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# A comparison of the Scott and Freise tests of badminton skills.

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S C H O O L   O F   E D U C A T I O N

Thesis

A C O M P A R I S O N   O F   T H E   S C O T T   A N D   F R E I S E   T E S T S  
O F   B A D M I N T O N   S K I L L S

Submitted by

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In Partial Fulfillment of Requirements for  
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CHAPTER I  
PURPOSE OF STUDY

This study is a comparison of the Scott tests of badminton skill<sup>1</sup> and the Freise tests of badminton skill.<sup>2</sup> There is a need for more scientific testing of these two batteries of tests. The Scott tests have been evaluated with only 29 cases; the Freise tests were devised from only 36 cases.

Skill tests have several purposes:

1. They may be used for classification of students into beginning, intermediate, and advanced classes for teaching the sport.
2. They may be used as motivating factors; as self-testing exercises, "compulsion by a system of training";<sup>3</sup> that is, when one skill is learned, a more difficult one may be tried.
3. They may be used to make badminton skill more

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1. M.G. Scott and E. French. Better Teaching Through Testing. A.S. Barnes, New York, 1945. pp. 48-55.

2. F.E. Freise. "A Simple Method of Evaluating Skill in Badminton Performance." B.U. Thesis, 1948.

3. American Red Cross. Instructor's Manual for Swimming and Diving Courses. Washington, D.C., 1938. p. 6.

uniform for mass teaching in gym classes. Teaching by progression, skills may be simplified, defined, and graded for large classes. For example, the swimming skills taught by the American Red Cross are organized into beginning,<sup>1</sup> intermediate, and advanced groups on skill work sheets.

These are ways of building a sport upon a firm foundation of successful skills.

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1. American Red Cross. op. cit., p. 11.

CHAPTER II  
SUMMARY OF SCOTT AND FREISE TESTS

Scott Tests

The Scott tests are made up of two tests:

1. The service test<sup>1</sup> is a test in which the service court is marked off in four concentric circles at distances of 22", 30", 38", and 46" from a midpoint (the intersection of the short service line and the center line). A clothesline rope is attached to net standards 20" above net. See Diagram 1 below.

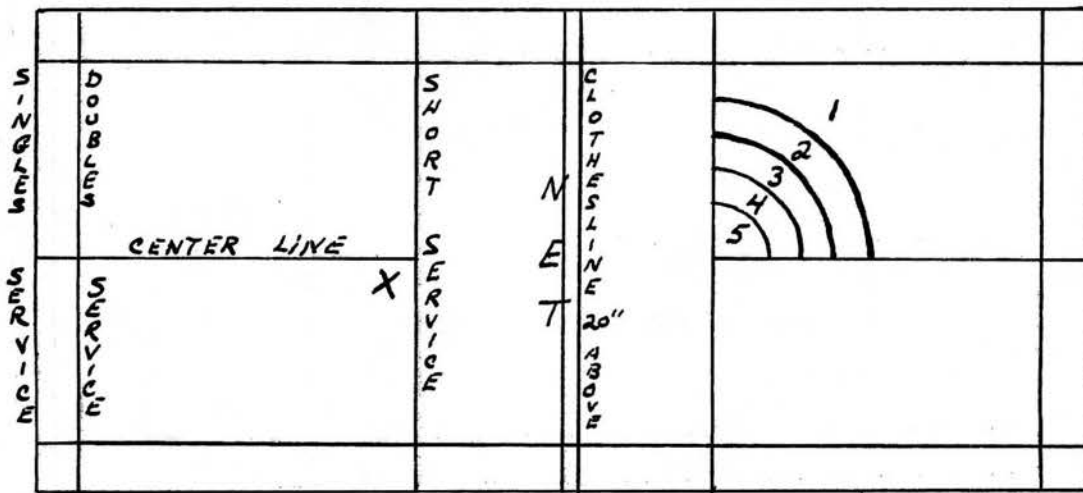


Diagram 1. Scott Service Test

1. M.G. Scott and E. French. op. cit., pp. 49-51.

In this test the player being tested stands anywhere in the service area diagonally opposite target. The player serves 20 birds between clothesline and net. The corner of target nearest intersection scores five; the next area, four; the next area, three; the next area, two; and the remaining area, one. No score is counted for any bird which does not go between rope and net. A bird which lands on a line receives the score of the higher area. Illegal serves are repeated.

The scores on the Scott service test of 29 Iowa University students were correlated with the ladder tournament standings of these students to find the validity (.66). Reliability (.88) was computed by the Spearman-Brown Odd-Even Prophecy Formula:<sup>1</sup>

$$R_x = \frac{Nr}{1 + (N-1)r}$$

R<sub>x</sub> = coefficient to be estimated

N = 2 or proportion of increase in length

r = correlation obtained on halves

T-scores have also been computed on over 200 University of Minnesota students.<sup>2</sup>

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1. M.G. Scott and E. French. *op. cit.*, pp. 240-241.  
 2. *Ibid.*, p. 55.

"This test measures accuracy of placement and also the ability to serve the bird in low flight. It is easy to administer and can be given off the courts, so that it does not interfere with play. The amount of practice should be held constant for all players, and the test should not be administered until the majority have acquired the ability to make short, low serves. The condition of the equipment affects the scores decidedly."<sup>1</sup>

2. The clear test<sup>2</sup> is a test in which the back court is divided into four parts. A clothesline rope or net is stretched across court 14 feet from net and eight feet high. A line is drawn across court two feet inside rear service line of the doubles' court. Another line is drawn across court two feet outside rear service line of the singles' court. See Diagram 2 below.

