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## An Investigation of the Relationship Between Verbal Responses and Responses to a Visual Perceptual Task\*

By FRANK R. CLARKE

For some time, psychologists have postulated the existence of a relationship between responses to perceptual tasks and responses to tests purported to measure personality variables. As Thurstone (8) states, "The fundamental hypothesis involved here is that the dynamics of perception and other restricted functions are not isolated and that these several functions are so related that some characteristic of the person as a whole might be inferred from the dynamics of one of these functions." Responses in terms of color or form to an ambiguous stimulus are thought by many to be correlated with more global characteristics of the individual. The labels 'color dominant' and 'form dominant' call to the minds of most clinical psychologists adjectives which are descriptive of the individual's mode of dealing with life situations.

The research on this question has resulted primarily in negative findings and little of practical value has been garnered from such studies. The most widely known research concerning color and form responses to ambiguous stimuli has centered about the Rorschach test. Rorschach workers suggest that the relative numbers of Form, Form-Color, Color-Form, and Color responses give important insights to the "total personality" of the subject. Their apparent confidence does not appear justified in terms of the research which has been reported in the literature. When considered *en masse* numerous studies concerning these variables (e. g., 4, 7, 10) give but little evidence for their usefulness. Even the suggestion that the FC score appeared to have some predictive value has been interpreted by Benton (1) as more likely a function of subjects' differential ability to synthesize more elements in their responses than of color or form *per se*.

Some workers have attempted to study this posited relationship between perceptual and personality variables with experimental techniques other than the Rorschach cards, but they too have met

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with but little success. Thurstone, who has shown an interest in this problem for a number of years, recently reported a relationship between form and color responses to a rather ingenious Kodachrome film of his own design, and verbal responses to questionnaire items (also of his own design) of the type often used to define personality variables. The present study deals with the cross validation of the results obtained by Thurstone (9).

The technique used by Thurstone involves two phases; first, the development of a new testing technique yielding six scores on a perceptual task, and second, the use of these scores as criteria to select verbal questionnaire items to form corresponding verbal scales by item analysis techniques. The need for cross-validation of such a study was pointed out by Thurstone. The development of scales on the basis of item correlations with an external criterion takes advantage of all chance errors, as well as assuming that the intercorrelations among these items are zero. The disadvantages of this method almost invariably result in the scale showing little or no correlation with the external criterion upon application to a new sample. The interest of this problem to psychology warranted an immediate cross-validation.

Thurstone's Kodachrome film is essentially an outgrowth of Schmidt's apparent movement test for color and form dominance. There are twelve presentations, each of twelve designs which the subject sees moving in a straight line. Form dominant subjects follow form despite flickering color, whereas color dominant subjects follow constant color despite changing form. Each design is presented in such a way that the forms (and thus the colors) travel once toward each of the twelve clock numerals which we may imagine superimposed on the screen. The subject merely views each presentation and reports in which direction the design is moving. He is given no indication that the designs may be seen moving in either direction.

Since Thurstone found in his early work that some subjects showed a definite directional bias, he devised a scoring system to provide six scores for each subject: Color, Form, Up, Down, Left, and Right. The test was individually administered in order to eliminate the extraneous screen distance variable and to permit convenient oral responses.

In Thurstone's study each of the 100 subjects were required to fill out three of his Temperament Schedules containing a total of 480 items which were edited to be entirely acceptable to the subjects. Each of these items was then correlated with each of the

six apparent movement scores. By chance alone, we would expect 24 items to show correlations significant at the 5% level with each of these scores; since the obtained number ranged from 54 to 76, the results suggested the operation of other than chance factors. The current cross-validation is for the purpose of investigating this possibility.

#### SUBJECTS

The subjects were 67 male students from an introductory psychology class at the State University of Iowa. A rough screening test used to eliminate two color blind subjects required that they respond correctly to at least 14 of 18 plates of the American Optical Company's revised selection of the *Pseudo-Isochromatic Plates for Testing Color Perception* (1940). The cards were not administered under standard conditions but were presented in the light cast by the projector beam at the distance at which the subject would subsequently view the projected designs. Three additional subjects were eliminated, two because of deviations in experimental procedure, and one whose results were extremely deviant in this and other experiments in the Department. Thus, results were computed for 62 subjects.

#### PROCEDURE

In an individual experimental session lasting approximately one and one half hours, each subject, in a darkened room\*, was given the test for color perception immediately followed by Thurstone's Kodachrome test. The subjects were then taken to another room and given two paper and pencil tests which are not considered in this paper, and from there to still another room where they were asked to fill out an inventory consisting of 300 items which, with the exception of 10 filler items, Thurstone had reported having correlations of .17 or above (significant at the 10% level of confidence) with scores obtained on other tests which we were investigating.

