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Learning of Random Shapes and Two Unique Sets of Concrete Nouns

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Abstract. In paired-associates learning, ten random shapes were used as stimuli and two sets of concrete nouns as responses. One set of nouns was high in descriptive appropriateness, *da*, the other set low. Two different groups learned the two combinations. Later, two additional groups learned with the pairings scrambled. Still later, a replication was made. The replication yielded results which, in most ways, were basically like those obtained originally; but there was an important exception that was related to the learning of the scrambled pairs for nouns of low *da* value.

Employing Methods 1 and 8 described by Attneave and Arnoult (1956) Somnapan (1962, 1968) generated two sets of 24-point random shapes from a single "prototype," 13 shapes per set, and then experimentally determined their relative discriminability. The aim was to obtain subsets of six mutually equally discriminable (MED) shapes to replace sets of six colored lights that served as stimuli in the Star Discrimeter (Lewis and Miles, 1956; Macek, 1958).

After discriminability data were available, it seemed certain that the shapes differed in meaningfulness (*m*). Lewis and Boehnert (1965) first used the production method described by Noble (1952) to obtain values of *m*. They were forced to conclude that *m* did not satisfactorily represent the meaningfulness of the shapes. They then resorted to a scaling procedure. They chose the first verbal response of each of 22 different subjects (Ss) to each of the 26 shapes, and had 90 Ss rate each of the 22 responses with respect to its corresponding shape for descriptive appropriateness (*da*) on a five-category scale ranging from 1 ("far-fetched" or "incongruous") to 5 ("especially suitable" or "just the thing"). The mean of 22 scale values thus obtained for each shape was, by definition, the connotative strength (*cs*) of the shape. Incidentally, the Pearson correlation coefficient for values of *m* and *cs* was an insignificant .09.

MAIN EXPERIMENT

Phinney (1963), working in the Motor Skills Laboratory as an NSF Undergraduate Research Participant, chose 10 of the 26 shapes for which two sets of concrete nouns were available, one

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Shape		*Low da Word*	*da Value*	*High da Word*	*da Value*
A-9		Pyramid	1.25	Dancer	3.79
A-3		Triangle	1.04	Duck	3.61
B-10		Plane	1.48	Jump	3.78
B-3		Spider	1.44	Man	3.58
A-1		Elephant	1.13	Mouth	3.15
B-1		School	1.13	Puppet	3.94
B-11		Axe	1.13	Villain	4.03
B-12		Animal	1.32	King	3.19
A-11		Octopus	1.50	Windmill	3.39
A-7		Bear	1.42	Halloween	3.41

Figure 1. 10 Shapes and two sets of nouns with their *da* values.

set high in *da* values, the other low. The shapes, their corresponding nouns, and the *da* values of the nouns are shown in Fig. 1. Kimble and Dufort (1955) and Noble and McNeely (1957) had shown that paired-associates learning is facilitated if pairs of dissyllables are high in *m* as compared with learning when the pairs are low in *m*. Phinney's aim was to determine whether shape-noun pairs are more readily associated if the nouns have high rather than low *da* values.

Forty undergraduate students served as Ss. None of the Ss had previously participated in a paired-associates learning experiment, so each was given procedural familiarization. For this purpose, eight pairs of dissyllables were used. Thereupon, each S was given response familiarization, that is, he (or she) memorized the 10 response words appropriate for one of the groups of 20 Ss. The learning of the shape-noun pairs then began. A Dunning Animatic film-strip projector was employed, two frames per pair. First, a shape would appear on the screen; then the shape and its noun. The rate of presentation was 3 sec.–3 sec., with anticipation (pronunciation) of the noun to occur when the shape alone was seen. The criterion, which each S reached, was 10 correct anticipations in 10.

The trend lines for the high and low *da* groups may be seen in Fig. 2, where the means of number of trials to successive criteria are plotted against number of correct responses (up to the final

