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The Validity of Personality Inventories Studied by a "Guess Who" Technique.
 CHAS. C. PETERS, Pennsylvania State College.

The purpose of this study was to determine to what extent scores based upon self-testimony on the Bernreuter, the Bell, and the Link personality inventories agree with the behavior of the subjects as observed by others. The population was made up of university freshmen. Descriptions of hypothetical persons standing high in each of nine personality traits, and descriptions of persons standing low in those traits, were placed in the hands of 605 subjects, who were asked to "nominate" for each of the 18 categories persons out of their class whom they had observed to be much like the persons described. From the returns "high" and "low" classes were determined for each of the nine traits, and for one over-all trait, from the persons "nominated" three or more times. These selected classes constituted only the extreme tails of the several distributions. The Bell, the Link, and the Bernreuter inventories had previously been administered to the freshmen. A new technique for biserial r from wide-spread classes was applied to determine a coefficient of correlation between the scores on the inventory and observed behavior, and these r 's were tested for statistical significance by certain appropriate newly developed formulas. The validity correlations ranged from $-.078$ to $+.503$ and averaged about $+.26$. All but two of them were highly significant statistically. The investigation revealed as high validity correlations as other indirect evidence would suggest as probable, and proved the usefulness of a new statistical procedure adapted to cases when measurements must be in terms of general observations where subjects are not known by enough observers to make the usual type of ratings feasible. [15 min.]

A Theory of the Stimulus. J. A. LYNCH, Rice Institute.

The following formula for the stimulus is submitted:

$$A_{\alpha} = \int_{i=1}^{\alpha} \Sigma a_i$$

with terms defined as follows:

A_{α} stands for a matured learning product;

$\Sigma_{i=1}^{\alpha} a_i$ assembles all situations to which A_{α} is relevant; and

a_i , a particular occasion for A_{α} , is a function of two factors:

where x_i = total number of elements,

y_i = unordered elements,

and $x_i - y_i$ = ordered elements,

$$a_i = \int y_i(x_i - y_i).$$

An *element* is a factor capable of manipulation as an entity emphasizing its symbolic efficacy.

Accrued readiness, A_n , influences a_i as an isolated member by *loading* its ordered-elements factor.

Concrete illustrations: (1) Of a_i : (i) a sentence expressing an idea in which the meanings of some of the words are known and some not; (ii) a jig-saw puzzle with some of the parts placed and some not.

(2) Of $\sum_{i=1}^n a_n$: (a) a series of sentences or word combinations expressing the same idea; or (b) a series of the above-described puzzles made from the same picture.

Different types of stimulus series are based upon the possible types of learning products which are classified roughly as rational, volitional, and sensory.

Every stimulus series is capable of evaluation from the standpoint of three criteria: (1) the learning process, (2) the learning product, and (3) pure activity.

As an *experiment*, it is suggested that a number of segments of one of the series described above be rated quantitatively, on the *a priori* basis, as R_1 , R_2 , etc., comparing,

$$\frac{R_1}{R_2} \text{ with } \frac{P_1}{P_2} \text{ or with } \frac{P_1}{P_2} \cdot \frac{T_2}{T_1},$$

T_1 and T_2 being time factors and P_1 and P_2 proficiency attained. Each practice, a_i , should be separately motivated; and its concluding phase should be separated from the initial phase of $a_{(i+1)}$ by a diversion of interest. [15 min.]

Analysis of Mental Growth of School Children. N. J. VAN STEENBERG, Carnegie Foundation.

The purpose of this paper is to describe the normal growth of intelligence as defined by Stanford-Binet mental age and to compare this normal trend with individual growth curves superimposed on it.

Published data from a number of sources, but principally from the Harvard Growth Study, have been analyzed to show the relationship between chronological age and Stanford-Binet mental age. It has been found that the frequency curves for successive CA's are not, as expected, normal, but significantly positively skewed and platykurtic. It is considered important to derive a method for comparing these curves one with another so as to reveal norms of the growth of intelligence. Comparison may be carried out by two methods: (a) A rational curve with its parameters a function of the CA might be derived; (b) by changing the mental age scale into a new one by means of a nonlinear transformation a new set of curves approximating normality can be obtained. Both methods have been employed, but since the concept of the normal curve is so much more readily understood by most psychologists, explanations are couched in terms of the second method. By means of the indices derived, a growth curve has been obtained by the method of absolute scaling, differing significantly from the one previously described by L. L. Thurstone.

Upon these curves of moving averages there have been superimposed various curves based upon data from multiple observations of single individuals. These

curves should provide a basis for the limitation of prediction of test intelligence. [15 min., slides.]

A Criterion for the Number of Factors in a Table of Inter-correlations. CLYDE H. COOMBS, University of Chicago.

The intercorrelations of tests of cognitive processes are generally positive, hence the test vectors lie in an n -dimensional cone or pyramid. Upon extracting a factor, a residual table of correlations is secured; a sign change is made before the next factor is extracted. This involves reflecting certain residual test vectors 180° until they again lie in a cone or pyramid. The extent to which they lie mutually close together is dependent upon the presence of common factors. An index of this mutual dependence is given by the number of negative entries in the residual matrix after sign change. The number of negative entries expected if only chance error factors remain depends upon the number of tests in the battery. A criterion based on this critical value is presented with examples of its application in experimental studies. [10 min.]

On the Number of Factors. QUINN MCNEMAR, Stanford University.