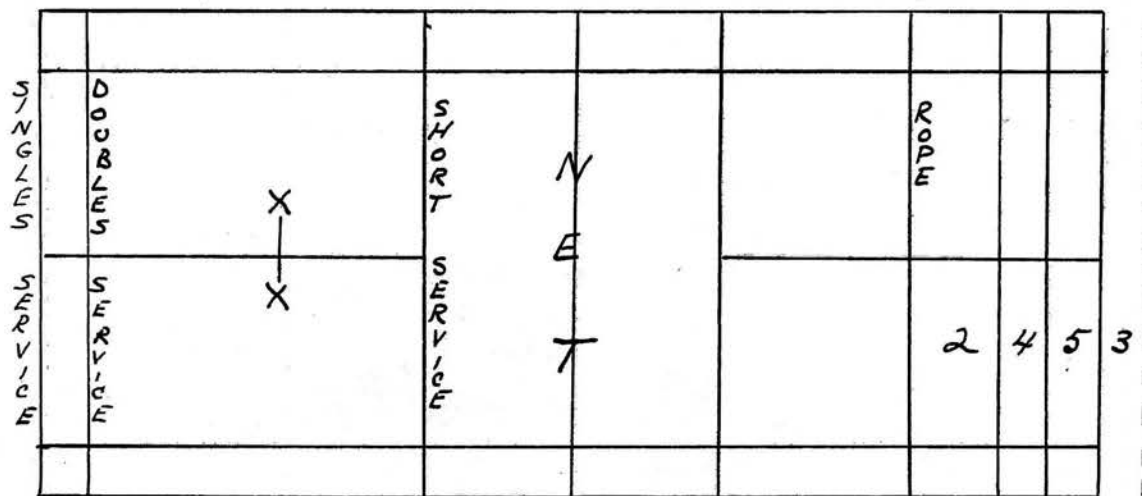


Diagram 2. Scott Clear Test

1. M.G. Scott and E. French. op. cit., p. 51.

2. Ibid., pp. 51-54.

On the other side of court player being tested should stand 11 feet from net and within area three feet on either side of center line. The tester (on the side of target) serves bird to player within area where he should be standing. (If bird is not served to where player should be standing, then it need not be played.) Player has 20 trials to clear first and second net. The first area behind the second net counts two; the next area, four; the next area, five; and the area outside of court, three. No score is received for any bird which is not cleared over rope and inside scoring areas. A bird landing on a line shall receive the score of the higher area.<sup>1</sup>

The scores on the Scott clear test of 29 Iowa University students were correlated with the ladder tournament standings of these students to find the validity (.60). Reliability (.91) was computed by the Spearman-Brown Odd-Even Prophecy Formula.<sup>2</sup> T-scores have also been computed on over 200 University of Minnesota students.<sup>3</sup>

1. M.G. Scott and E. French. op. cit., pp. 52-54.

2. See above, page 4.

3. M.G. Scott and E. French. op. cit., p. 55.

"This test, even with the disadvantage of the bird being put in play by another player, is so highly reliable that it should be done to determine the effect of fewer trials... It measures power and to some extent accuracy in the strokes. It would also seem logical that it is a measure of the player's judgment."<sup>1</sup>

Scott suggests the following formula for the proper weighing of the service test and clear test:<sup>2</sup>

Service / 1.2 Clear

By multiple correlation and using this formula, the validity coefficient was computed as .85.

#### Freise Tests

The Freise tests are made up of four tests:

1. The service test<sup>3</sup> is a test in which four targets are placed within service area of singles' court. Two 20" by 20" targets are placed in the front service area; two 30" by 30" are placed in the rear service area. Player being tested stands in service court diagonally opposite and serves 10 shots, alternating five to front court and five to back court. Shots to right targets (opponent's backhand) back and front, score five; shots to left front, score four; shots to left back, score three; shots to center front, score three; shots to center back, score four; and shots to middle,

1. M.G. Scott and E. French. op. cit. p. 54.

2. Ibid., p. 54.

3. F.E. Freise. op. cit., pp. 13-17.

score only two. See Diagram 3 below.

