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A normative study of tachistoscopic localization skill

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A NORMATIVE STUDY OF
TACHISTOSCOPIC LOCALIZATION SKILL

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TABLE OF CONTENTS

INTRODUCTION

Many practitioners in the past fifteen years have used localization training as part of their office visual training program. Professor Samuel Renshaw of Ohio State University first suggested the possibility of localization skills being used in the field of visual training in the early 1940's. Haynes[1] in 1946, Brock in 1949, Wolf and many others have used both single and multiple object localization as part of tachistoscopic training programs. These clinicians are in agreement that localization skill improves with practice; however, little has been done in the field of optometry to quantify this aspect of vision in terms of standardized tests and performance expecteds.

Sherman describes the use of tachistoscopic localization methods in teaching artists how to view an object and to reproduce it tactually without viewing directly what was drawn.[2] Lyons and Lyons have developed a tachistoscopic visual training exercise involving localization, orientation or direction of figures shown under timed exposure. Neither Lyons and Lyons or Sherman have published their methods of scoring, testing, nor have they quantified their training results.

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1 H. M. Haynes, Unpublished lecture notes, Pacific Univ., 1963.
2 Hoyt L. Sherman, Drawing by Seeing, 1947.

A search of the psychological literature also has been unprofiitable in revealing any standardization of localization tests from which performance of space localization can be predicted. Although considerable work has been done in the visual perception areas, only a few specific works could be found that apply in a general way. Typical of these were the experiments of Hochberg and McAllister, and Salomon and Zener.

Hochberg and McAllister concluded from their experiment involving multiple figures comprised of angles and line segments that, "The less the amount of information needed to define a given organization as compared to other alternatives, the more likely that the figure will be so perceived."[3]

Salomon and Zener in their study involving localizing a dot as an extension of a line found for all four lengths of line increase, the variability increases linearly with increase of distance of the dot from the line. With the longer distances of the dot from the line, it decreases in a non-linear fashion with increase in line length.[4]

These studies illustrate tendencies of response, but do not define a localization skill standard test. From the above, and efforts made to search the literature for pertinent information, it was concluded that no published standardized localization test appears to be available for clinical use.

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3 J. Hochberg and E. McAllister, A Quantitative Approach to Figural Goodness, Jnl, Exp. Psych., 1953, p. 361-364.

4 A. S. Salomon and K. Zener, The Perception of Direction, American Psychologist, Vol. 1, 1946, p. 271.

THE PROBLEM

The purpose of this experiment was to contribute to the development of a test sufficiently high in reliability to be acceptable for clinical use in evaluating tachistocscopic localization skill.

This investigation is an extension of an earlier study of localization testing by John Brockmeier and James Vale[5] under the direction of Professor Harold M. Haynes.

The term "localization" pertains to quantitatively evaluating a subject's skill in reporting the number and spatial position of a random arrangement or familiar grouping of figures projected tachistoscopically in a homogeneous field.

The Brockmeier-Vale investigation studied localization of one to six figures. The accuracy of the subjects tested ranged from 65% using a single figure in the field to 28% using six figures in the field. The reliability factor of .49 found in the Brockmeier-vale experiment indicates that a minimum of 126 exposures would be required to develop a reliability of .90. This number of exposures made the test impractical for clinical use.

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5 J. Brockmeier, J. Vale, A Normative Study of a Proposed Localization Test, Pacific University Library, 1961.

The low reliability factor of the Brockmeier-Vale study is attributed largely to the number of figures used in the slide configurations, and in particular to the localization scoring method. Basically, scoring was predicated on both identifying correctly the number of figures presented in each exposure, and in correct localization of each figure. The criterion for a correct localization was a response placed within or touching the boundaries of each circular test figure. Responses which did not meet these criteria were scored zero. This method of scoring did not make adequate allowance for grading localization skill as it was possible for a subject to localize close to a scoring position and yet receive a score of zero. This reflected no better performance than the subject with the least localization ability.

It was believed that circles used in the Brockmeier-Vale study provided adequate stimulus for the study of localization; therefore, circles were again used in this investigation. In addition, it was thought that higher correlation would be achieved if the study were conducted on a more limited scale using randomized arrangements of one and three figure groupings arbitrarily chosen. By testing a minimum of fifty subjects it was anticipated that sufficiently reliable data would be obtained from which a localization test practical for clinical use could be designed.

EXPERIMENT PROCEDURE

A. Equipment

1. Slide projector with tachistoscope flash control.
2. Back projection screen.
3. Slides: 2 x 2, 35 mm.
4. Recording forms for subjects' test results.

