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Assessing the Connotative Strengths of Random Shapes

Don Lewis
University of Iowa

Joanna B. Boehnert
University of Toronto

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Assessing the Connotative Strengths of Random Shapes[1]

DON LEWIS[2] AND JOANNA B. BOEHNERT[3]

Abstract: After sets of mutually equally discriminable random shapes, all generated from a single prototype, had been identified, the members of the several sets were immediately recognized as differing in associativeness or meaningfulness. The meaningfulness (*m*) of each shape was determined through an application of the production method. The computed values of *m* did not, in many cases, coincide with the meaningfulness of the shapes as judged by several trained observers. Satisfactory indices of the heterogeneity (and, conversely, the homogeneity) of the verbal responses to each of the shapes seemed impossible to obtain. Thereupon, the degree of appropriateness of each verbal response (word or short phrase) for describing its corresponding shape was determined through an interval scaling procedure. The mean of 22 scale values—descriptive appropriateness values—for each shape was taken to be the connotative strength (*cs*) of the shape. The Pearson r for the *m* and *cs* values was an insignificant .09. The tentative, but fairly firm, conclusion was that values of *cs* were more clearly indicative, than were values of *m*, of what the shapes signified when seen by groups of untrained observers.

Over the past four years, one of the principal aims of several of us working in the Iowa Psychology Laboratory, has been to "size up" and thereby gain greater control over the stimuli employed in discriminative motor tasks. Our abiding interest has continued to be research on the acquisition, transfer, and retention of perpetual-motor skills of different kinds and of different degrees of complexity. Investigations of discriminative skills (as

[1] Based in part on a paper read by the junior author in a symposium on random shapes at the 1963 meeting of the Midwestern Psychological Association, held in Chicago.
[2] University of Iowa, Iowa City, Iowa.
[3] Now at the University of Toronto, Toronto, Ontario, Canada.

contrasted from tracking or following skills), involving several discrete responses to a corresponding number of discrete stimuli, had indicated that relationships among the stimuli were of crucial importance, especially in transfer situations.

Suppose, for example, that three different directional responses are to be made from a central starting point and that each response is associated with one of three stimuli. Suppose, further, that the three stimuli, A, B, and C, lie along a single dimension (either physical or psychological) and are equal distances apart. Their arrangement might be indicated by the simple diagram at the left in Fig. 1. The distance from A to B is the same as that

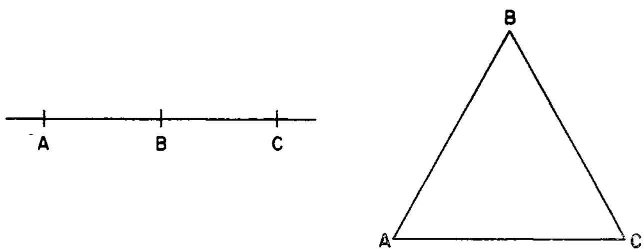

Figure 1. Two schematic representations of the locations of three stimuli, A, B, and C, under two different conditions of discriminability.

from B to C. If these distances represent relative discriminability, then pairs AB and BC are equally discriminable while pair AC is much more discriminable than either of the other two. If the task were to be made easier, the distances between A and B and B and C could be increased but kept equal; and if the task were to be made more difficult, the distances could be decreased. In either case, the discriminability of pair AC would be greater than that of the other two pairs. Differences in discriminability, similar to the one illustrated, were believed to be of importance in transfer situations, their importance increasingly great as the number of stimuli (and number of corresponding responses) increased.

The aim of recent research has been to find sets of from three to nine stimuli per set, the components of each set to be mutually equally discriminable and also approximately equal in connative strength. Think, first, of the discriminability problem. If three stimuli are mutually equally discriminable (if they constitute an MED set), they could be represented, as in the diagram at the right in Fig. 1, as located at the three apexes of an equilateral triangle. Different general levels of discriminability could be depicted by triangles of different sizes. If the stimuli could not be differentiated, any one from any other, they would all fall at a single point, at the center of the triangle.[4]

After some discouraging preliminary investigations (the most intriguing of which utilized photographs of snowflakes), the decision was made to work with sets of random shapes generated from a single prototype in accordance with methods 1 and 8 as described by Attneave and Arnoult (1956). The first fruitful study was done by Somnapan (1962). One of the two sets generated by him is shown in Fig. 2. He began with 13 shapes and was seeking the particular six among them which came closest to meeting the MED criterion.