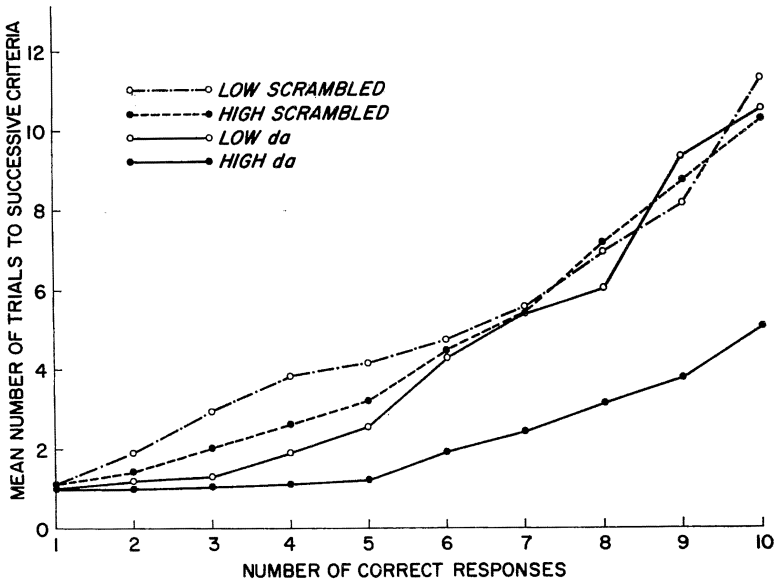

Figure 2. Trend lines for the four experimental groups.

criterion of 10). The means are given in the second and third columns of Table 1. The t value for the difference between the sums of these means is 4.64 which, with 18 *df*, is highly significant ($p < .001$). The difference between the means of number of trials to reach the criterion of 10 correct anticipations in 10 is 1.90 (8.95–7.05) with $t = 2.40$ for which, with 38 *df*, $p < .025$.

Table 1. The Mean Number of Trials, Beyond the Inspection Trial, Required by Each of Four Groups to Attain Successive Criteria

Number of Correct Responses	High *da* Group	Low *da* Group	High *da* Group Pairs Scrambled	Low *da* Group Pairs Scrambled
1	1.00	1.00	1.15	1.15
2	1.00	1.25	1.50	1.25
3	1.20	1.90	2.15	1.70
4	1.30	2.65	2.90	2.30
5	1.75	3.75	3.60	3.90
6	2.35	4.10	4.75	4.95
7	2.80	4.95	6.20	6.50
8	3.55	6.70	8.30	8.15
9	5.10	7.70	9.50	9.65
10	7.05	8.95	11.50	12.15

Supplementary Experiment

The foregoing differences probably arose primarily from the *da* values of the two sets of nouns. However, there was the possibility that they arose, at least in part, from such aspects of the nouns as pronounciability, similarity, familiarity, etc. Consequently, two additional groups were run, 20 Ss per group as before, but now the pairings shown in Fig. 1 were abandoned; and there was a "scrambling" of the nouns within each set. The altered shape-noun combinations are given in Table 2.

Table 2. The Way the Shape-Noun Pairs Were Rearranged for the Supplementary Experiment

Shape	Low *da* Nouns Scrambled	High *da* Nouns Scrambled
A-9	Triangle	Halloween
A-3	Plane	Man
B-10	Elephant	Mouth
B-3	Animal	Windmill
A-1	Pyramid	Dancer
B-1	Octopus	Duck
B-11	Spider	Jump
B-12	School	Puppet
A-11	Bear	King
A-7	Axe	Villain

The 40 Ss were given procedural familiarization and each one memorized the 10 nouns in the appropriate set. Then the learning trials began. The results are depicted by the two broken-line curves in Fig. 2, based on the means listed in the last two col-

umns of Table 1. The curves (trend lines) are virtually coincident throughout their course; at no point do they lie a significant distance apart. Beyond five correct responses, they are consistently above the low *da* trend line (and, of course, the high *da* line). The means of number of trials, 11.50 and 12.15, to attain the final criterion of 10 correct anticipations in 10 are both significantly greater ($p < .01$) than those for the high and low *da* groups.

The trend lines in Fig. 2, together with the means in Table 1, were more or less in accordance with expectations and would undoubtedly have been accepted without misgivings if a conflicting result had not subsequently been obtained. During academic year 1965-66, Posey, Johnson, and Lewis [5] made a study which, in part, was a duplication of Phinney's main and supplementary experiments. Nine random shapes (instead of 10) were used as stimuli. They were far more homogeneous than the previous 10; they closely approached the MED ideal. But there were, as before, two sets of concrete nouns, one with high *da* values, the other with low *da* values, for the nine shapes. Two of the several groups of Ss, 20 per group, learned to associate either the high or the low *da* nouns with the shapes. Two other groups, 20 Ss each, learned either the high or low *da* nouns, *scrambled.* The results were basically the same as those obtained by Phinney, with one important and baffling exception. The trend line for the low *da* scrambled group lay consistently below that for the low *da* group.

