

5-1-1964

A comparison study between the binocular cross cylinder test at near and the Hodgens nearpoint red-green test

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Recommended Citation

Russell, John and Frewing, Bert, "A comparison study between the binocular cross cylinder test at near and the Hodgens nearpoint red-green test" (1964). *College of Optometry*. 253.
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A comparison study between the binocular cross cylinder test at near and the Hodgens nearpoint red-green test

Abstract

The purpose of this project is to compare the responses of the Hodgens Near Point Red-Green Test with the responses to the binocular fused cross cylinder test at near, and secondly to determine if the Hodgens Near Point Red-Green Test is acceptable as a substitute for the already accepted binocular fused cross cylinder test at near.

Degree Type

Thesis

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A COMPARISON STUDY BETWEEN THE BINOCULAR CROSSED CYLINDER TEST
AT NEAR AND THE HODGENS NEARPOINT RED-GREEN TEST

CLINICAL YEAR PROJECT

BY

John Russell

Bert Frewing

— May 1964 —

ACKNOWLEDGEMENTS

We express our appreciation to Dr. D.T. Jans, Professor of Optometry, and Dr. William R. Baldwin, Dean of the College of Optometry, for their guidance and interest in our project. In addition we wish to thank those who so willingly cooperated with us by serving as subjects for this study.

J. R.
B. F.

CONTENTS

	PAGE
PURPOSE	1
INTRODUCTION	2
PROCEDURE	3
ORGANIZATION OF DATA	6
DISCUSSION AND CONCLUSION	9

PURPOSE

The purpose of this project is to compare the responses of the Hodgens Near Point Red-Green Test with the responses to the binocular fused cross cylinder test at near, and secondly to determine if the Hodgens Near Point Red-Green Test is acceptable as a substitute for the already accepted binocular fused cross cylinder test at near.

INTRODUCTION

The Hodgens Near Point Test, comprised of four test targets on a revolving dial, is a testing device which has recently been developed to facilitate near point testing. The device is attached to the reading card holder of the Green's Refractor, where the test material can be easily and quickly presented to the patient. The basic test target, and only one used in the study, is a rectangular transilluminated grid of vertical and horizontal lines on a red-green background. The developers of the Hodgens Near Point Test state that the red-green target can be substituted for the crossed cylinder lenses and companion card customarily used; further the inventors state that the Hodgens Near Point Test is a better test because it "substitutes easier discrimination, based on the chromatic interval, for the more difficult judgment of differences in blackness."