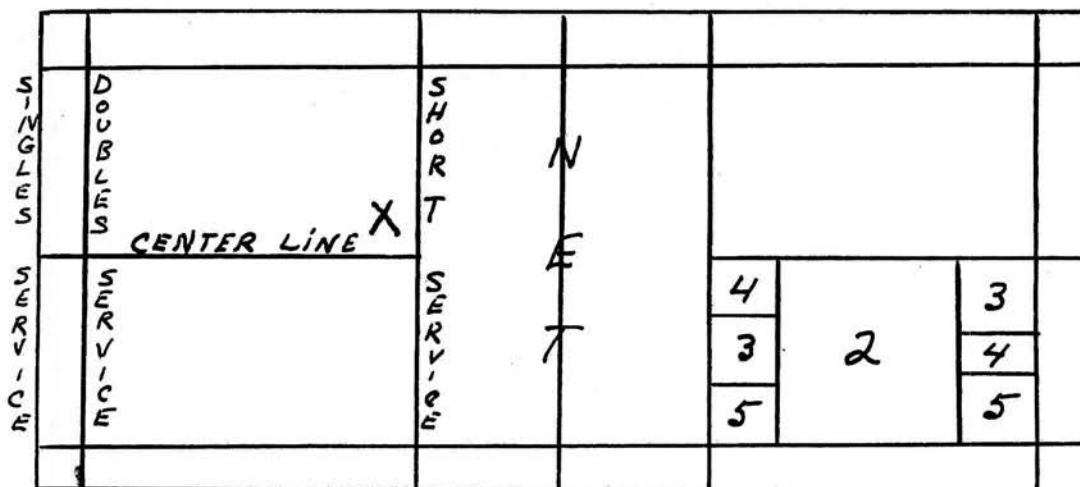


Diagram.3. Freise Service Test

2. The clear test<sup>1</sup> is a test in which another net or rope is used across court 17 feet from center net to section off an area five feet from rear service line of singles' court. Player plays five birds served by tester and receives five points for each shot placed beyond second net and inside line. The five birds served by tester are served to: 1) front court (at intersection of short service line and center line); 2) back-court (at intersection of rear service line and center line); 3) left court center; 4) right court center; and 5) place where shot was missed before. Each shot must be taken alternately by forehand and backhand. See Diagram 4 on following page.

1. F.E. Freise. op. cit., pp. 18-20.

D O U B L E S	4 X	S H O R T	N E	R O P E	5	5
	C E N T E R L I N E					
S E R V I C E	X 3	S E R V I C E	T		5	5

Diagram 4. Freise Clear Test

3. The drop-shot from mid-court test<sup>1</sup> is a test in which the area in front of the short service line is extended to the net. Two 20" by 20" targets are placed in the extreme right and left corners next to the net. A line is drawn four feet from center. Player being tested stands in mid-court opposite targets and receives 10 trials served by tester as follows: 1) forehand--left court, 2) backhand--right court, 3) backhand--left court, 4) forehand--right court, 5) forehand--left court, 6) backhand--right court, 7) backhand--left court, 8) forehand--right court, 9) forehand--left court, and 10) backhand--right court.<sup>2</sup> Drop-shots

1. F.E. Freise. op. cit., pp. 21-23.

2. Five trials only were given by the author because: 1) a balance was needed especially with the other drop-shot test, and 2) time was limited in the actual school program.

returned to targets, score five; area next to targets, score three; area next to center line, score one. See Diagram 5 below.

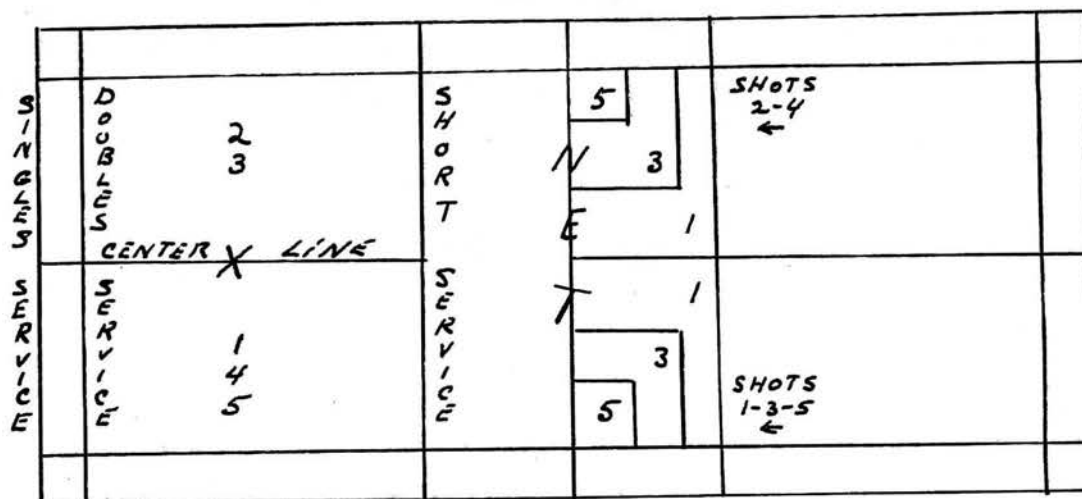


Diagram 5. Freise Drop-Shot Mid-Court Test

4. The drop-shot from back-court test<sup>1</sup> is a test in which two lines are drawn parallel to the net; one four feet from the net; the other three feet from the net. Player stands at the intersection of rear service line of singles' court and center line. Five trials are served by tester as follows: 1) forehand--left court, 2) backhand--right court, 3) backhand--left court, 4) forehand--right court, 5) forehand--left court. Drop-shots returned to area close to net, score five; next area, score three; and farthest area, score zero. See Diagram 6 on following page.

1. F.E. Freise. op. cit., pp. 24-26.

S I N G L E S	D O U B L E S	S H O R T	S H O T S 2-4			
	2 3 X C E N T E R L I N E		N E 5 3 0			
S E R V I C E	S E R V I C E	S E R V I C E	T S H O T S 1-3-5			

Diagram 6. Freise Drop-Shot Back-Court Test

In computing the reliability of these tests, Freise used the test-retest method. He found a reliability of .80.<sup>1</sup> Compared with Scott's .88 to .91,<sup>2</sup> Freise's reliability is low.

Freise computed the validity of his test by correlating the test-retest scores with the criteria--ladder tournament. He found a validity of .86.<sup>3</sup> Scott's validity of .85<sup>4</sup> compares very well.

1. F. E. Freise. op. cit., p. 28.

2. See above, pp. 4-6.

3. F.E. Freise, op. cit., p. 30.

4. See above, p. 7.

CHAPTER III  
PROCEDURE AND TECHNIQUE

Ladder Tournament

The ladder tournament used by Scott and Freise will be the method used for evaluating and comparing these tests. It is assumed that the girl with the greatest possible skill will be in first place, and so on down the ladder. When the ladder becomes stationary, then the skill is finely distributed. Re-testing with other groups will remove slight differences.