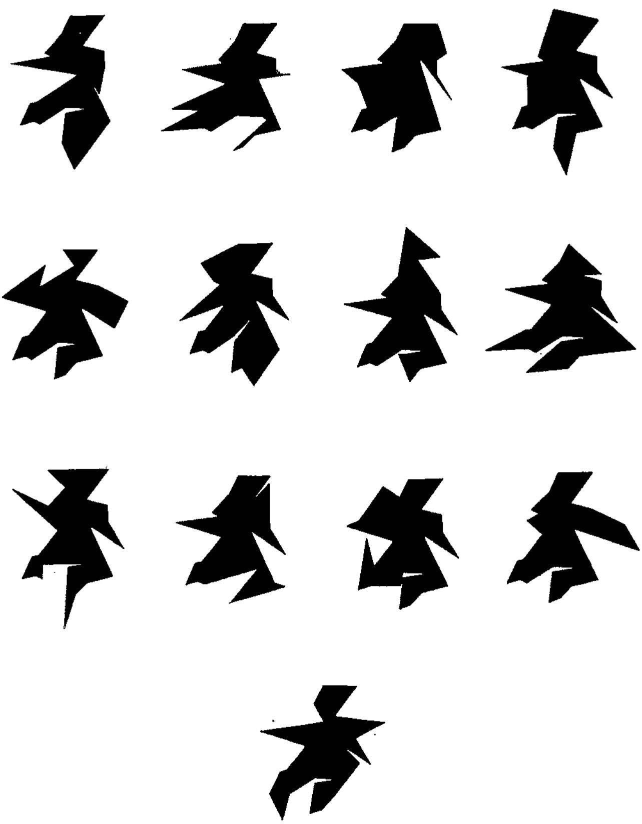

Figure 2. The 13 random shapes in Somnapan's Set A. The identifying numbers of the shapes are as follows: 1 to 4 across the top row, 5 to 8 across the second row, 9 to 12 across the third row, and 13 at the bottom.

[4] Four MED stimuli could be located at four points in three-dimensional space, each point a fixed distance from every other (within a sphere, say). Five or six or seven MED stimuli could conceptualized as lying at five or six or seven points, as the case might be, in four-, five-, or six-dimensional space (in three different hyperspheres), the distance between any two points, in each set of stimuli, being the same as that between any other two. The number of hypothetical dimensions of the hypersphere required for positioning n MED stimuli would always be n-1.

The procedures used by Somnapan in identifying MED sets of random shapes cannot be presented here. They will be described in detail in a monograph to be published in the near future. For present purposes, it is enough to show, in Fig. 3, the six stimuli among the 13 seen in Fig. 2 which came closest to satisfying the MED criterion.

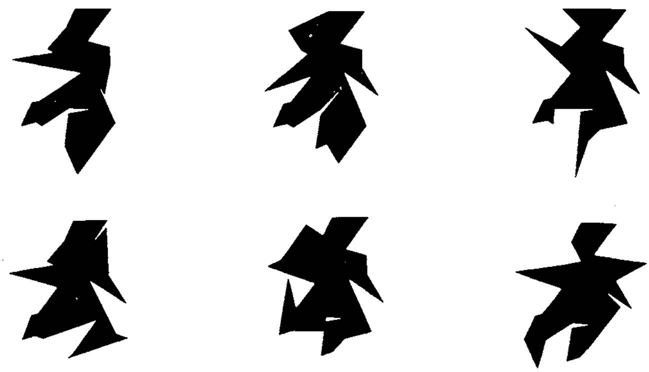

Figure 3. The six random shapes among the 13 in Fig. 2 which came closest to meeting the MED criterion. The shapes in the top row are Nos. 1, 6, and 9, those in the bottom row, Nos. 10, 11, and 13.

Consider, now, possible differences in connotative strength possessed by the members of an MED set of random shapes. The term "connotative strength" and the more familiar terms "association value" and "meaningfulness" have essentially the same signification. The reason for our use of connotative strength (cs) will be indicated later.

Even a casual inspection of the 13 shapes in Fig. 2, and of the special six in Fig. 3, reveals that some of the shapes are much more suggestive of things and events than are others, that is to say, they *mean* more. These obvious differences in meaningfulness led to our studies of the relative "power" of different shapes to call forth associations. What are now commonly called random shapes were once referred to either as ambiguous shapes or nonsense shapes. It is now generally recognized that some random shapes are no more nonsensical than are some trigrams—consonant-vowel-consonant combinations of letters—traditionally called nonsense syllables.