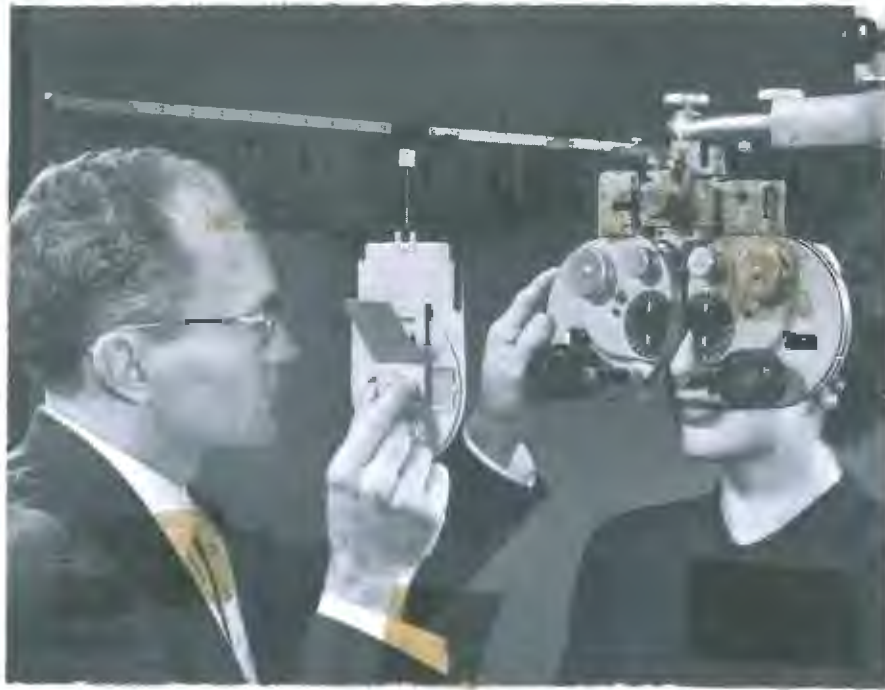
PROCEDURE

- A. The subjects were numbered one through eighty-eight. Odd numbered subjects were presented with the binocular fused crossed cylinder test at near first. Even numbered subjects were presented with the Hodgens Near Point Red-Green Test first.
- B. The near pupillary distance was in place.
- C. Hodgens Near Point Red-Green Test
 1. The near-point lamp is placed directly over and ten inches above the reflector plate.
 2. The lamp shade is adjusted so that no light is reflected on the patient or on the front of the test plate.
 3. The test target is placed at 16 inches.
 4. The room illumination is dim.
 5. Testing was begun with two diopters of plus added to the lenses of the best visual acuity at far (#7A).
 6. The question, "How many red-green charts do you see?" was asked as a check to make sure the target was fused.
 7. The patient was next asked, "Are the lines darker and more distinct on the red or on the green side of the target?" If the subject said "red", which was usually the case, minus spheres were added in .25 diopter steps until the subject said "green". If the subject said "green" after the plus 2.00 diopters was added, plus was added in .25 diopter steps until the subject reported "red". Then minus spheres were added to the reversal. If the subject reported "the same" through an interval of 1.00 diopter or more the finding was recorded as "no response" and the patient was not included in the statistical comparison.
- D. Binocular Fused Crossed Cylinder Test
 1. The near-point lamp is directed against the wall.
 2. The test target, cross grid, is placed at the 16 inch distance.
 3. The Jackson crossed cylinders are in place.
 4. Room illumination is dim.

5. Testing was begun with two diopters of plus added to the lenses of the best visual acuity at far (#7A).
6. The red dots of the Jackson crossed cylinders were placed along the 0° - 180° meridians.
7. The question, "How many charts do you see?" was asked as a check to make sure the target was fused.
8. The subject was then asked, "which lines are darker and more distinct, those lines running up-and-down or across?" The expected response at this point is "across". If the expected response was given the Jackson crossed cylinders were then reoriented so that the red dots were aligned with the 90° meridian. The subject was then asked again "which lines are darker and more distinct, those lines running up-and-down or those lines running across?" The expected response at this point is "up-and-down". If the expected responses were given the subject was then qualified to be a part of the study.
9. If the subject qualified then the plus was decreased in .25 diopter steps until the subject gave the "across" response. If the subject reported "equal" through an interval of 1.00 diopter or more the finding was recorded as "no response" and the patient was not included in the statistical comparison.

E. Equipment

1. Green's Refractor
2. Hodgens Near Point Test
3. Cross Grid
4. Jackson Crossed Cylinders
5. Near point lamp



Hodgens Near Point Test in Use



Front View



Back View

ORGANIZATION OF DATA

Eighty-two subjects with an age range from eight to thirty-eight years were tested. A distribution by age, sex, and refractive status is as follows:

