Paired-Associates Learning of Random Shapes and Concrete Nouns of Two Levels of Descriptive Appropriateness

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Abstract: Forty college students learned a 12-item list of paired-associates with random shapes as stimuli and concrete nouns as responses. The nouns had been rated high, medium, and low in descriptive appropriateness (*da*). The pairs were presented either black on white, or white on black, with half the Ss assigned to each condition. Learning was significantly faster for pairs containing nouns with high *da* values and for the black on white mode of presentation.

The study here reported was concerned primarily with differences between the rates of learning pairs of random shapes and nouns, when the degree of descriptive appropriateness (*da*) of the nouns was high (*HI*) in one case and low (*LO*) in the other. The mode of presenting the pairs, black on white, and white on black, was of incidental interest.

Items for a paired-associates learning task can be selected so as to permit assumptions to be made, prior to learning, regarding the degree of associative strength between stimulus and response members. If the stimuli, because of already existing habits, suggest responses which are correct in the learning task, the S-R connections should be made readily with rapid learning resulting. If the stimuli, on the other hand, more or less consistently elicit verbal responses which are not correct in the learning task, old habits must be inhibited or unlearned and new ones established; and learning should be retarded.

Underwood and Schulz (1960) constructed lists in which the stimulus of a pair was a concrete noun and the response an adjective which described the noun by some sense impression such as "hard" or "sweet". The adjectives were either high or low in "dominance"—often or seldom associated with the nouns. College students learned more rapidly the lists containing the "high dominant" responses. These lists, however, were composed of pairs which the S-R connection, prior to learning, was narrowly restricted. When Wicklund, Palermo, and Jenkins (1964) varied strength of associative connection between stimuli and responses by means of free association norms, they found a significant effect of strength of association on paired-associate

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learning in children, although Jenkins (in press) failed to obtain differences in learning with adult Ss when associative strength was varied. The possibility is suggested that the language habits of adults are so firmly ingrained, even for low associates, that expected differences in rate of learning will not appear.

If language habits introduce barriers in investigations of the effects of strength of association on verbal learning in adults, the use of novel, that is, unfamiliar, stimulus material may provide a solution, especially if there is some way of estimating the strength of the connections between the novel stimuli and the to-be-learned responses. The recent scaling of concrete nouns and short phrases in terms of their appropriateness for describing or representing random shapes (Lewis & Boehnert, 1965) seems to provide such a pool of stimulus-response material.

Vanderplas and Garvin (1959a) obtained association values (a) for a large number of random shapes. Subsequently, shapes of 3 levels of a were used as stimuli in a paired-associates task where trigrams (CVC combinations) of 0% association value (Glaze) served as responses. No differential effects were obtained for the three levels of a. Except for a preliminary study mentioned by Lewis and Boehnert (1965), random shapes have apparently not been used as stimuli in other investigations of paired-associates learning involving verbal responses of different association value or meaningfulness.

The present study was done in order to assess, in a paired-associates learning situation, the effects on degree (or rate) of learning when nouns of high and low descriptive appropriateness (da) were paired with 24-point random shapes selected from those constructed by Vanderplas and Garvin (1959a). It was expected that the pairs containing HI-da nouns would be learned more rapidly provided that the previously rated values of da did, in fact, reflect the strength of S-R connections. If rated appropriateness did not reflect strength of connection, or if this variable is unrelated to learning, the number of correct responses for HI-da and LO-da groups would not differ.

METHOD

Design. Two groups of Ss learned a single 12-item paired-associates list. The design was a 2 x 2 factorial; two levels of da constituted a within-Ss factor while two modes of presenting the shapes—black on white, and white on black—constituted a between Ss factor. Twenty subjects were assigned randomly to each of the two modes of presentation.