During the summer of 1966, two visiting college teachers [6] (under the NSF Research Participation Program) sought to explain the contradictory result. Two explanations seemed somewhat reasonable. One was stated in terms of a possible difference between the learning of monosyllabic nouns on the one hand and dissyllabic nouns on the other. The second explanation was built around the notion that interference or facilitation (or both) might occur inadvertently in connection with the placing of shape-noun pairs in several different orders to avoid serial learning. The experimental results were interesting in themselves but failed to throw any light on the main problem.

The Replication

In view of the paradoxical situation, two of the authors (Mrs. Posey and Miss Horr) undertook a replication of Phinney's experiments using the same shapes and nouns. To the greatest extent possible, they duplicated his procedures and his way of an-

[5] With the assistance of David B. Kyner and Susan E. Munson, both of whom were NSF Undergraduate Research Participants.

[6] Dr. James G. Carnathan of Wheaton College and Dr. Ernest L. Johnson of Mississippi State College for Women.

alyzing and summarizing results. The trend lines for their four groups are shown in Fig. 3, with the means listed in Table 3.

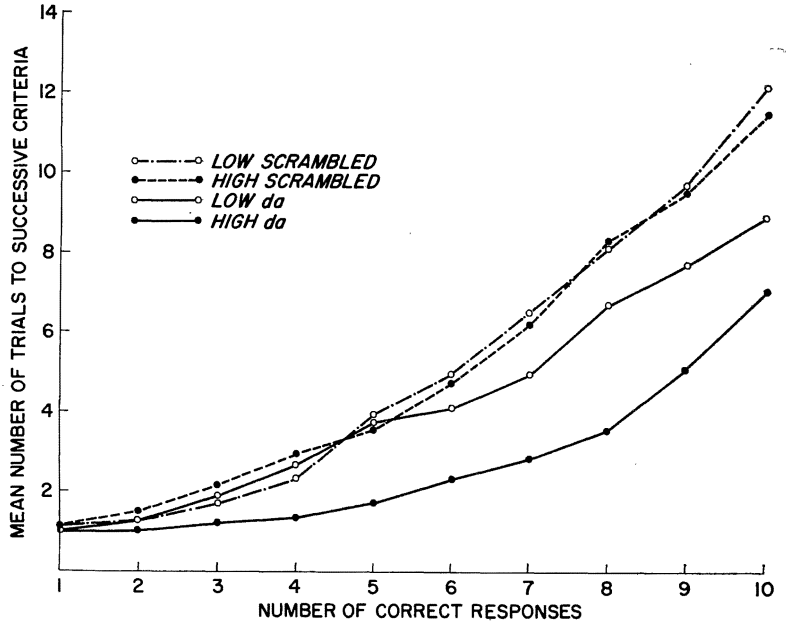

Figure 3. Trend lines for the four experimental groups in the replication of Phinney's study.

Table 3. The Mean Number of Trials, Beyond the Inspection Trial, Required by Each of the Four Groups in the Replication of Phinney's Experiments to Attain Successive Criteria

Number of Correct Responses	High *da* Group	Low *da* Group	High *da* Group Pairs Scrambled	Low *da* Group Pairs Scrambled
1	1.0	1.0	1.1	1.1
2	1.0	1.2	1.4	1.9
3	1.0	1.3	2.0	2.9
4	1.1	1.9	2.6	3.8
5	1.2	2.5	3.2	4.1
6	1.9	4.3	4.4	4.7
7	2.4	5.4	5.4	5.5
8	3.1	6.0	7.1	6.9
9	3.7	9.3	8.7	8.1
10	5.0	10.4	10.2	11.2

Fig. 3 should be carefully compared with Fig. 2. The main thing to be noted is that, in both figures, the trend lines for the low *da* group and the high *da* scrambled group lie conspicuously and consistently above the line for the high *da* group, clearly indicating that the learning task for the latter group was much eas-

ier than the tasks for the other two. A further thing to be noted is that the results obtained in the replication confirm only part of Phinney's findings. As seen in Fig. 3, the upper three trend lines (beyond five correct responses) overlap and at places are virtually coincident. This overlapping does not appear in Fig. 2. The one conclusion that seems inescapable is that high and low *da* values play a role, in paired-associates learning, comparable to that played by high and low *m* values.

ACKNOWLEDGEMENT

Professor R. W. Schulz, Department of Psychology, University of Iowa, should be given credit for proposing the scrambling of the shape-noun pairs as a possible means of taking account of differences between the two sets of nouns, other than their high and low *da* values.

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