Two conditions were used in presenting Thurstone's Kodachrome test. As a result of some incorrect information in one of Thur-

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\*As the lighting in this room tended to vary to a small extent with outside conditions, and as this variable would most likely affect the Color score, the hypothesis that lighting conditions had no effect on Color score was tested with a simple t. The subjects were arbitrarily divided into two groups (N's of 32 and 30), brightest conditions versus darkest conditions, and the mean Color score for these groups computed. Not only was the 't' non-significant, but the difference was in the direction opposite to that which would be expected on *a priori* grounds. Thus the null hypothesis could not be rejected.

stone's laboratory reports and some unwarranted assumptions on the part of this author, the first 45 subjects (which shall be referred to as Group I) were seated beside the projector (an Ampro 600 which had a 300 watt bulb) at a distance of five feet from a beaded glass screen. When these inaccuracies were discovered, an additional 17 subjects (Group II) were run seated beside the projector which now contained a 750 watt bulb at a distance of seven feet from a white drawing paper screen. The intensity of the light reflected by the screen was approximately the same for both these groups.

RESULTS

In this cross-validation study, the questionnaire items which Thurstone had found to be correlated .20 or above (significant at the 5% level of confidence) with each of the six subscores on the Apparent Movement Test were scored so as to result in six corresponding subscores on the new verbal questionnaire. If Thurstone's original study based on item analysis is to be supported, we would expect significant correlations between scores on the Apparent Movement Test and corresponding scores on the questionnaire subscales. The obtained correlations for Group I, Group II, and the total sample (Groups I and II combined) are shown in Table I.

Table 1

Correlations between verbal scales and corresponding subscales on the Apparent Movement Test subscales

| Scales           | N  | C    | F   | U    | D    | L    | R   |
|------------------|----|------|-----|------|------|------|-----|
| r's for Gr I     | 45 | +06  | +09 | -.11 | -.05 | -.10 | +06 |
| r's for Gr II    | 17 | -.13 | +12 | -.10 | -.08 | -.28 | +54 |
| Z Gr I - Z Gr II |    | .19  | .03 | .01  | .03  | .18  | .54 |
| r's for total Gr | 62 | +01  | +10 | -.11 | -.05 | -.14 | +14 |

Considering for a moment only those correlations for the total sample we find that none of these correlations are significant at even the 20% level of confidence. The contention that these are merely chance correlations is given added strength by noting that three of the six are negative, with an average of about -.01. Also, it appears that they are rather randomly distributed about zero. Thus, the relationships reported by Thurstone fail to be sustained upon cross-validation.

Groups I and II were combined in light of two considerations. First, the difference between corresponding Pearson product-moment r's for the two groups were analyzed by Fisher's z-technique,

and none were found to differ significantly at the 5% level of confidence. See Table I. (A  $z=.61$  is necessary for significance at this level.) Secondly, in an effort to ascertain whether or not the change of conditions resulted in any systematic differences in the scores of these two groups, the hypothesis that there is no difference between the population means for Group I and those for Group II was tested by means of a Lindquist Type I design (5). The obtained means and variances are given in Table II.

Table 2

Obtained means and variances for the samples considered in this study

| Scales                 | N   | C                 | F      | U     | D      | L      | R      |
|------------------------|-----|-------------------|--------|-------|--------|--------|--------|
| Group I                | 45  | M 8.13            | 63.42  | 6.31  | 32.22  | 18.62  | 13.24  |
|                        |     | $\sigma^2$ 54.12  | 363.13 | 81.06 | 268.48 | 186.64 | 126.63 |
| Group II               | 17  | M 9.53            | 71.41  | 2.94  | 31.65  | 12.35  | 13.45  |
|                        |     | $\sigma^2$ 46.83  | 415.20 | 15.59 | 310.98 | 71.71  | 122.73 |
| Total Sample           | 62  | M 8.52            | 65.61  | 5.39  | 32.06  | 16.90  | 13.45  |
|                        |     | $\sigma^2$ 52.51  | 390.04 | 65.37 | 280.25 | 162.93 | 122.73 |
| Thurstone's*<br>Sample | 100 | M 12.82           | 51.34  | 4.04  | 38.70  | 20.02  | 16.54  |
|                        |     | $\sigma^2$ 115.22 | 490.37 | 57.60 | 328.16 | 221.01 | 186.92 |

\*Values estimated from grouped frequency distribution.