Four groups were picked by the author because the freshman, sophomore, junior, and senior groups fall into the four natural classes found in high school. The largest number possible to have in these groups was found to be 60.<sup>1</sup>

It was necessary to adapt the ladder tournament to the large groups. Each group was divided into three ladder tournaments of 20 girls each. When the three ladders became stationary, the players of one ladder were allowed to play players of their own rung level on the other two ladders. That is, players in each place played off games in order to

---

1. Limited by school program.

find a rank on a single ladder of 60. In this manner the three ladders were merged as one. When the tournament was finished each girl could beat the two girls under her, but not the two girls above her. With 60 girls the variation in skill should be very fine.

#### Description of Testing Program

These tests were given at Notre Dame High School, Chicago. At Notre Dame, there is a gym-auditorium situation; that is, there is a gym in which classes are conducted; but it is also used as an auditorium which supplies the needs--play, dances, music practices, Latin club, French club, student council, religious activities--of 700 girls during the school year. These tests were conducted in the gym classes. Each gym class met twice a week for 45 minutes--after the girls changed clothes, the playing time was about 35 minutes.

None of the 240 girls that took part in these experiments had had any special training in badminton before this year. Four junior girls were dropped along the way because of injuries (not from badminton).

Each class of 60 was divided into three squads of 20 girls each. That gave each squad about 10 minutes practice time to work on strokes. Strokes were worked on about two months before the game was taught. In the meantime the girls played lead-up games--each time with a

different partner--learning the different strokes. In this way, the squads were already formed for the three preliminary ladder tournaments.

The service tests were set up on the five badminton courts for two weeks. The Scott test was placed on the right court; the Freise test was placed on the left court. Then all of the other tests were set up in the following manner:<sup>1</sup>

- Court 1--Scott Clear  
Freise Clear  
Freise Drop-Shot Mid-Court
- Court 2--Scott Clear  
Freise Clear  
Freise Drop-Shot Back-Court
- Court 3--Scott Service  
Scott Clear  
Freise Service  
Freise Clear  
Freise Drop-Shot (alternate)
- Court 4--Scott Clear  
Freise Clear  
Freise Drop-Shot Mid-Court
- Court 5--Scott Clear  
Freise Clear  
Freise Drop-Shot Back-Court

2

A large chart was made by the author so that the girls would know what court to go to for the tests they hadn't taken. For test scores obtained in all four groups, see Appendix A, pages 28-35.

- 
1. See pictures of actual testing program, pp. 16-19.
  2. See Diagram 7, p. 15.





Plate 1. Scott Service Test

COMMERCIAL

BOND

W. S. BENTLEY



Plate 2. Second Ropes for Scott and Freise Clear Tests



Plate 3. Scoring Areas for Scott and Freise Clear Tests



Plate 4. Position of Player and Tester in Scott Clear Test (#3) and Freise Clear Test (#4)



Plate 5. Scoring Areas for Scott Service Test and Freise Drop-Shot Back-Court Test



Plate 6. Scoring Areas for Freise Service Test and Freise Drop-Shot Mid-Court Test

Statistical Procedure

1

There were twelve correlations made in order to compare these tests. The correlation method used was Pearson's Product-Moment Coefficient:

$$R = \frac{\text{sum } xy}{\sqrt{(\text{sum } x^2) (\text{sum } y^2)}}$$

R = correlation coefficient to be found

x = deviation from the mean of the first group of scores

y = deviation from the mean of the second group of scores

The following correlations were made:

1. Ladder Rank and Scott Formula <sup>3</sup> --Freshmen.

The ladder rank was used, not only to find the validity of the Scott tests with these high school groups, but also to compare with the ladder rank and Freise Total. The Scott Formula was used to insure proper weighing of the service and clear tests as the Freise Total includes drop-shot tests which Scott has not made.

2. Ladder Rank and Scott Formula--Sophomores.
3. Ladder Rank and Scott Formula--Juniors.
4. Ladder Rank and Scott Formula--Seniors.

1. See below, Appendix B, p. 36.

2. J.P. Guilford, Fundamental Statistics in Education and Psychology. McGraw-Hill Book Company, New York and London, 1942. pp. 202-203.

3. See above, p. 7.

5. Ladder Rank and Freise Total--Freshmen.
6. Ladder Rank and Freise Total--Sophomores.
7. Ladder Rank and Freise Total--Juniors.
8. Ladder Rank and Freise Total--Seniors.
9. Scott Total of Service and Clear Tests vs. Freise Total of Service and Clear Tests--Freshmen.
10. Scott Total of Service and Clear Tests vs. Freise Total of Service and Clear Tests--Sophomores.
11. Scott Total of Service and Clear Test vs. Freise Total of Service and Clear Tests--Juniors.
12. Scott Total of Service and Clear Tests vs. Freise Total of Service and Clear Tests--Seniors.

Validity is achieved through the correlations of the test scores with the ladder rank. If these test scores correlate proportionally with the ladder ranks, than these skill tests are true measures of skill in badminton.

Reliability is achieved by getting the same results with the four different groups on the same material as long as each group is controlled by its own degree of skill-- and does not compete with the other groups.