B. Physical Arrangement

1. The projector was located on one side of the back projection screen at a fixed distance, projecting an image of the slide onto the screen. This distance was maintained to insure a uniform projection with the inside dimension of the frame or peripheral boundary of the projection measuring 17.8 x 17.8 centimeters.
2. The subject was seated directly in alignment with the screen on the side opposite to the projector, and at a distance of one meter from the screen to the subject's eyes.
3. The height of the projection was adjusted to place the field of view in front of the subject at eye level.
4. The room illumination was 4 foot-candles at the source, .25 foot-candle at subject's line of sight, and 1 foot-

candle at the viewed side of the projection screen with the projector lamp on.

5. The exposure time for each timed slide was 1/25 second.

C. Procedure and Instructions

1. The subject was seated in the chair, given a recording booklet, and an untimed slide was projected on the screen. The following instructions were then given:

"This is an experiment in timed exposure localization skill. You will be tested with slides similar to the one you now see projected on the screen. The test battery consists of eighteen single-figure exposures and eighteen three-figure exposures. The dark boundary you see on the screen is the same size as the square on your recording form. As the slides are flashed on the screen, you are to record, by placing a single dot within the square on the form, your best judgment of the location of the center of each circle you see. Prior to starting the basic test, you will be shown five untimed exposures and one timed practice exposure. You may take as much time as you think necessary on the untimed exposures to make judgments as to the location of the centers of the circles in reference to the surrounding boundary. The first mark will be regarded as your response for the purpose of the test. Please do not erase, cross out, or in any way change any mark placed in the square in response to a timed exposure. You may now record on the test form before you the location of the center of the circle projected on the screen."

2. The five untimed exposures were shown, then the subject was advised that the sixth would be a timed practice exposure. Prior to starting the timed exposure sequences the following instructions were given: "To prepare yourself for each timed slide, look at the center of the screen. Before flashing each exposure I will give you the instructions; 'ready, now,' and then flash the test configuration on the screen. You may then record your observation."

3. The thirty-six test slides were then presented to the subject. The numbers of the slides being shown were checked against corresponding page numbers on the test forms in order to avoid errors in scoring. All the slides in the one-figure display were shown first, followed by the three-figure groups.

D. Organization of the Test

1. Subjects chosen for the test were limited to those between the ages of fifteen and thirty-five, having visual acuity correctable to 20/20 OU, and who had not received tachistoscopic training within the past year. All subjects were required to wear their habitual prescription.

2. The timed test battery consisted of eighteen one-figure groupings and eighteen three-figure groupings. The slides were so ordered as to have two test sequences (A and B) in each of the figure groupings. The odd numbered slides comprised sequence "A", and the even numbered slides sequence "B". The slides of sequence "A" were identical to those of sequence "B" but randomly ordered in their presentation to avoid two like slides being seen in direct sequence. Randomization was achieved using a statistical table of random numbers (see Table IV).

3. This random arrangement provided a test procedure from which the correlation between sequences "A" and "B" could be determined and a factor of reliability predicted.

E. Scoring Method

1. Based on the results of the first ten subjects, a scoring method was determined by measuring in millimeters the difference between the stimulus and response positions of the test figures. No attempt to analyze the direction of the deviation was included in the scoring system. The scoring system included only quantitative evaluation of the mean deviation of the response from the physical position of the test object.

2. For purposes of statistical analysis the range of the deviation of response from the physical position of the

test object was ordered into thirteen four-unit class intervals or a span from one through forty-nine millimeters, and computations derived using the sum of the squares from a frequency greater than one. In order to work in practical units of measurement the computations were rounded off to the nearest millimeter. The statistical data as computed for the first ten subjects was as follows:

TABLE I

Statistical Data for the First Ten Subjects

	One Figure	Three Figure
Mean	14	16
Median	10	16
Mode	Bimodal 6 and 8	18
Sigma	9	9
Prob. Error (2/3 Sigma)	6	6

3. Using the probable error (2/3 Sigma) the score interval derived was as follows:

TABLE II

Score Intervals

Score	Interval in mm
1	0 - 6
2	7 - 12
3	13 - 18
4	19 - 24
5	25 - 30

Score	Interval in mm
6	31 - 36
7	37 - 42
8	43 - 48
9	49 - 54
10	55 - 60

These values were used in determining scores for each subject tested. Any response omitted or any response greater than sixty millimeters deviation was arbitrarily scored 10.

4. The response for each figure on each slide was scored, and the average scores for the "A" and "B" sequences were computed for each figure grouping. All scores were rounded off to the nearest 0.1 and multiplied by 10 for convenience. Scores thus computed have been used in constructing the graphs included in this study. In order to translate scores into deviation units (2/3 Sigma) such scores should be divided by 10. To further translate deviation units into millimeters, multiply deviation units by 6.

RESULTS

The statistical data obtained from testing fifty subjects is indicated in Table III.