AGE	SUBJECTS	SEX	REFRACTIVE STATUS
8-12	1	1F	1E
12-20	1	1F	1E
20-30	73	72M, 1F	12E, 21H, 42M
30-40	7	7M	1E, 4H, 2M

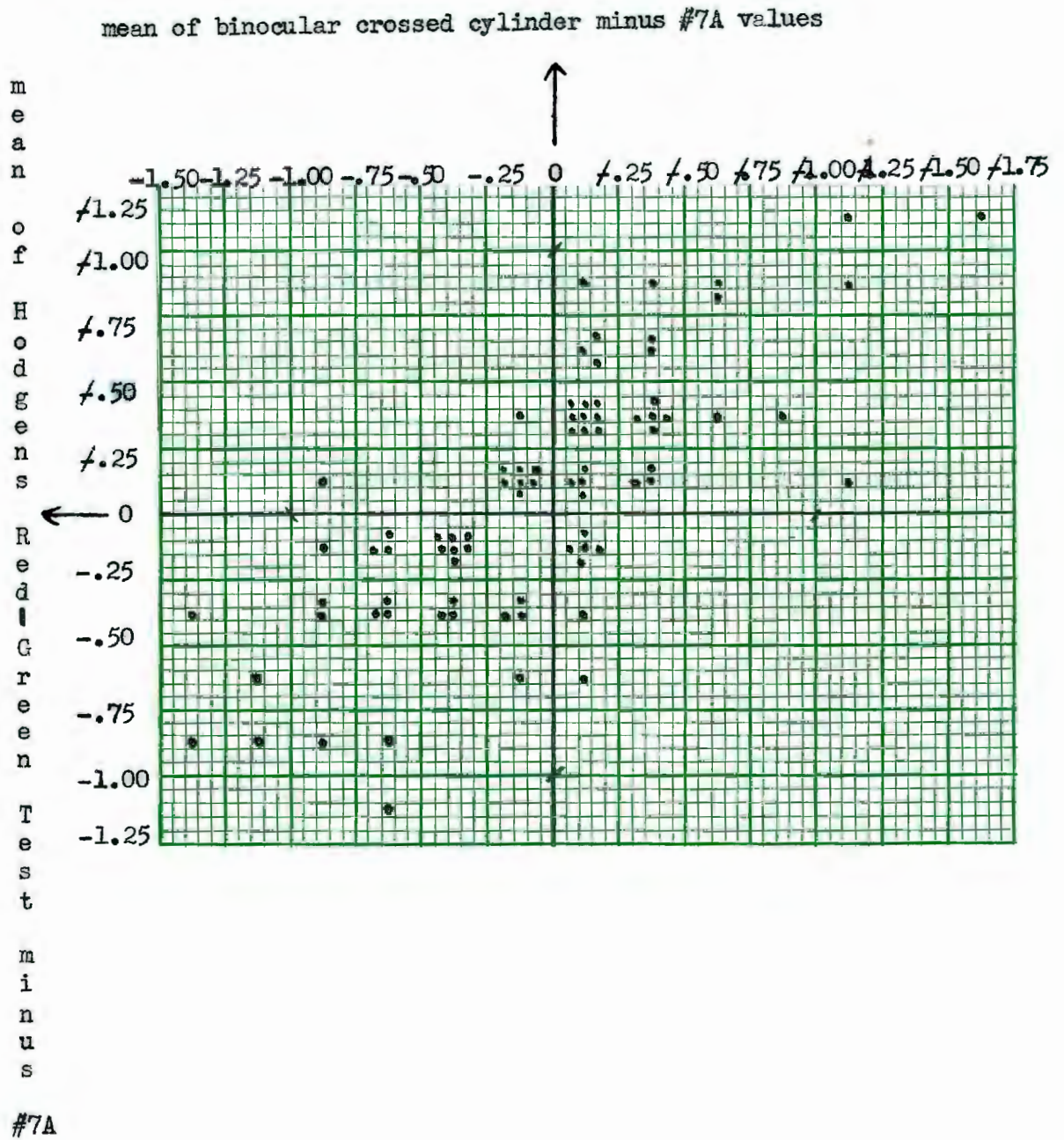
Of these, 97% were college students and 91% were optometry students. 6% were college students of non-optometric areas.

Because the data was quite extensive it has not been included in this paper, only the statistical conclusions have been presented.

Figure 1 is a scattergram representing the deviation of paired crossed grid and Hodgens Red-Green Test findings from their individual norms. Each dot represents the paired findings from their individual norms. Each dot also represents the paired findings of one subject. The findings are placed on the scattergram with an accuracy to the nearest .25 diopter interval. All dots within a .25 diopter interval have equal values.

The formulae used in the statistical analysis and the statistical results are given on page 8.

Figure 1 is a scattergram representing the paired binocular crossed cylinder and Hodgens Near Point Red-Green for each subject plotted by their deviation from the means.



STATISTICAL ANALYSIS

Formulas¹

$$\text{Mean } (\bar{X} \text{ and } \bar{Y}) \quad \bar{X} = X/n, \quad \bar{Y} = Y/n$$

where X = near point crossed cylinder test values minus #7A
 Y = Hodgens Near Point Red-Green Test values minus #7A
 n = number of subjects