## CHAPTER IV

### SUMMARY

This study is a comparison of the Scott tests of badminton skill and the Freise tests of badminton skill. The Scott tests are the service test and the clear test.<sup>1</sup> The Freise tests are the service test, the clear test, the drop-shot mid-court test,<sup>2</sup> and the drop-shot back-court test.

Four groups--60 freshmen, 60 sophomores, 56 juniors, and 60 seniors--of Notre Dame High School, Chicago, were selected for this study. A ladder tournament was formed and played off in each group in order to find the rank difference of badminton skill of each girl in the group. Then each girl was given the two Scott tests and the four Freise tests.

The following chart is a summary of the correlations made with the test scores of these groups:

	Freshmen	Sophomores	Juniors	Seniors
Ladder Rank vs. Scott Formula	-.54	-.13	-.27	.01
Ladder Rank vs. Freise Total	-.39	.04	-.03	.16
Scott Total of Service and Clear vs. Freise Total of Service and Clear	.32	.26	.32	.03

1. Supra, pp. 3-7.
2. Supra, pp. 7-11.

CHAPTER V  
CONCLUSIONS

Correlations

The correlation of the ladder rank and the Scott Formula is negative (-.54) in the freshman group; negative (-.13), therefore higher than the freshman, in the sophomore group; negative (-.27), low again in the junior group; and positive (.01), and almost zero in the senior group.

The correlation of the ladder rank and the Freise Total follows the same pattern of very low and negative correlations: freshmen negative (-.39); sophomores positive and higher (.04); juniors negative and lower (-.03); and seniors positive and higher (.16).

The intercorrelation of the Scott and Freise total of service and clear tests is very low and could only be considered significant because the freshman (.32), sophomore (.26), and junior (.32) correlations vary little, and therefore are highly reliable. In the senior group, time was shorter because of graduation activities.

When the Scott and Freise tests are correlated with a ladder tournament rank with these high school girls, there

is no correlation above .16. The validity of these tests when compared with the ladder tournament is negative or low (-.54 to .16). Therefore, these tests are not valid for high school girls. The fine motor skills of these badminton tests are too difficult for high school girls--especially the younger group of freshmen.<sup>1</sup>

Throughout the testing program, the author found these conditions in the separate skill tests obviously too hard for students:

1. In the Scott service test the clothesline rope caused the greatest difficulty and the lowest scores. There were few scores that had no successful shots out of 20 trials. But there were very few girls at these age levels who have mastered enough control to place the bird between the rope and net continuously.

2. In the Freise service test the alternate serve--the one to the back-court targets--was difficult. Here the high school girls had trouble getting enough wrist power to place the bird beyond the center scoring area.

3. In the Scott clear test very high scores were made because the rope cut across about mid-court. However, scoring three points for putting the bird out-of-bounds does not seem to simulate a real game situation.<sup>2</sup>

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1. See negative correlations, p. 22.

2. See description of Scott clear test, p. 5.

4. On the other hand, the Freise clear test was very difficult because the rope was three feet further back in the back-court area. Again--and especially in the backhand shots--high school girls do not have the wrist power to place the bird in the back court.

5. Freise's drop-shot tests did not appear too difficult as a player calls upon very little wrist strength and power to place the bird just over the net. Again it was the alternate shot--the long backhand that caused many low scores.

The fluctuations of the senior group are hard to explain except that these tests were given at the end of the year. Many seniors were taken out of class for senior activities--thus decreasing their possible practice time.

Another factor which must be considered is the psychology of the game. Many girls who had mastered the necessary skills did not use them in the ladder tournament games. In some cases it was a concept of sportsmanship that it wasn't "nice" to be "mean" to your opponent--friend by using these skills. In other cases, the players were so busy hitting the bird that they didn't think of using these skills.

Therefore, the test scores correlated with the ladder tournament were found to be very low and not valid in testing the skill of high school girls. The greatest factor against both the Scott tests and the Freise test is motor maturity

of high school girls--or the lack of it--proven by the high negative correlations of the younger group--correlations which grow progressively higher (but are still lower than (.16) as the group becomes more mature.

Limitations of Study and Suggestions  
for Further Research

Large beginning classes were used to teach badminton skills. Large classes should be used only for testing purposes. Skills should be taught individually.

A control group is needed for each year to make study more valid.

More time was needed to re-test groups to make the study more reliable.

Modifications of these skill tests should be made and tested with high school groups.

There are no individual studies of each of these six tests.

There is no study of factors which must be considered in the psychology of the game. Poor psychological situations<sup>1</sup> effect the losing and winning of games, and thus the ladder rank.

There is no study of the effect of teaching skills just before giving the skill tests--then following with the ladder tournament.

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1. Supra, p. 25, paragraph 4.

### Educational Significance

The intricate motor skills of badminton require that it be placed in the high school curriculum not earlier than the second year. The wrist skills needed in badminton can not be considered as large muscular activities which freshmen girls can master. The most significant place of badminton would be in the second and third year--as outside interests are detracting in the senior year at the end of the year.

Skill tests should be taught before actual game play--as the ladder tournament proves ineffective before skill tests are given.

Modifications of these skill tests could be given to classify students into beginning, intermediate, and advanced groups for teaching sport.

Skill tests--when not too many or too difficult--could be used as motivating factors.

Simplified skill tests--these tests very much modified--could be used to make teaching more uniform in large classes.