TABLE III

Test Results

	Cor. Coef.	Mean	Median	Mode	Std. Dev.
A. One Figure					
Sequence A	.92	29.72	28.5	24	9.7
Sequence B		29.16	28.5	21, 26, 39*	9.2
*Trimodal					
B. Three Figure					
Sequence A	.86	33.28	33.5	29	7.5
Sequence B		33.76	33.0	37	8.3
C. Total Test					
One Figure	.50	29.42	29.0	25	9.3
Three Figure		33.42	33.0	35	7.6

A correction for attenuation of correlation between the one figure and three figure groups of the total test is .56.[6]

It was the objective of this study to develop a clinically

6 C. C. Peters and W. R. Van Voorhis, Statistical Procedure and Their Mathematical Basis, p. 203.

feasible localization test. The test used in this experiment was so ordered as to provide information which could be statistically analyzed, and anticipated to yield an acceptable reliability. The high correlations obtained between the test sequences as reflected in Table III show that a localization test practical for clinical use can be designed around figure groupings similar to those used in this experiment. The data shown in the table was computed directly from raw scores assigned to the test for each subject as discussed under Scoring Method, Subsection E, of the Experiment Procedure.

CLINICAL OBSERVATIONS

All the subjects tested seemed to express an interest in the experiment. Many asked questions regarding their test scores and how these scores were related to their visual performance.

The subjects were all cooperative; they followed instructions diligently, and it appeared they were putting forth their best efforts in the testing situation. Some subjects approached the test with high confidence. This group seemed to indicate higher performance than other subjects. Nearly all subjects displayed little difficulty in responding to the single figure exposures, but several subjects were visibly disturbed with the three figure displays. Overall, there seemed to be a general tendency for the recorded responses to show a contraction of the three figure groupings. Frequently two responses would show considerably less deviation than the third for a given slide.

Some subjects commented that they thought their localization accuracy was adversely affected because they were viewing a vertical presentation and translating it to a horizontal reproduction. Other subjects commented that although the test battery seemed quite simple, they felt they should have performed better than they did.

SUGGESTIONS FOR FUTURE STUDIES

It has been demonstrated that the correlation between sequences "A" and "B" of both the single and three figure groupings is sufficiently high that either sequence can be substituted for the other in a test situation.

Examination of individual test scores indicates that some subjects performed relatively good on single figure exposures, but were significantly lower in performance in localizing the three figure presentations. The few individuals whose scores were better for the three figure exposures than their score for the one figure exposures did not show a significant difference.

If a localization test practical for clinical use is to be designed, such a test should be tested in a practical situation. Accordingly, it is suggested that either the "A" or "B" sequence of the three figure slides be used in testing subjects enrolled in the reading enhancement program, and a correlation established between the localization test and the reading rate and comprehension scores of the subjects.

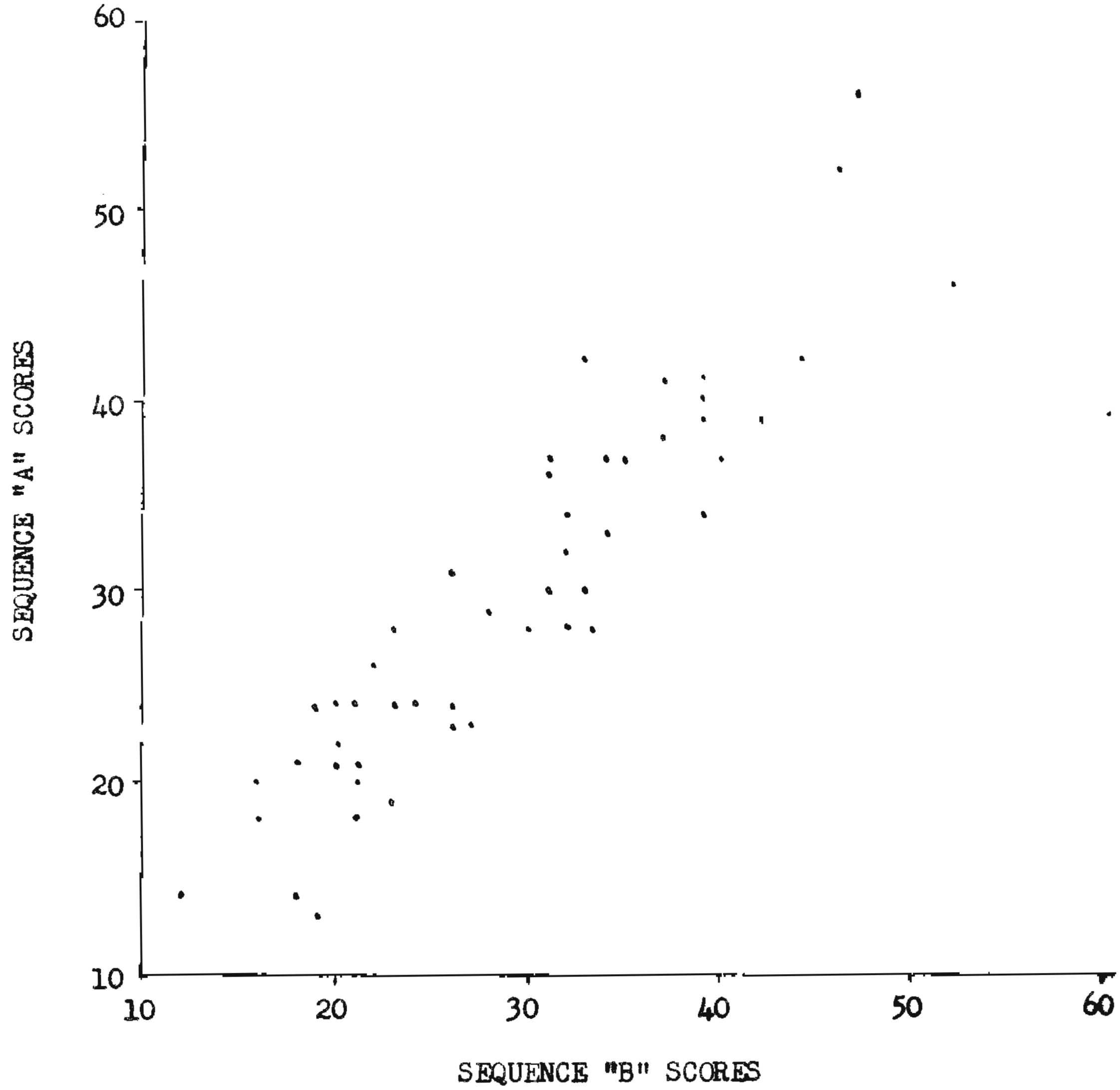
In that the circles comprising the configurations used in this investigation were centered on uniform radii around a central point of the test slides, it is suggested that localization errors in the present data be analyzed in terms of spacing and group contraction.