Associativeness of Verbal Materials

In connection with research in the broad area of verbal learning, three different approches have been made in assessing the associativeness of trigrams (nonsense syllables), adjectives, paralogs, and other verbal materials. Glaze (1928) began the normative work with 1,665 CVC combinations, none of which formed words. His measure of the *association value* (symbolized herein by *a*) of each combination was the percentage of subjects reporting at least one association, during a 3 sec. exposure interval. Glaze's method has been applied, in modified form, by other investigators—most recently and most extensively by Archer (1960) and Noble (1961).

In 1952, Noble introduced the "production method." His specific purpose was to assess the associativeness of 96 pronounceable dissyllables (two-syllable nouns and paralogs). His measure of the *meaningfulness* (*m*) of each was the average number of associations written down, during a period of 60 sec., by 119 airmen (at an Air Force base). Mandler (1955), applied the production method to 100 selected "nonsense" syllables, a period of 30 sec. being allowed for writing down associations to each.

A third method—a scaling procedure—was used by Noble, Stockwell, and Pryer (1957) in obtaining the *scaled meaningfulness* (*m'*) of 100 syllables (trigrams) selected from Glaze's original list. The subjects judged each syllable in terms of the number of associations it aroused, in relation to a five-category scale ranging from "none" through "average" to "very many". Values of *m'* were calculated through an application of the method of successive intervals, as explicated by Edward & Thurstone (1952). Noble (1961) subsequently employed the procedure in getting *m'* values for 2,100 CVC combinations of the English alphabet.

Associativeness of Random Shapes

After an initial uncertainty concerning methodology, we finally decided to begin by using the production method. Vanderplas and Garvin (1959) had used a modification of Glaze's procedure in obtaining association values (*a*) for six different sets of random shapes, including one set of 30, all having 24 points and each constructed independently by method 1 of Attneave and Arnoult (1956). Our decision to use the production method in evaluating the associativeness of Somnapan's shapes was not based on the fact that all 26 of them (two sets of 13 each) had been generated from a single prototype, but arose from our desire to obtain verbal materials, preferably single concrete nouns, some often associated with particular shapes and others seldom associated with them—material that might subsequently serve useful purposes, especially in verbal pretraining studies.

The meaningfulness (*m*) of 26 shapes, all generated by Somnapan from a single prototype, was sought. These included the 13 shapes shown in Fig. 2 and 13 others that constituted Set B.

The subjects were all students in a large introductory phychology course. They participated in groups of from 22 to 25 individuals. Each subject was given two half-sheets of lined paper, stapled together. Associations to a "practice" shape were written down on the top sheet. Instructions: "You will first see a random (or ambiguous) shape projected on the screen, black on white. It will be projected for 30 sec. During this time, you are to write down any associations that the shape brings to mind: things, places, events, and the like...." The practice shape was No. 24-1 in the Vanderplas-Garvin paper (1959, p. 151).

After turning to the second sheet, the subjects in a given group wrote down, during a 30 sec. period all associations aroused by one of the 26 "test" shapes. Every test shape was responded to by a different group of subjects. This precaution was taken to avoid possible interaction effects.

The meaningfulness (*m*) value—the average number of associations written down—for each shape, was easily determined. The range of the *m* values for the 13 A shapes (in Fig. 2) was from 1.46 to 3.04, while that for the 13 B shapes was from 1.64 to 3.42. (Table 1 includes the *m* values for the A shapes, Table 2 the *m* values for the selected six.) The ranges gave reason for

Table 1. The meaningfulness (*m*) and connotative strength (*cs*) of each of the 13 random shapes in Somnapan's set A. The shapes are reproduced in Fig. 2 where their placements correspond to the locations of their identifying numbers below

Shape No.	1	2	3	4
m	1.83	1.46	2.20	2.25
cs	2.12	2.35	2.65	2.79
Shape No.	5	6	7	8
m	2.40	2.08	3.04	2.09
cs	2.32	2.34	2.60	2.84
Shape No.	9	10	11	12
m	2.42	2.54	2.84	2.65
cs	2.55	2.30	2.55	2.43
Shape No.		13		
m		2.40		
cs		2.44		

Table 2. The meaningfulness (*m*) and connotative strength (*cs*) of each of the six random shapes, among the 13 shown in Fig. 3, which came closest to meeting the MED criterion.

