiveness of shots from the 3 court areas.

Area	Effective			Ineffective			Normal		
	Front	Mid	Back	Front	Mid	Back	Front	Mid	Back
Male	2.00	0.60	6.00	6.40	15.00	5.60	91.60	84.40	88.40
Std Dev	2.16	1.35	3.86	2.50	6.06	3.81	-	-	-
Female	3.30	1.00	6.80	7.50	11.00	7.50	89.20	88.00	85.70
Std Dev	3.40	2.11	3.58	3.24	20.89	2.80	-	-	-
Average	2.65	0.80	6.40	6.95	13.00	6.55	90.40	86.20	87.05

Table 6 Effectiveness of shots based on techniques.

Technique	Effective							Ineffective						
	Cl	Dr	Sm	Bk	Lift	Net	Push	Cl	Dr	Sm	Bk	Lift	Net	Push
Male	0.4	1.4	16.5	0.6	0.4	2.0	0.7	2.6	6.6	6.4	15.0	2.9	8.4	7.7
Std Dev	1.3	2.0	10.8	1.4	0.8	2.9	1.6	3.9	5.3	5.2	6.1	2.5	5.8	7.3
Female	1.5	8.2	14.5	1.0	1.2	5.6	1.2	7.4	7.5	10.4	7.6	7.6	6.7	14.9
Std Dev	2.5	4.1	14.7	2.1	2.5	6.4	3.8	5.0	4.6	15.0	11.4	5.0	2.9	30.6
Average	0.95	4.8	15.5	0.8	0.8	3.8	0.95	5	7.05	8.4	11.3	5.25	7.55	11.2

In order to compare the techniques used by males and females during major competitions, a t-test was adopted and results (Table 7) showed that there are significant differences for the

percentage of shots using the technique of Clear, Drop, Smash, Block and Net between the males and females ($p < .05$). This is especially so for Clear and Drop and Block technique where p is almost equal to zero.

Table 7 p-value on percentage of shots based on techniques by both gender.

Technique	Clear	Drop	Smash	Block	Lift/Lob	Net	Push
p-value	≈ 0	0.001	0.010	0.001	0.794	0.032	0.297

CONCLUSION: Badminton tactics play an important role in international competitions. The most frequently used technique is the lift followed by net and clear. Males used more nets and clears while females used more clears and drop shots. The technique of lift however was used frequently by both genders. Comparative studies via ANOVA showed that there are significant differences among the percentage of shots used in the three main court areas. In terms of effectiveness of shots, the highest ineffective rate is from mid court, which is likely due to mistakes committed when returning a smash using the block technique. Overall highest effective rate is from the backcourt and this is likely to be due to the technique of smash used from backcourt for winning points. The Smash technique has the highest effective rates for both genders. However, the ineffective rate of smash for females is relatively high. This shows that although most points can be won using the smash technique, most mistakes are often committed here for females. Finally, a t-test was adopted for technique comparisons and results showed that there are significant differences for the percentage of shots using the technique of Clear, Drop, Smash, Block and Net between the males and females.

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