Localization ability as a function of age should also be investigated. The subjects in this study consisted of college students almost entirely. It would be well to consider a broader segment of the population, and an investigation made of children of elementary and junior high school levels.

SUMMARY

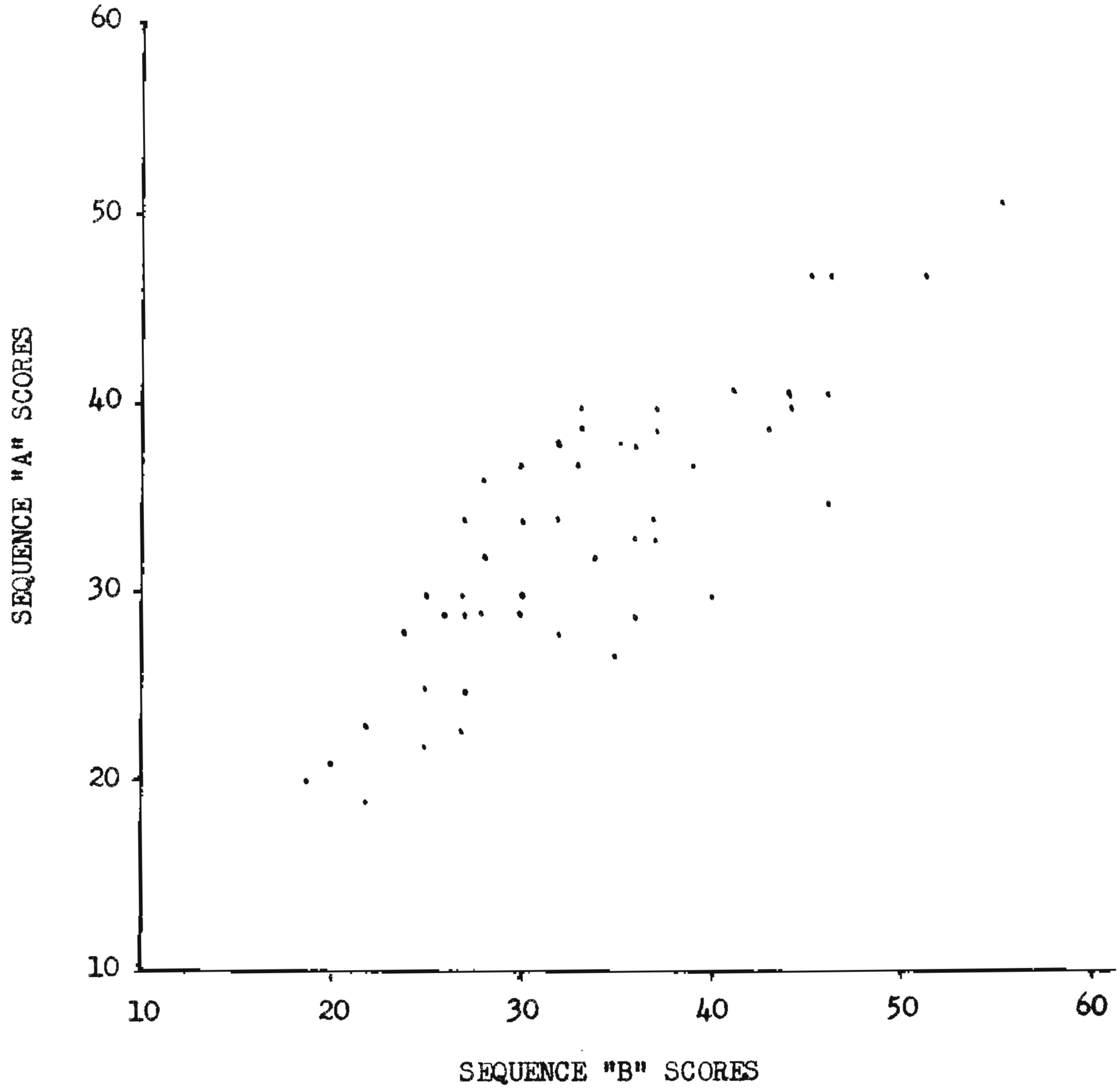
This study statistically tested the localization skill of fifty subjects by presenting two sequences of single circle displays and two sequences of three circle displays. Both the single circle and the three circle sequences were identical in their own area except the order of presentation was statistically randomized. The correlation between single circle sequences was .92 and between the three circle sequences .86. The correlation between single circle test scores and three circle test scores was .50. The reliability of the test and scoring system is adequate for clinical purposes.