Shape No.	1	6	9
m	1.83	2.08	2.42
cs	2.12	2.34	2.55
Shape No.	10	11	13
m	2.54	2.84	2.40
cs	2.30	2.55	2.43

hope, but hope soon turned to dismay. The overall results were not as anticipated; the *m* values were not in accord with the combined judgments of several trained persons in the laboratory. To illustrate: Shapes 3, 4, and 8 (in Fig. 2) were deemed to be highly suggestive of animate and/or inanimate things, and yet their m values were on the low side. In fact, $m = 2.09$ for shape 8, was third-lowest. In contrast, shapes 7 and 11, judged to be only moderately meaningful, had m values of 3.04 and 2.84, the two highest among the 13. Similar incongruities were found for the B shapes.

Had closer attention been paid by us to the result obtained by Vanderplas & Garvin (1959), we might have predicted what we found, at least in part. Vanderplas & Garvin calculated not only an association value (a) but also a heterogeneity index (H) for each of 180 shapes (of six different degrees of complexity). The correlation coefficient for the a, H values was .48. The greater the number of subjects reporting associations to a shape, the more heterogeneous the associations were.

What was needed, we decided, was an index of the heterogeneity (and, conversely, an index of homogeneity) of the verbal associations aroused in different persons by each shape. If a shape were very familiar and completely meaningful to everyone, the response to it would be invariant. Take a five-pointed star. The first and only response to it would be "star". If additional responses were requested, as in the production method, they would probably be "star light," "star bright," "star at night," etc. The responses would be maximally homogeneous. If a shape were extremely ambiguous, the responses might be almost anything. They would lie near the top in heterogeneity.

In our study, the responses to shapes with low m values tended to be homogeneous. For example, shape 8 (in Fig. 2) had an m values of 2.09. The first responses of 16 subjects to it were: Chinese man, Chinese warrior, shadow of Chinese man, drunk man, human shape, someone running, Chinese man, Chinese man, modern man, man running, tree, Christmas tree, Christmas tree, tree, pagoda, man. Contrariwise, shapes with relatively high m values tended to elicit heterogeneous verbal responses. As an example, the first responses of 16 subjects to shape 10 (in Fig. 2), with $m = 2.54$, were: cruhed insignia, pieces of puzzle, man running, metal scraps, face of clown, native, bird in flight, skyline, Halloween mask, bird, butterfly, tinfoil, airplane, face, hawk, soldier.

Mandler (1955), using the production method with 100 nonsense syllables (trigrams), proposed an index p (associative prepotency) for measuring "the tendency of a stimulus to evoke the same association from different Ss." This index is comparable to the one we attempted to define and calculate—an index of inter-subject sameness or homogeneity of response. We tried to develop categories into which most or all of the responses to a shape could be placed. The problem of categorizing was squarely faced but could not be solved. Inasmuch as we, in the laboratory, could not reach agreement on categories that might be used, we abandoned further attempts to find a suitable index of homogeneity.

Descriptive Appropriateness of Verbal Responses

An entirely different approach was finally decided upon. The first response (association) of each of 22 subjects to each of the 26 shapes was shown with its corresponding shape and judged for descriptive appropriateness on a category scale. Fig. 4 is a reproduction of what the judges saw at the top of their response sheets: a five-category scale of degree of appropriateness ranging from "far-fetched" (or "incongruous") to "especially appropriate" (or "just the thing").