It is obvious from the literature involving the application of factorial methods that considerable difficulty is being experienced in assigning meaning to those factors extracted beyond the first few. It seems reasonable to assume that one cause for this predicament is the likelihood that more factors have been extracted than justifiable in the light of the sampling errors which affect the original correlational matrix. Certain of the empirical efforts to derive a criterion for the number of factors have been inadequate because it was wrongly assumed that chance sampling errors affect independently the several r 's in a table of inter-correlations.

In order to secure situations in which the number of factors was known for a defined universe, and in order to give free rein to the known fact that for a given sample the sampling fluctuations of correlation coefficients are correlated, resort has been made to tables of random numbers. Variables have been defined in terms of a predetermined number of factors plus specifics, "scores" for samples of from 150 to 250 have been built up, the product moment correlations calculated, and the resulting matrices subjected to centroid analysis. The situations used include the following: 9 variables, 1 factor; 10 variables, 2 factors; 10 variables, 3 factors; 14 variables, 3 factors (one of which was general).

Several proposed criteria for number of factors are examined in the light of these analyses. [15 min., slides.]

A Factorial Study of Visual Gestalt Effects. L. L. THURSTONE, University of Chicago.

This paper is a description of a program for the study of personality types by objective and experimental methods and more especially with a series of individual laboratory tests of perceptual functions. In the typological literature there have been many suggestions of perceptual functions that are supposed to be diagnostic of types. Although this field has not been seriously exploited, there has been some experimentation, mostly in Europe. In the present study a series of 33 perceptual measures are used, the total program requiring about five hours of laboratory time for each subject. The results will be analyzed factorially in the hope of determining some fundamental dimensions of temperament that might be appraised objectively and without using paper-and-pencil questionnaires. Among the perceptual tests are the following: the windmill illusion, the Wundt bright-

ness contrast illusion, brightness constancy, size constancy, six optical illusions, the Gottschaldt figures, Street Gestalt completion test, Schmidt's color and form preference in apparent movement, after-image of movement, duration of the positive after-image, dark adaptation time, the complication clock, peripheral span, flicker-fusion rate, personal tempo, apparent movement tolerance. Most of the tests represent visual Gestalt effects. [15 min.]

The Isolation of Musical Abilities by Factorial Methods. J. E. KARLIN, University of Chicago.

The existing evidence in the music field is discussed briefly from the point of view of application of factorial methods of analysis. The main body of the article consists of an account of an analysis of two different batteries of music tests by Dr. L. L. Thurstone's multiple factor analysis technique. The trait configuration of each analysis was rotated into a promisingly intelligible simple structure. There appear to be, also, striking consistencies between the results of the two analyses indicating stability of possible music factors. The line of future work in this domain is indicated shortly. [15 min.]

The Relation of Primary Mental Abilities to Preference Scales and to Vocational Choice. DOROTHY C. ADKINS, Social Security Board, Federal Security Agency.

This paper is a report of two studies, the first of which was conducted jointly by Dr. G. F. Kuder and the author. We were concerned with the extent to which one's abilities are related to the types of activities which he prefers.

The experimental edition of Thurstone's *Tests for Primary Mental Abilities*, yielding scores on seven primary ability composites, was given to 512 University of Chicago freshmen in September, 1938. The same students filled out an experimental edition of Kuder's *Preference Record*, which yields scores for nine types of activities. Results are presented in terms of ability profiles for contrasted groups on each preference scale for men and for women. In addition, Pearson intercorrelation coefficients of all measures used were obtained. The profiles and correlations reveal relatively slight overlapping between the measures of ability and the preference measures. The trends which do appear are in line with our expectations. If measures in each of these domains have prognostic value for certain criteria of success, a combination of the two sorts of measures ought to prove more effective than measures in either of the two fields alone.

In the second study, the problem was to investigate the relations of primary mental abilities to vocational choice. *The Primary Mental Abilities Tests* were administered to male students in several departments of various universities. The subjects were either graduate students or seniors majoring in a given subject-matter field. Primary composite scores were averaged for each of the vocational fields. Results were plotted in terms of ability profiles for each vocational choice group. It is demonstrated that the ability profiles of the various vocational groups differ and that the differences are reasonable. [15 min., slides.]

The Relation of Test Difficulty and Factorial Composition Determined From Individual and Group Forms of Primary Mental Abilities Tests. WILLIS C. SCHAEFER, University of Chicago.

The growth of factorial studies in the cognitive field of human ability gives increasing evidence for the reliability of the functional unities thus determined. Less is known as to the conditions determining the appearance of factors, the validity question. This study reports an experimental investigation of the hypothesis that the perceptual component of a test is a function of the relative difficulty

of the task and, consequently, that the perceptual factor as defined by Thurstone's tests for the Primary Mental Abilities is of essentially different nature from that of the number, space, and verbal abilities defined by the same system.

Following this hypothesis it should be possible to construct tests of various difficulties for each of several types of content such that the factorial description of this battery would show a fanning of test vectors for each series of tests between the perception axis and an axis X , where X represents, in turn, the number, space, and verbal axes.

The test battery given to 100 college men consisted of (a) 18 paper-and-pencil standard reference tests for the primaries, group administered; and (b) 16 experimental tests representing six types of test material, each in several levels of difficulty, individually administered and scored in terms of reaction times for each item. This test material was projected from 35-mm. film, the subject's responses being made with finger keys to enable greater experimental control over chance variables. Results are reported on the relation of group and individual testing methods for comparable test material and on the implications of the difficulty-hypothesis for the factorial analysis of ability. [15 min., slides.]