**APPENDICES**

Appendix ATest Scores of 60 Freshmen--Notre Dame High School

Ladder Rank	Scott Service	Scott Clear	Scott Total	Scott Formula	Freise Service	Freise Clear	Freise Total	Drop-Shot Mid	Drop-Shot Back	Freise Total
1	48	77	125	140	21	25	46	0	8	54
2	29	52	81	91	12	5	17	9	14	40
3	38	76	114	129	25	15	40	4	6	50
4	29	55	84	95	19	10	29	5	5	39
5	12	54	66	76	18	0	18	6	8	32
6	13	56	69	80	12	5	17	3	3	23
7	24	85	109	126	20	0	20	10	6	36
8	42	71	113	127	23	15	38	10	0	48
9	13	77	90	105	20	20	40	2	17	59
10	28	63	91	103	23	0	23	5	5	33
11	3	57	60	71	22	0	22	4	5	31
12	38	49	87	96	21	10	31	6	10	47
13	18	35	53	60	18	10	28	13	17	58
14	10	49	59	68	11	0	11	10	7	28
15	0	87	87	104	19	5	24	4	3	31
16	41	42	83	91	4	5	9	6	0	15
17	6	64	70	82	20	10	30	4	8	42
18	23	51	74	84	23	25	48	11	7	66
19	34	43	77	85	20	5	25	2	10	37
20	0	74	74	88	24	0	24	6	3	33
21	2	76	78	93	7	0	7	1	9	17
22	7	61	68	80	15	15	30	7	0	37
23	30	58	88	99	14	0	14	4	6	24
24	14	69	83	96	19	15	34	3	13	50
25	10	64	74	86	20	0	20	14	0	34
26	11	47	58	67	20	0	20	8	9	37
27	24	55	79	90	19	20	39	1	3	43
28	16	46	62	71	15	15	30	9	14	53
29	25	55	80	91	15	15	30	1	3	34
30	22	54	76	86	12	5	17	0	17	34
31	12	33	45	51	27	5	32	5	6	43
32	7	54	61	71	15	0	15	1	3	19
33	16	35	51	58	4	15	19	3	11	33
34	13	67	80	93	19	15	34	0	3	37
35	16	51	67	77	20	0	20	7	3	30
36	7	61	68	80	22	0	22	5	0	27
37	12	72	84	98	13	20	33	6	5	44
38	12	56	68	79	14	0	14	1	0	15
39	18	69	87	100	16	20	36	2	3	41
40	4	6	10	11	24	0	24	1	6	31
41	3	61	64	76	36	5	41	9	3	53
42	22	73	95	109	15	5	20	4	0	24
43	20	85	105	122	19	5	24	11	3	38
44	10	55	65	76	13	15	28	7	19	54
45	6	56	62	73	11	5	16	2	3	21

Ladder Rank	Scott Service	Scott Clear	Scott Total	Scott Formula	Freise Service	Freise Clear	Freise Total	Freise Drop-Shot		Freise Total
								Mid	Back	
46	11	13	24	26	7	20	27	4	0	31
47	17	2	19	19	16	0	16	2	5	23
48	11	6	17	18	22	0	22	3	3	28
49	8	46	54	63	30	5	35	0	0	35
50	5	42	47	55	8	10	18	1	3	22
51	14	39	53	60	9	0	9	9	0	18
52	22	20	42	46	8	5	13	6	0	19
53	17	51	68	78	15	5	20	4	5	29
54	9	34	43	49	19	0	19	1	5	25
55	7	40	47	55	10	20	30	2	0	32
56	33	14	47	49	14	10	24	0	12	36
57	17	32	49	55	18	5	23	2	0	25
58	7	65	72	85	17	20	37	9	8	54
59	7	6	13	14	4	5	9	4	9	22
60	12	36	48	55	11	15	26	3	6	35

Test Scores of 60 Sophomores--Notre Dame High School

Ladder Rank	Scott Service	Scott Clear	Scott Total	Scott Formula	Freise Service	Freise Clear	Freise Total	Drop-Shot Mid	Drop-Shot Back	Freise Total
1	24	50	74	84	17	15	32	10	11	53
2	36	63	99	111	20	15	35	2	3	40
3	9	67	76	89	18	15	33	2	9	44
4	44	71	115	130	22	20	42	5	8	55
5	12	68	80	93	17	10	27	1	12	40
6	6	60	66	78	7	10	17	2	6	25
7	24	47	71	80	19	10	29	11	13	53
8	0	36	36	43	9	0	9	3	0	12
9	31	68	99	112	8	10	18	3	15	36
10	34	37	71	78	17	0	17	4	6	27
11	43	44	87	95	19	15	34	6	12	52
12	10	38	48	55	8	0	8	1	3	12
13	13	75	88	103	23	20	43	4	13	60
14	11	52	63	73	17	6	23	4	10	37
15	12	37	49	56	14	10	24	3	8	35
16	9	54	63	73	15	5	20	3	14	37
17	2	9	11	12	12	0	12	3	13	28
18	21	72	93	107	24	10	34	10	9	53
19	40	39	79	86	10	5	15	5	0	20
20	1	80	81	97	20	13	33	4	0	37
21	25	70	95	109	21	17	38	2	3	43
22	3	74	77	91	21	10	31	5	11	47
23	18	72	90	104	20	5	25	5	13	43
24	4	16	20	23	3	6	9	2	3	14
25	17	76	93	108	8	0	8	5	9	22
26	3	68	71	84	10	5	15	3	6	24
27	21	43	64	72	23	10	33	8	8	49
28	1	46	47	56	2	8	10	7	8	25
29	23	26	49	54	18	0	18	2	0	20
30	0	61	61	73	12	0	12	4	3	19
31	4	22	26	30	18	13	28	5	3	36
32	25	65	90	103	18	15	33	1	23	57
33	17	40	57	65	19	5	24	3	11	38
34	8	45	53	62	18	20	38	4	9	51
35	11	50	61	71	7	0	7	1	3	11
36	32	34	66	72	9	15	24	0	0	24
37	9	47	56	65	18	10	28	5	11	44
38	8	60	68	80	13	10	23	3	0	26
39	0	57	57	68	24	10	34	8	3	45
40	25	32	57	63	23	0	23	4	9	36
41	9	23	32	36	22	5	27	7	8	42
42	22	47	69	78	21	0	21	2	0	23
43	17	78	95	110	21	0	21	15	0	36
44	8	18	26	29	35	15	50	5	0	55
45	12	54	66	76	19	15	34	0	9	43
46	13	61	74	86	19	15	34	6	9	49
47	4	27	31	36	12	0	12	3	0	15
48	17	27	44	49	23	5	28	3	5	36