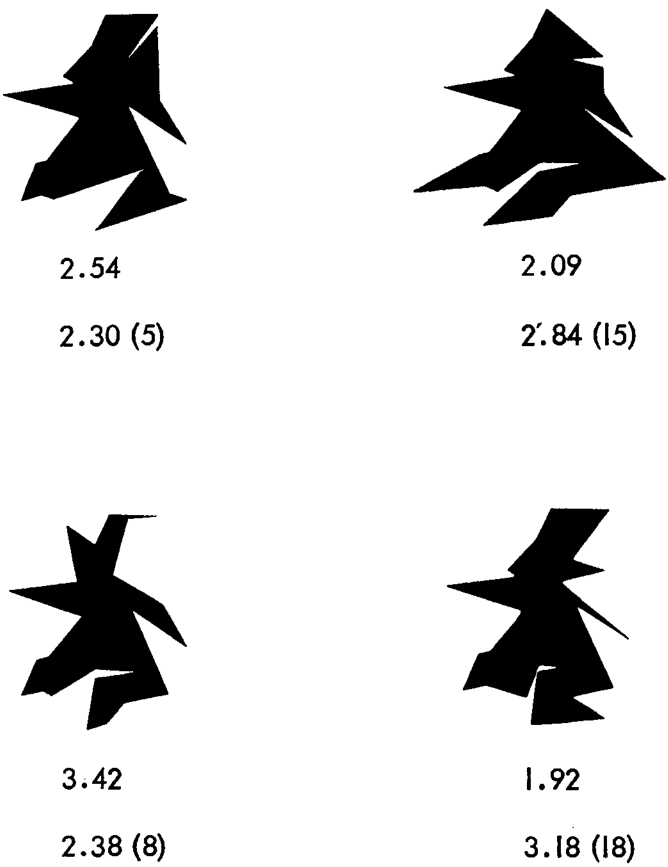

Figure 4. The 5-point scale of descriptive appropriateness.

The judges were 180 students enrolled in the elementary psychology course. They made their observations in small groups of varying sizes (12 to 20 per group). Because the total number of judgments to be made was large (22 responses times 26 shapes = 572), 90 of the students judged 11 of the responses to to each shape while 90 judged the other 11. This meant that each student made 286 judgments.

The instructions were mimeographed and distributed to the judges. However, they were read aloud by the experimenter, to insure that they were fully understood. They began as follows: "You will be asked to judge the degree of appropriateness of different words and short phases for describing (or representing) what are called random shapes." Examples were given, followed by preliminary practice. The shapes were projected randomly, one at a time, by means of 2 x 2 slides. Corresponding words and phrases were projected directly beneath the shapes by means of film strips. A shape and a verbal response to it were viewed together for 5 sec., whereupon a buzzer sounded to signal the beginning of 3 sec. interval for writing down the number of the judged scale value. The 286 judgments were made by each of the small groups in about 45 minutes, with three 60 sec. "breaks" suitably interspersed.

Connotative Strengths

The data were analyzed with an IBM 7070 computer. Of greatest interest were the median scale values for the 572 verbal responses to the 26 shapes, 22 responses per shape. The medians were measures of descriptive appropriateness (*da*) —the suitability of the words and short phrases for representing the shapes.

The mean of the 22 *da* values for each of the 26 shapes was computed. The 26 means of medians were regarded as measures of connotative strength (*cs*)—the relative "prepotency" of the shapes to elicit words and phases which would be judged highly appropriate for descriptive purposes.

Values of *cs* for Somnapan's A shapes may be seen in Table 1. Similar values for his 13 B shapes are available, of course, but are not included in this paper. The range of the values in Table 1 is from 2.12 to 2.84. (The range for the B shapes is from 2.09 to 3.18.) The reason for the use of the term connotative strength instead of association value or meaningfulness is that values of *cs* were obtained in a very unique way. "Association value" and "meaningfulness" are terms that presumably have been preempted by investigators of verbal learning.

The question arises as to whether or not values of *m* and *cs* are actually two measures of the same intrinsic characteristics of the 26 shapes. A Pearson r was computed, and turned out to be an insignificant .09. This outcome clearly suggested that the two measures could not both be indices of what the shapes *meant* to the many students who wrote down associations to them and later judged the associations (words as well as short phrases) with respect to their degree of descriptive appropriateness.

Can a decision now be reached as to whether values of *cs* better reflect what random shapes *mean* than do values of *m*? Not a final decision, perhaps; but the evidence favors *cs*. Compare A shape 10 and 8, shown across the top in Fig. 5. The *m*

NAME ____________ CLASSIFICATION ____________

FAR-FETCHED	BARELY ADMISSIBLE	PASSABLE	APPROPRIATE	ESPECIALLY SUITABLE
1	2	3	4	5
INCONGRUOUS	GENERALLY INAPPROPRIATE	ACCEPTABLE	APT	JUST THE THING

Figure 5. At the top, from left to right, are A shapes 10 and 8; at the bottom, B shapes 13 and 11. Under each shape are its *m* and *cs* values. In parentheses, after each *cs* value, is the number of verbal responses (in 22) that had *da* values greater than 2.49.