Standard Deviation (s)

$$s = \sqrt{\sum x^2/n-1} \quad (X \text{ values})$$

$$\text{where } x = X - \bar{X}$$

$$s = \sqrt{\sum y^2/n-1} \quad (Y \text{ values})$$

$$\text{where } y = Y - \bar{Y}$$

Variance (s²)

$$s^2 = \sum x^2/n-1 \quad (X \text{ values})$$

$$s^2 = \sum y^2/n-1 \quad (Y \text{ values})$$

Correlation Coefficient (r)

$$r = \sum xy/n-1 / \sqrt{(\sum x^2/n-1)(\sum y^2/n-1)}$$

Test for significance (t)

$$t = r / \sqrt{1-(r^2)} \cdot \sqrt{n-2}$$

Statistical Results

$$\bar{X} \quad (X \text{ values}) = 0.93 \text{ diopters}$$

$$\bar{Y} \quad (Y \text{ values}) = 0.82 \text{ diopters}$$

$$s \quad (X \text{ values}) = 0.988$$

$$s \quad (Y \text{ values}) = 1.040$$

$$s^2 \quad (X \text{ values}) = 0.9775$$

$$s^2 \quad (Y \text{ values}) = 1.0872$$

$$r \quad (\text{correlation of } X \text{ and } Y) = 0.74$$

$$t \quad (\text{test for significance}) = 2.7397$$

¹ Allen L. Edwards, "Statistical Analysis", Rinehart & Company, Inc., New York 1959, pp 40-53-68-167.

DISCUSSION AND CONCLUSION

The correlation coefficient was 0.74. It is impossible from the statistical conclusions of our study to make definite statements as to whether the tests are tests of the same function or that one test can be substituted for the other on an individual basis. To be able to obtain decisive conclusions of the above nature will require tests of reliability in which each of the tests is correlated with itself. This requires data that we have not taken for this study.

Of the 82 subjects who responded to the tests 32 judged the red-green test to be the easier test to respond to, 39 judged the cross-grid test as the easier test to respond to, and 11 judged that there was no difference in ease of response to the two tests.

Of the six subjects in the "no response" group four showed no response to the cross-grid test and two showed no response to the red-green test. None of the "no response" group had no response to both tests.

APPENDIX

APPENDIX

DATA

Subjects	#7A	X CG-#7A	Y HRG-#7A	D
1. WP	-2.00	/1.00	/1.25	-0.25
2. LD	-1.50	/1.50	/1.25	/0.25
3. WM	/0.50	/1.25	/1.25	0.00
4. RL	-1.00	/1.25	/1.25	0.00
5. RD	/1.00	/1.50	/1.50	0.00
6. DS	/0.50	/1.00	/1.25	-0.25
7. RW	-0.25	/0.25	/0.75	-0.50
8. GG	0.00	/0.50	/0.75	-0.25
9. RC	-5.50	0.00	/0.75	-0.75
10. LS	-0.50	/0.75	/1.00	-0.25
11. TG	/0.75	/1.00	/1.50	-0.50
12. JN	-2.50	/1.00	/1.00	0.00
13. JW	0.00	/0.50	/0.50	0.00
14. HM	0.00	/1.50	/1.75	-0.25
15. SA	/0.50	/1.00	/1.25	-0.25
16. ML	/0.50	/1.00	/1.25	-0.25
17. RD	-2.25	/0.50	/0.75	-0.25
18. RG	-2.00	/1.00	/1.25	-0.25
19. DW	/0.50	/1.00	/0.50	/0.50
20. DJ	/0.25	/1.00	/0.75	/0.25
21. WB	0.00	/1.00	/1.50	-0.50
22. RM	-1.00	0.00	0.00	0.00
23. RA	-2.25	/2.00	/2.00	0.00
24. GS	0.00	/1.25	/1.00	/0.25
25. RW	/0.62	/1.00	/1.25	-0.25