Ladder Rank	Scott Service	Scott Clear	Scott Total	Scott Formula	Freise Service	Freise Clear	Freise Total	Freise Drop-Shot		Freise Total
								Mid	Back	
49	50	38	88	95	10	4	14	15	6	35
50	19	77	96	111	20	0	20	3	3	26
51	5	0	5	5	23	0	23	11	9	43
52	22	60	82	94	10	15	25	4	3	32
53	13	32	45	51	14	15	29	2	11	42
54	6	46	52	61	22	0	22	9	3	34
55	56	30	86	92	21	25	46	7	6	59
56	12	35	47	54	19	10	29	5	14	48
57	23	51	74	84	8	15	23	0	9	32
58	5	28	33	38	19	10	29	2	9	40
59	21	51	72	82	23	25	48	2	3	53
60	16	37	53	60	14	10	24	15	8	47

Test Scores of 56 Juniors--Notre Dame High School

Ladder Rank	Scott Service	Scott Clear	Scott Total	Scott Formula	Freise Service	Freise Clear	Freise Total	Freise Drop-Shot		Freise Total
								Mid	Back	
1		82	92	108	23	25	48	0	6	54
2	10	55	58	69	19	10	29	1	8	38
3	3	81	91	107	16	0	16	0	0	16
4	10	47	62	71	9	5	14	10	0	24
5	15	61	89	101	12	10	22	2	0	24
6	28	50	61	71	19	15	34	6	9	49
7	11	61	91	103	17	0	17	5	5	27
8	30	49	64	73	15	5	20	6	8	34
9	15	57	86	97	17	15	32	8	3	43
10	29	55	63	74	8	15	23	3	6	32
11	38	85	85	102	18	5	23	6	3	32
12	0	70	103	117	15	20	35	7	3	45
13	33	53	53	63	13	5	18	8	6	32
14	0	76	101	116	18	10	28	3	10	41
15	25	51	68	78	24	25	49	9	5	63
16	17	55	73	84	16	20	36	8	11	55
17	18	66	75	88	10	15	25	0	6	31
18	9	47	50	59	4	10	14	8	12	34
19	3	70	103	117	17	10	27	0	0	27
20	33	47	64	73	21	20	41	3	3	47
21	17	52	62	72	14	10	24	5	3	32
22	10	75	130	145	16	5	21	3	0	24
23	55	72	106	120	7	25	32	3	0	35
24	34	74	103	117	21	10	31	0	5	36
25	29	31	51	57	14	4	18	3	5	26
26	20	66	76	89	16	10	26	2	11	39
27	10	63	74	86	10	0	10	1	6	17
28	11	42	67	75	10	5	15	0	6	21
29	25	57	57	68	0	10	10	0	6	16
30	0	42	44	52	17	0	17	4	0	21
31	2	57	86	97	13	10	23	1	0	24
32	29	35	53	60	7	0	7	0	3	10
33	18	82	114	130	9	10	19	14	8	41
34	32	80	97	113	8	15	23	6	3	32
35	17	23	32	36	9	5	14	7	0	21
36	9	4	20	20	14	0	14	5	0	19
37	16	57	65	76	26	5	31	8	14	53
38	8	68	81	94	7	15	32	6	6	34
39	13	36	51	58	20	15	35	4	5	44
40	15	32	46	52	6	0	6	1	3	10
41	14	34	64	70	18	5	23	0	6	29
42	30	34	40	46	9	0	9	1	6	16
43	6	19	24	27	15	15	30	5	5	40
44	5	53	81	91	35	5	40	5	5	50
45	28	72	119	133	33	0	33	7	8	48
46	47	71	116	130	24	5	29	8	5	42
47	45	68	97	110	21	20	41	5	11	57
48	29	53	74	84	7	0	7	3	0	10

Ladder Rank	Scott Service	Scott Clear	Scott Total	Scott Formula	Freise Service	Freise Clear	Freise Total	Freise Drop-Shot		Freise Total
								Mid	Back	
49	5	45	50	59	2	0	2	4	3	9
50	28	70	98	112	10	15	25	0	0	25
51	0	47	47	56	9	15	24	8	3	35
52	42	51	93	103	26	20	46	4	0	50
53	0	44	44	52	19	5	24	6	3	33
54	20	39	59	66	23	0	23	5	0	28
55	29	79	108	123	10	0	10	2	6	18
56	8	68	76	89	22	15	37	0	0	37

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Test Scores of 60 Seniors--Notre Dame High School