SCATTERGRAPH OF SINGLE FIGURE RELIABILITY



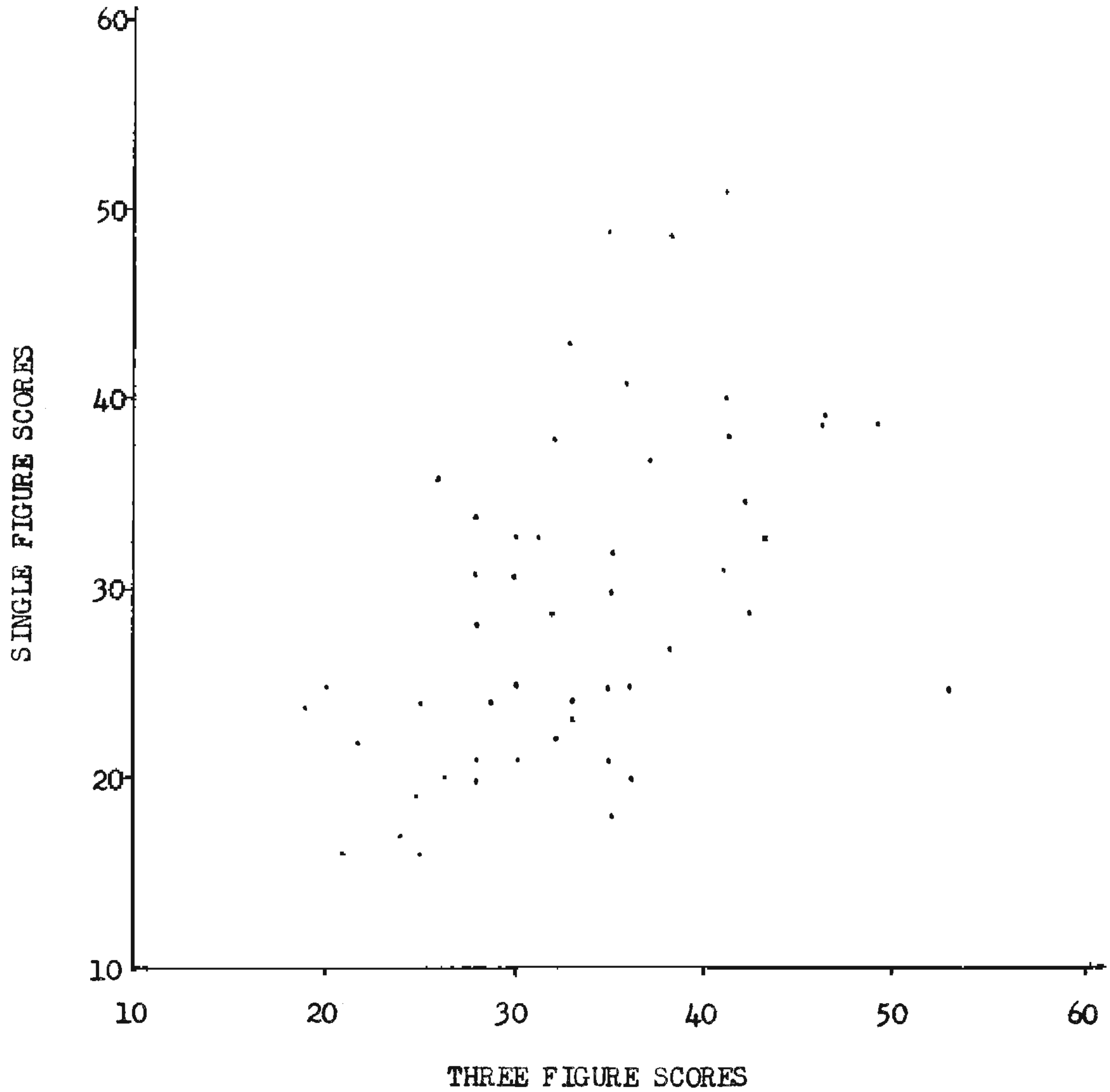
SCATTERGRAPH I

SCATTERGRAPH OF THREE FIGURE RELIABILITY



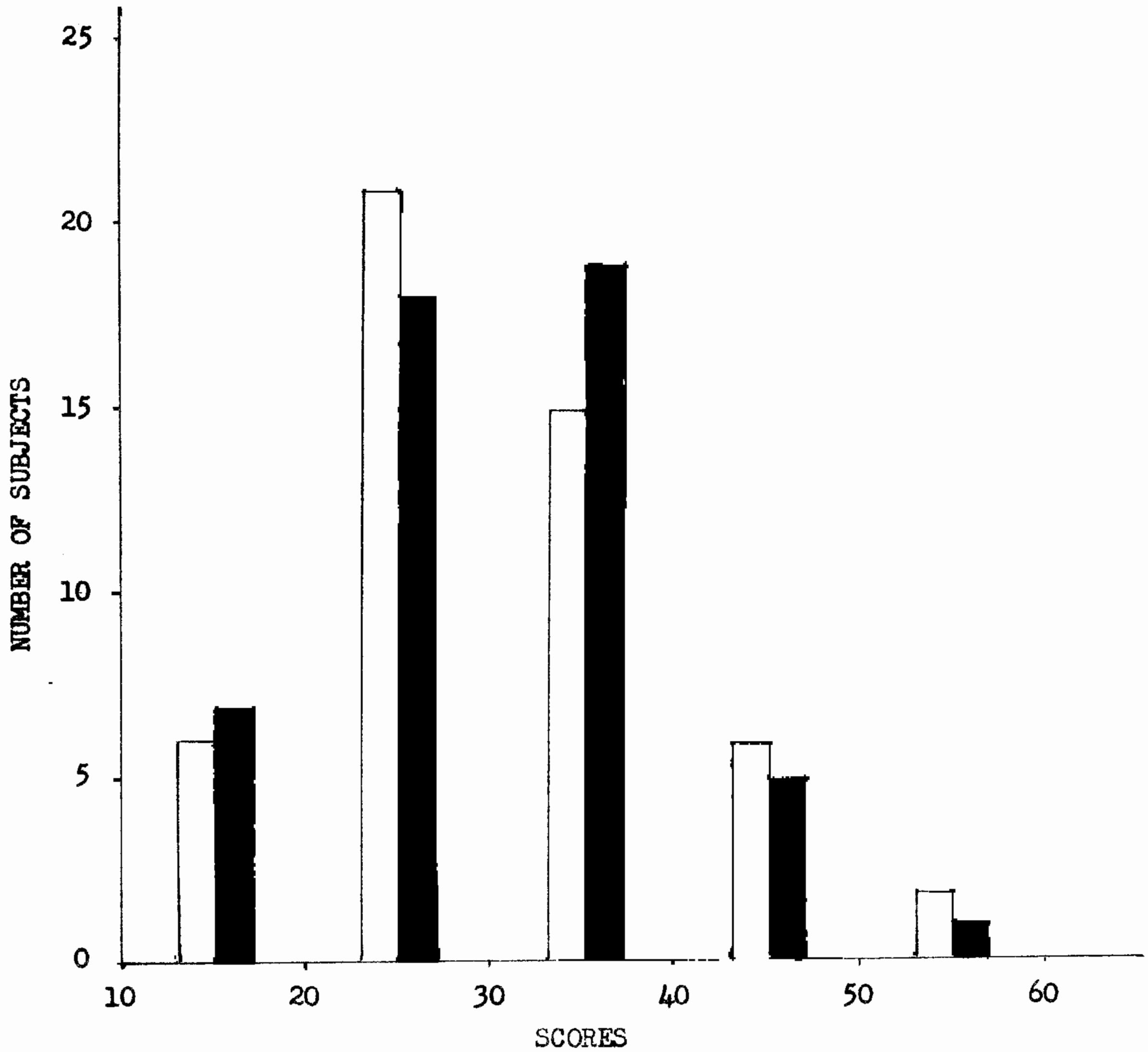