DATA

Subjects	#7A	X CG-#7A	Y HRG-#7A	D
26. RM	-3.25	/1.25	/1.75	-0.50
27. BV	-6.25	/1.75	/1.25	/0.50
28. JH	-3.75	/0.75	/1.00	-0.25
29. LY	0.00	-0.25	0.00	-0.25
30. IB	/0.50	/2.50	/2.00	/0.50
31. RS	-2.00	/0.25	-0.25	/0.50
32. DM	/1.50	/0.50	/0.75	-0.25
33. LW	-0.75	/1.00	/0.75	/0.25
34. DT	-1.75	/0.25	/0.75	-0.50
35. JB	-3.75	/1.00	/0.75	/0.25
36. AM	/0.75	/0.25	/0.50	-0.25
37. GD	-3.25	/0.25	/0.50	-0.25
38. MD	-1.00	-0.25	/0.25	-0.50
39. JE	/2.25	/1.25	/1.00	/0.25
40. CB	-0.37	/1.00	/1.50	-0.50
41. RH	/1.00	/0.50	/0.75	-0.25
42. JH	0.00	/0.25	0.00	/0.25
43. ?B	00.00	/0.50	/0.50	0.00
44. RJ	-3.75	/1.00	/1.75	-0.75
45. JP	0.00	/1.00	/0.25	/0.75
46. KC	0.00	-0.50	/0.50	-1.00
47. DL	-1.50	/1.00	/1.00	0.00
48. CA	-1.25	/1.00	/1.00	0.00
49. LJ	/0.25	/1.25	/1.50	-0.25
50. JO	-2.75	/0.75	/0.75	0.00

DATA

Subjects	#7A	X CG-#7A	Y HRG-#7A	D
51. GS	-0.25	/0.75	/0.75	0.00
52. RH	-0.25	/0.50	/0.50	0.00
53. LL	-0.50	/0.75	/1.00	-0.25
54. RH	0.00	/0.25	/0.75	-0.50
55. JP	-4.00	/0.75	/1.25	-0.50
56. BM	-3.00	/1.00	/1.25	-0.25
57. JE	/0.50	/0.75	/0.75	0.00
58. CT	-3.25	/2.00	/1.75	/0.25
59. LD	/0.50	/0.75	/0.75	0.00
60. LV	-1.50	/1.25	/1.50	-0.25
61. TC	-2.50	/0.75	/1.00	-0.25
62. SY	/0.50	/0.50	/0.75	-0.25
63. SW	/0.75	0.00	/1.00	-1.00
64. GB	-0.75	/0.75	/1.00	-0.25
65. AO	-1.00	/0.75	/0.50	/0.25
66. BS	-2.50	/2.00	/1.00	/1.00
67. RW	-0.50	0.00	/0.50	-0.50
68. WE	0.00	/1.25	/1.25	0.00
69. JF	0.00	/0.75	/0.50	/0.25
70. KT	/0.25	/0.75	/0.50	/0.25
71. HH	/0.25	/1.00	/0.75	/0.25
72. JW	-1.50	/1.25	/1.25	0.00
73. HO	-0.75	0.00	/0.50	-0.50
74. MB	0.00	/1.00	/1.25	-0.25
75. KW	-0.50	/1.25	/1.00	/0.25

DATA

Subjects	#7A	CG ^X #7A	HRC ^Y #7A	D
76. GK	/0.50	/0.25	/ 0.50	/0.25
77. PO	-0.75	/0.50	/0.75	-0.25
78. D 8	/0.50	/1.25	/1.25	0.00
79. RH	/0.50	/0.50	/0.75	-0.25
80. PD	0.00	/1.50	/1.75	-0.25
81. BF	/0.25	-0.50	0.00	-0.50
82. JR	-2.75	+ .75	/0.25	/0.50

STATISTICS

Subjects	D^2	X^2	Y^2	XY
1. WP	0.0625	1.0000	1.5625	1.2500
2. LD	0.0625	2.2500	1.5625	1.8750
3. WM	0.0000	1.5625	1.5625	1.5625
4. RL	0.0000	1.5625	1.5625	1.5625
5. RD	0.0000	2.2500	2.2500	2.2500
6. DS	0.0625	1.0000	1.5625	1.2500
7. RW	0.2500	0.0625	0.5625	0.1875
8. GG	0.0625	0.2500	0.5625	0.3750
9. RG	0.5625	0.0000	0.5625	0.0000
10. LS	0.0625	0.5625	1.0000	0.7500
11. TE	0.2500	1.0000	2.2500	1.5000
12. JN	0.0000	1.0000	1.0000	1.0000
13. NW	0.0000	0.2500	0.2500	0.2500
14. HM	0.0625	2.2500	3.0625	2.6250
15. SA	0.0625	1.0000	1.5625	1.2500
16. ML	0.0625	1.0000	1.5625	1.2500
17. RD	0.0625	0.2500	0.5625	0.3750
18. RG	0.0625	1.0000	1.5625	1.2500
19. DW	0.2500	1.0000	0.2500	0.5000
20. DJ	0.0625	1.0000	0.5625	0.7500
21. WB	0.2500	1.0000	2.2500	1.5000
22. RM	0.0000	0.0000	0.0000	0.0000
23. RA	0.0000	4.0000	4.0000	4.0000
24. GS	0.0625	1.5625	1.0000	1.2500
25. RW	0.0625	1.0000	1.5625	1.2500