Ladder Rank	Scott Service	Scott Clear	Scott Total	Scott Formula	Freise Service	Freise Clear	Freise		Drop-Shot Back	Freise Total
							Freise Total	Mid		
1	23		92	105	11	5	16	12	3	31
2	9	69	59	69	8	10	18	2	8	28
3	0	50	49	58	27	0	27	3	3	33
4	3	49	59	70	18	25	43	6	0	49
5	23	56	90	103	13	5	18	6	0	24
6	2	67	67	80	2	0	2	4	8	14
7	1	65	35	41	26	10	36	4	8	48
8	0	34	14	16	20	5	25	0	0	25
9	21	14	66	75	16	5	21	4	11	36
10	24	45	108	124	18	0	18	2	0	20
11	17	84	38	42	19	0	19	0	0	19
12	37	21	84	93	27	15	42	5	7	54
13	5	47	65	77	27	15	42	4	8	54
14	35	60	80	89	19	15	34	5	10	49
15	0	45	30	36	11	10	21	2	3	26
16	29	30	82	92	17	15	32	6	18	46
17	28	53	100	114	27	5	32	4	8	44
18	22	72	57	64	15	0	15	9	5	29
19	29	35	92	104	17	15	32	1	3	36
20	7	63	42	49	22	0	22	6	9	37
21	18	35	72	82	32	0	32	6	12	50
22	35	54	110	125	17	0	17	10	0	27
23	12	75	102	120	31	5	36	1	6	43
24	5	90	60	71	25	5	30	2	10	42
25	12	55	45	51	15	10	25	1	13	39
26	13	33	68	79	22	15	37	1	0	38
27	9	55	39	45	5	0	5	0	9	14
28	9	30	48	55	12	0	12	5	15	32
29	40	39	100	112	17	5	22	0	11	33
30	18	60	55	62	24	10	34	6	16	56
31	21	37	84	96	10	10	20	4	0	24
32	0	63	76	91	16	15	31	11	18	60
33	22	76	86	98	10	15	25	6	10	41
34	14	64	42	47	17	10	27	0	9	36
35	5	28	83	98	14	0	14	7	8	29
36	27	78	62	69	7	0	7	8	3	18
37	41	35	63	67	18	0	18	4	9	31
38	14	22	80	93	17	0	17	5	0	22
39	4	66	67	79	23	10	33	8	6	47
40	13	63	63	73	27	0	27	1	0	28
41	33	50	63	73	27	15	31	2	11	44
42	30	55	88	99	16	5	30	1	0	31
43	1	56	86	96	25	15	32	6	11	49
44	6	62	63	75	17	5	28	4	0	32
45	13	44	50	58	23	10	29	3	3	35
46	29	69	82	95	19	5	33	0	0	33
47	35	14	43	45	28	0	15	6	9	30
48	8	72	107	121	15	15	39	2	0	41
		44	52	60	24					

Ladder Rank	Scott Service	Scott Clear	Scott Total	Scott Formula	Freise Service	Freise Clear	Freise Total	Freise		Freise Total
								Drop- Mid	Shot- Back	
49	7	75	82	97	27	10	37	3	11	51
50	38	69	107	120	8	15	23	15	3	41
51	3	63	66	78	31	15	46	5	15	66
52	35	58	93	104	27	20	47	7	5	59
53	9	32	41	47	33	10	43	3	6	52
54	22	59	81	92	26	20	46	6	13	65
55	4	51	55	65	20	15	35	6	5	46
56	20	30	50	56	23	15	38	8	0	46
57	16	39	55	62	17	25	42	6	0	48
58	9	25	34	39	9	0	9	6	3	18
59	4	47	51	60	19	0	19	3	3	25
60	39	48	87	96	0	0	0	4	11	15

Appendix B

	Mean	Sum $x^2$	Sum $y^2$	Sum $xy$	Square Root ( $\Sigma x^2$ ) ( $\Sigma y^2$ )	Correlations
Ladder Rank	30.5	17995.0		-15720.0		
Scott Formula	77.7		46105.0		829673871.0	-.54
Freshmen						
Ladder Rank	30.5	17995.0		-3796.0		
Scott Formula	73.9		42574.0		766129927.0	-.13
Sophomores						
Ladder Rank	28.5	14360.0		-6959.0		
Scott Formula	84.6		43333.0		622261880.0	-.27
Juniors						
Ladder Rank	30.5	17995.0		156.0		
Scott Formula	78.0		38119.0		685951405.0	.01
Seniors						
Ladder Rank	30.5	17995.0		-4575.0		
Freise Total	35.1		7429.0		133699251.0	-.39
Freshmen						
Ladder Rank	30.5	17995.0		545.0		
Freise Total	37.0		9882.0		177826590.0	.04
Sophomores						
Ladder Rank	28.5	14360.0		-295.0		
Freise Total	32.6		9474.0		136046640.0	-.03
Juniors						
Ladder Rank	30.5	17995.0		2173.0		
Freise Total	37.3		9417.0		169458915.0	.16
Seniors						
(S/C)						
Scott Total	67.8	34051.0		4325.0		
Freise Total	24.8		5149.0		175328599.0	.32
Freshmen						
Scott Total	64.6	32787.0		3808.0		
Freise Total	25.4		6335.0		207705645.0	.26
Sophomores						
Scott Total	73.8	34151.0		4815.0		
Freise Total	24.3		6576.0		224576976.0	.32
Juniors						
Scott Total	68.1	29661.0		486.0		
Freise Total	26.7		6837.0		202821918.0	.03
Seniors						

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