Lists. As already stated, 12 of Vanderplas and Garvin's 24-

point shapes were the stimuli. Four of the shapes were paired with nouns which had previously been rated at the low end of the appropriateness scale, while four others were paired with nouns rated at the high end. An additional four shapes were paired with nouns of intermediate da value in order to lengthen the list to 12 items. The nouns had been rated on a 5-point scale on which number 1 stood for very inappropriate (incongruous; far-fetched); number 5 for highly appropriate (especially suitable; just the thing). The 12 pairs are shown in Fig. 1 with the da value of each noun shown in parentheses. The average da values for the HI group is 3.839; for the LO group, 1.365; and for the intermediate group, 2.351.
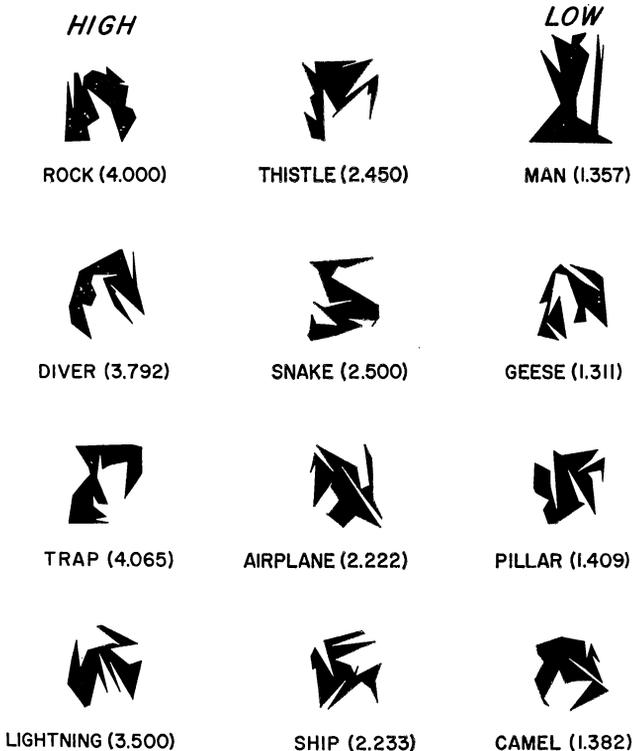

Figure 1. Random shapes and associated words with values of descriptive appropriateness (da) in parentheses.

The four shapes in each sub-group, considered alone without reference to their associated verbal responses, had been found to possess approximately equal average connotative strengths-2.363, 2.370, and 2.354 for the HI, MED, and LO sub-groups, respectively. They also had approximately equal average association values—36, 32, and 38. (For the a values of the 12 shapes,

individually, see Vanderplas & Garvin (1959a.) The nouns, within each appropriateness level, have comparable frequencies of occurrence in the Thorndike-Lodge list (1944).

The twelve pairs were strip-filmed in five random orders to prevent serial learning. No pair appeared twice in succession and pairs from each level appeared about equally often in each ordinal position.

Procedure. Items were projected by a Dunning Animatic 16 mm. filmstrip projector at a 2:2 sec. rate, that is, the stimulus shape was shown alone for a 2 sec. anticipation period, and then the correct noun appeared below it for another 2 secs. A 4-sec. interval elapsed after each complete presentation of the 12-item list. Standard paired-associates instructions were read to the Ss. They were to say aloud each correct noun during the anticipation period. Each S was run individually for 15 test trials.

Subjects. Forty Ss enrolled in an elementary psychology course served in the experiment. They were randomly assigned to the black on white and white on black sub-groups. By participating, the Ss fulfilled part of a course requirement. None of the Ss had previously taken part in an experiment which used random shapes. No S was dropped from the experiment.

RESULTS AND DISCUSSION

The means of number of correct responses per test trial made by the 20 Ss in the black on white, and the 20 in the white on black, sub-groups, and for HI and LO levels of *da*, are plotted in Fig. 2. The means are based on all four pairs for the HI *da*
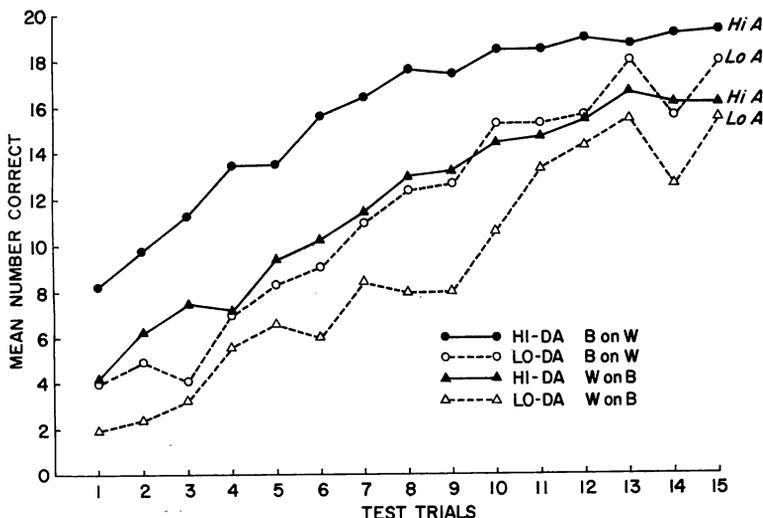

Figure 2.   Trend lines for 2 levels of descriptive appropriateness (*da*) and for two modes of presentation, white on black and black on white.