STATISTICS

Subjects	D^2	X^2	Y^2	XY
26. RM	0.2500	1.5625	3.0625	2.1875
27. BV	0.2500	3.0625	1.5625	2.1875
28. JH	0.0625	0.5625	1.0000	0.7500
29. LY	0.0625	0.0625	0.0000	0.0000
30. IB	0.2500	6.2500	4.0000	5.0000
31. RS	0.2500	0.0625	0.0625	-0.0625
32. DM	0.0625	0.2500	0.5625	0.3750
33. LW	0.0625	1.0000	0.5625	0.7500
34. DT	0.2500	0.0625	0.5625	0.1875
35. JB	0.0625	1.0000	0.5625	0.7500
36. AM	0.0625	0.0625	0.2500	0.1250
37. GD	0.0625	0.0625	0.2500	0.1250
38. MO	0.2500	0.0625	0.0625	0.0625
39. JE	0.0625	1.5625	1.0000	1.2500
40. CB	0.2500	1.0000	2.2500	1.5000
41. RH	0.0625	0.2500	0.5625	0.3750
42. JH	0.0625	0.0625	0.0000	0.0000
43. ?B	0.0000	0.2500	0.2500	0.2500
44. RJ	0.5625	1.0000	3.0625	1.7500
45. JP	0.5625	1.0000	0.0625	0.2500
46. KC	1.0000	0.2500	0.2500	-0.2500
47. DL	0.0000	1.0000	1.0000	1.0000
48. CA	0.0000	1.0000	1.0000	1.0000
49. LJ	0.0625	1.5625	2.2500	1.8750
50. JO	0.0000	0.5625	0.5625	0.5625

STATISTICS

Subjects	D^2	X^2	Y^2	XY
51. GS	0.0000	0.5625	0.5625	0.5625
52. RH	0.0000	0.2500	0.2500	0.2500
53. LL	0.0625	0.5625	1.0000	0.7500
54. RH	0.2500	0.0625	0.5625	0.1875
55. JP	0.2500	0.5625	1.5625	0.9375
56. BM	0.0625	1.0000	1.5625	1.2500
57. JE	0.0000	0.5625	0.5625	0.5625
58. CT	0.0625	4.0000	3.0625	3.5000
59. LD	0.0000	0.5625	0.0625	0.5625
60. LV	0.0625	1.5625	2.2500	1.8750
61. TC	0.0625	0.5625	1.0000	0.7500
62. SY	0.0625	0.2500	0.5625	0.3750
63. SW	1.0000	0.0000	1.0000	0.0000
64. GB	0.0625	0.5625	1.0000	0.7500
65. AO	0.0625	0.5625	0.2500	0.3750
66. GS	1.0000	4.0000	1.0000	2.0000
67. RW	0.2500	0.0000	0.2500	0.0000
68. WL	0.0000	1.5625	1.5625	1.5625
69. JF	0.0625	0.5625	0.2500	0.3750
70. KT	0.0625	0.5625	0.2500	0.3750
71. HH	0.0625	1.0000	0.5625	0.7500
72. JW	0.0000	1.5625	1.5625	1.5625
73. HO	0.2500	0.0000	0.2500	0.0000
74. MB	0.0625	1.0000	1.5625	1.2500
75. KW	0.0625	1.5625	1.0000	1.2500

STATISTICS

Subjects	D^2	X^2	Y^2	XY
76. GK	0.0625	0.0625	0.2500	0.1250
77. PO	0.0625	0.2500	0.5625	0.3750
78. DE	0.0000	1.5625	1.5625	1.5625
79. RH	0.0625	0.2500	0.5625	0.3750
80. PD	0.0625	2.2500	3.0625	2.6250
81. BF	0.2500	0.2500	0.0000	0.0000
82. JR	0.2500	0.5625	0.0625	0.1875