of 10 is seen to be 2.54 (given just below the shape). This value was second highest among those for the 13 A shapes. In contrast, the *m* of 8 is 2.09, fourth from the bottom. Which of the two shapes most immediately and clearly suggests the same or similar things? The answer, in part at least, is provided by the two lists of initial words and short phases, on a preceding page, which were written down by two different groups of 22 subjects. Chinese man, Chinese warrior, Christmas tree, pagoda, and the like, for shape 8. Crushed insignia, face of clown, butterfly, airplane, soldier, and other dissimilar responses, for shape 10. Fifteen of the 22 first responses to shape 8, only five of the 22 to shape 10, had *da* values greater than 2.49. Almost anyone would surely say that the *cs* of 2.84 and 2.30 are far more indicative of the relative "meaningfulness" of shapes than are the *m* values of 2.09 and 2.34.

Another striking example of a reversal in the position of two shapes is shown at the bottom of Fig. 5, where shapes 13 and 11 from Somnapan's (1962) set B are pictured. The *m* of shape 13 is 3.42 while the *m* of 11 is only 1.92. Now, compare the *cs* values: 2.38 and 3.18. Which of the two shapes is most immediately suggestive of the same or similar words and short phrases. Here are 17 (out of 22) first responses to shape 11 written down by 17 different persons: soldier, running fat man, spy, man staggering down a street, man wearing top hat, man with top hat and cloak, man with tall hat and cape, villain in tall hat and cloak, villain from a melodrama, piece of puzzle, running man, running man in top hat with cane, man in cartoon, villain, man running, dancer, dancer. Note the homogeneity of the asociations. In contrast, note the marked hetergeneity of the following 17 first responses to shape 13: clawing hand, elf, Halloween, witch, star, part of a star, face, shadow, scarecrow, bug, person talking, paper shape, clown, ghost, running man, jumper, madness. Eighteen of the 22 first responses to shape 11 had *da* values greater than 2.49 while only 8 of 22 to shape 13 stood equally high. In fact, 14 of the responses to shape 11, while only two of those to shape 13, had *da* values equal to or greater than 3.00. Can anyone reasonably doubt that the *cs* values for the two shapes are far better indices than are the *m* values of the degree to which the shapes have potentiality for arousing specific and uniform associations?

Support for the view that values of *da* for concrete nouns elicited by random shapes have essentially the same import as values of either *a* or *m* for trigrams, paralogs, and adjectives, comes from a preliminary paired-associates study utilizing pairs of shapes and concrete nouns of high (HI) and low (LO) *da*. Ten shapes selected from Somnapan's (1962) sets A and B were the stimuli. They were paired, for one group of 20 Ss, with concrete nouns of HI-*da*, and for another group of 20, with nouns of LO-*da*. The average number of trials required to learn a criterion of 10 correct anticipations on a single trial was significantly less, at the .01 level for the HI-*da* than for the LO-*da* pairs. Interestingly enough, when the two sets of nouns were scrambled so that no one of them had been associated with its new shape, rate of learning was markedly retarded. A study recently completed (Leonard and Lewis, 1965) has yielded confirming results.

An altered procedure for assessing the *cs* of random shapes has now been employed. The production method, as such, was discarded. Subjects viewed each shape for 30 sec. Then they each wrote down the single concrete noun which seemed best to describe the shape. A total of 33 nouns from 33 different Ss was obtained for each of 57 shapes, including 18 from the Vanderplas-Garvin (1959) 24-point set. Scaled values of *da* were obtained for each noun. The average of 33 *da* values for each shape was taken as the *cs* of the shape. (The shapes and nouns used by Leonard and Lewis (1965) were among all these.)

Now that the *cs* values of many shapes have been assessed, and sets of MED shapes have been identified, the way is open to a rigorous control over stimuli to be employed in discriminative perceptual-motor tasks.

ACKNOWLEDGMENTS

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Value Patterns in Three Midwest Colleges

JOHN R. TISDALE

Abstract: The Allport, Vernon, Lindzey *Study of Values* reported norms were compared with scores from a sample from three midwest liberal arts colleges. The total college group consisted of 440 Ss, 183 males and 257 females. The individual samples showed both resemblances to and differences from each other and the appropriate sex norms, when they were examined on the basis of the mean values obtained for each of the test's six variables and of the relative rank assigned to each. The composite group showed differences in amounts rather than ranks on the scales. It was concluded that the appropriateness of the Manual norms was not established by this survey, although it was tentatively predicted that large samples of females would probably rank the variables much the same as the norms.