SCATTERGRAPH II

SCATTERGRAPH OF SINGLE FIGURE VS. THREE FIGURE TEST SCORES



SCATTERGRAPH III

SCORE FREQUENCY FOR SINGLE FIGURE DISPLAYS



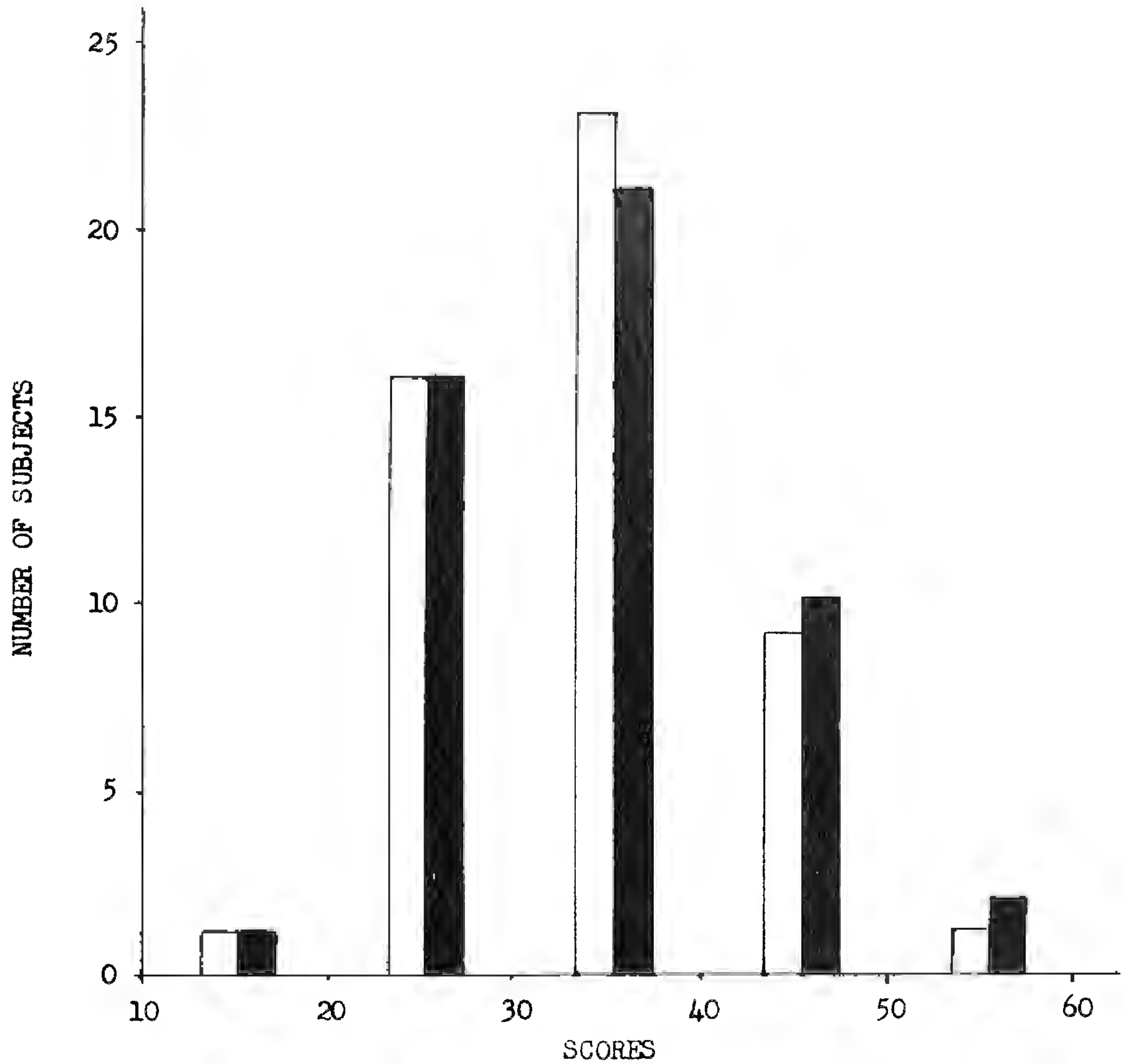
Sequence "A" in white

Sequence "B" in color

	A	B
Mean	29.72	29.16
Median	28.5	28.5
Mode	24	Trimodal at 21, 26 and 39
Std. Dev.	9.7	9.2
Correlation	.92	