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condition, but on only three of the pairs for the LO condition. The reason for this difference is that the first pair in the column labeled LO in Fig. 1, that is, the response "man" to the top shape, was responded to correctly on every one of the 15 test trials by 39 of the 40 Ss. The single error made on this pair was on the first trial.

The curves in Fig. 2 do not reveal any evidence of a condition by trials interaction. The differences in means between the HI and LO *da* conditions are significant for the black on white ($t = 6.238$, df 19, p<.001) and also the white on black ($t = 4.369$, df 19, p<.001) modes of presentation.

Of incidental interest in the present experiment was the possibility that the effects of HI and LO *da* on learning might be different under the two modes of presentation. The original ratings of the appropriateness of the nouns for describing the shapes had been done with black on white projection. As was anticipated, learning was faster in the present experiment when presentation was black on white ($F = 15.88$, df 1 & 38, p<.001), but the differences between the HI and LO conditions were significant under both modes. The rated *da* values, therefore, are related to performance in paired-associates learning even though the white on black condition depressed overall level of performance.

If the data from the first pair in the LO condition are included in the analysis, there is an apparent interaction ($F = 5.27$, df 1 & 38, p<.05). A significant difference is still found between the HI and LO *da* conditions for the black on white mode ($t = 3.944$, df 19, p<.001) but this difference, though in the same direction, is not significant for white on black.

The results seem to support the conclusion that the rated appropriateness values are positively related to paired-associates learning. And since, in the preparation of the lists, the associativeness of the stimuli and of the responses for all groups was equated, the faciliation effect cannot be attributed to stimulus or response meaningfulness. The effect seems due, rather, to associative strength as it is reflected by the *da* values. In other words, random shapes can enter more rapidly into associative connections when they are paired with nouns of HI-*da* than when paired with nouns of LO-*da*. This is not to say, of course, that factors, such as intralist similarity, could not be manipulated in such a way as to alter these results, but within the conditions of the present experiment, the prediction of greater ease of learning with HI *da* was supported. Informal support was also given by the unsolicited comments of subjects upon the completion of the 15 test trials; they frequently remarked that the

shape did not "look like" the word for the pairs they found difficult to learn.

In so far as a random shape elicits a verbal response unique to it, another response would no doubt be easily learned if it were related in some meaningful way to this unique response, and to be more difficult to learn if it were unrelated to it. The relatively greater ease with which words of higher descriptive appropriateness were learned as responses in the present experiment may reflect the fact that there is less competition from other responses.

The present results indicate that degree of learning may not be a gradually increasing function of rated appropriateness. Pairs containing nouns of intermediate *da* were learned almost as if they were high in *da* rather than intermediate. A parallel finding is reported in the Wicklund, Palermo, & Jenkins study (1964). They trained children on pairs of words of HI, MED, or LO "free" association value and obtained significant differences between the LO condition and both the MED and HI, but the HI and MED did not differ from one another.

The average appropriateness value of the shape may also be a factor related to learning, apart from the strength of associative connection; that is, a HI value shape may lead to more rapid learning than a LO, even if unrelated response terms were paired with both. This is the result which would be expected if the average appropriateness value is analogus to meaningfulness as usually defined. The stimulus for the pair which was learned immediately by almost every S in the present study has a high avarage value of *da* and ranks highest in *a* value among the 30 Vanderplas & Garvin 24-point shapes. Unfortunately, the response "man" in this pair, although rated LO in *da*, is unmistakably related to other responses to the shape—"statue", "knight," and "warrior"—which were rated high. Any *post hoc* speculation as why this pair deviated from expectation must be made with caution. Factors other than descriptive appropriateness must surely affect paired-associates learning involving random shapes, but they still remain to be identified. Results of the present study do indicate that descriptive appropriateness is at least one predictor of level of performance in paired-associates learning.

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Assessing the Connotative Strengths of Random Shapes[1]

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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

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[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.

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