Because of the extreme heterogeneity of variance it was considered desirable to run two separate tests, one involving the three categories with the largest variances (Form, Down, and Right), the other, those with the smallest variances (Color, Up, and Left). Quite likely, the requirement of homogeneity of variance is still not satisfied, particularly in the latter case, but from both empirical and theoretical considerations it appears that this requirement is not as assential as has been generally supposed. Norton (6) found that violation of this assumption, in as much as it affects the validity of the test, results in a distribution of variance ratios which has a greater number of cases at the extremes than does an F distribution based on an equal number of degrees of freedom. Thus, violation of this assumption results in obtaining more significant results than is indicated by the percentage values in the F-table. The same applies, although to a somewhat lesser degree when violating the assumption of homogeneity of form of distributions. This would suggest that the F's obtained in this analysis would tend to appear more significant than they actually are. None of the obtained F's are significant at even the 10% level of confidence.

**Table 3**

Analysis of variance to test differences in corresponding means of Group I and Group II

| Analysis of C, U, and L Scores        |     |             |              | Analysis of F, D, and R Scores       |     |             |              |
|---------------------------------------|-----|-------------|--------------|--------------------------------------|-----|-------------|--------------|
| Source                                | df  | Sum Squares | Mean Squares | Source                               | df  | Sum Squares | Mean Squares |
| Between Subjects                      | 61  | 6795.89     |              | Between Subjects                     | 61  | 6622.99     |              |
| B                                     | 1   | 279.47      | 279.47       | B                                    | 1   | 274.52      | 274.52       |
| Error (b)                             | 60  | 6516.42     | 108.61       | Error (b)                            | 60  | 6348.48     | 105.81       |
| Within Subjects                       | 124 | 15010.67    |              | Within Subjects                      | 124 | 129194.67   |              |
| A                                     | 2   | 4396.94     |              | A                                    | 2   | 86649.76    |              |
| AB                                    | 2   | 369.63      | 184.82       | AB                                   | 2   | 524.28      | 262.14       |
| Error (w)                             | 120 | 10244.10    | 85.37        | Error (w)                            | 120 | 42020.63    | 350.17       |
| Total                                 | 185 | 19613.44    |              | Total                                | 185 | 135817.66   |              |
| F=MS <sub>AB</sub> /MS error (w)=2.16 |     |             | N.S.         | F=MS <sub>AB</sub> /MS error (w)<1   |     |             | N.S.         |
| F=MS <sub>B</sub> /MS error (b)=2.57  |     |             | N.S.         | F=MS <sub>B</sub> /MS error (b)=2.59 |     |             | N.S.         |

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## DISCUSSION

There are several factors which may have contributed to this complete lack of positive results upon cross-validation. One is the relatively low reliabilities of the scales under consideration. These are given in Table IV. The coefficients for the Apparent Movement subscales were computed by means of Guttman's formula (2), whereas the coefficients for the verbal subscales were computed by Kuder-Richardson formula #21 (3). While low, these reliability coefficients are sufficient to permit a significant correlation to obtain.

Table 4  
Split half reliabilities for the scales investigated

| Scales                    | C   | F   | U   | D   | L   | R   |
|---------------------------|-----|-----|-----|-----|-----|-----|
| App't. Mov. Test reliabs. | .67 | .87 | .76 | .87 | .87 | .85 |
| Verbal Quest. reliabs.    | .46 | .69 | .67 | .62 | .51 | .47 |

Also there may be some differences between the population sampled at the University of Chicago and that sampled at the State University of Iowa. Approximate means and variances were computed from grouped frequency distributions provided by Thurstone, and it would appear that there is probably a significant difference between the two groups. (See Table I.) It is impossible to make an appropriate test of this difference because of lack of necessary data; however, on testing the difference between corresponding means with the t-ratio, one of the differences was significant at the 5% level of confidence, and two at the 1% level. Although we cannot attach any probability statement to the overall difference, it appears that this difference might be significant.

However, the lack of positive results in this cross-validation most likely results from the fact that posited relationship between the Apparent Movement Test and the verbal items simply does not exist. As has been pointed out before, an item analysis of the sort Thurstone has made has two major faults. First, it capitalizes on all chance fluctuations in the data, resulting in shrinkage when applied to a new sample. Secondly, this technique assumes that the intercorrelations among the verbal items are zero. Inspection of the items making up these various subscales suggests that this ideal is far from being attained.



Thus, the poor prognosis for Thurstone's investigation (for this area has been characterized by negative results), and the weakness of the method used leave little room for surprise when the posited relationship is not supported upon cross-validation.

#### SUMMARY

Thurstone has reported finding relationships between scores obtained on a perceptual task and those obtained on a verbal questionnaire. As these relationships were obtained by means of item analysis, a cross-validation was undertaken. None of the relationships reported by Thurstone were sustained.

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