SCORE FREQUENCY GRAPH I

SCORE FREQUENCY FOR THREE FIGURE GROUPS



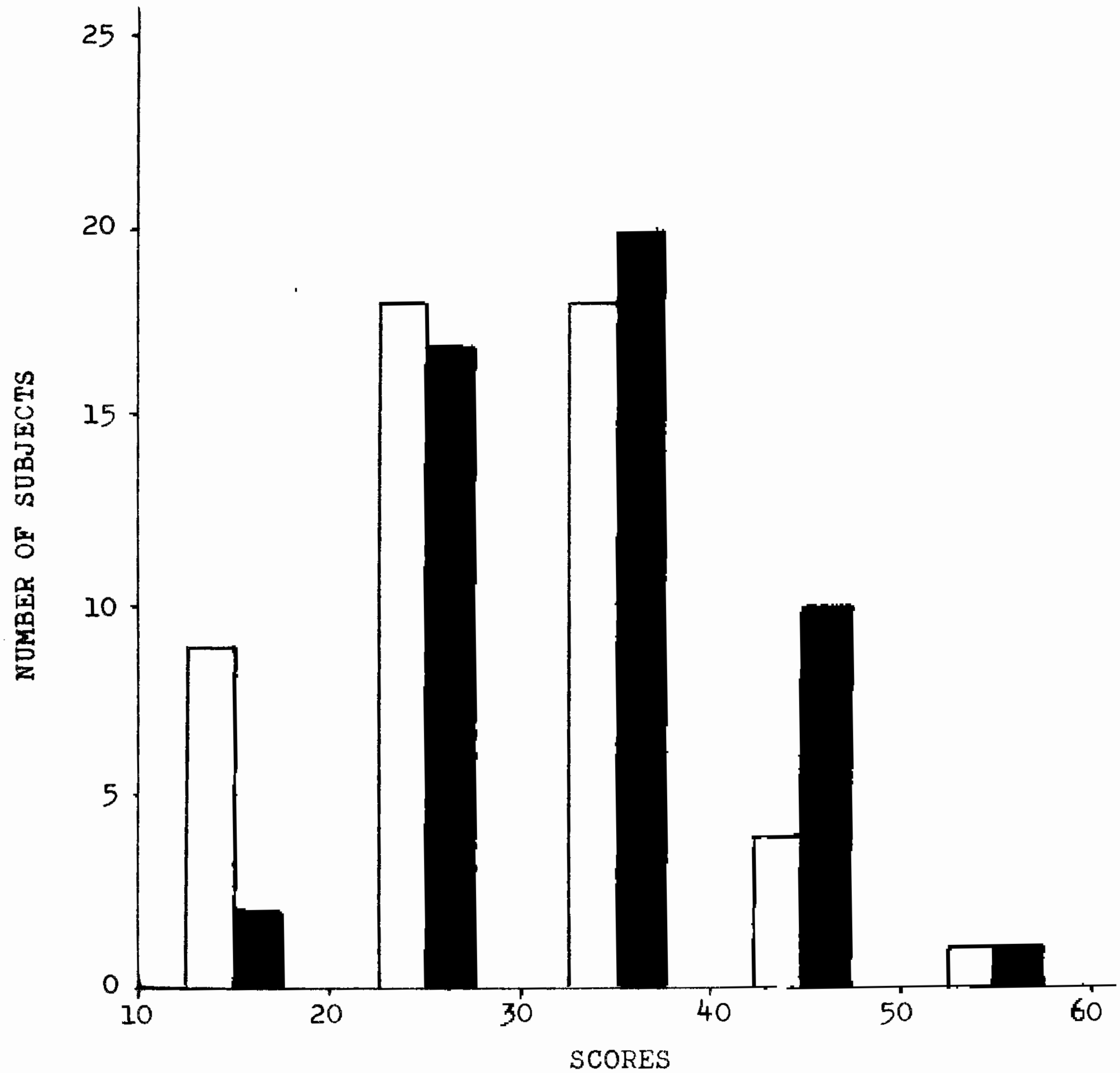
Sequence "A" in white

Sequence "B" in color

	A	B
Mean	33.28	33.76
Median	33.5	33
Mode	29	37
Std. Dev.	7.5	8.3
Correlation	.86	

SCORE FREQUENCY GRAPH II

SCORE FREQUENCY FOR TOTAL TEST



One-Figure Test in white

Three-Figure Test in color

	One Figure	Three Figure
Mean	29.42	33.42
Median	29.00	31.50
Mode	25.00	35.00
Std. Dev.	9.25	7.58
Correlation .50		

SCORE FREQUENCY GRAPH III

TABLE IV

RANDOM ORDER OF PRESENTATION

ONE FIGURE GROUP		THREE FIGURE GROUP	
Order	Slide No.	Order	Slide No.
1	2	19	27
2	13	20	34
3	8	21	25
4	15	22	20
5	4	23	29
6	12	24	22
7	3	25	30
8	7	26	21
9	18	27	35
10	1	28	31
11	5	29	36
12	10	30	24
13	17	31	33
14	9	32	23
15	16	33	32
16	6	34	26
17	14	35	19
18	11	36	28

7 Edwards, Allen l., Statistical Analysis, Table of Random Numbers, Table I, 1946. p. 196.

NAME ____________________ TEST NO. ________

AGE ____________

SCORE Number Localization

Number	Localization
______	______
______	______
______	______

Page ______

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