

## Abstractness, Imagery, and Meaningfulness in Paired-Associate Learning<sup>1</sup>

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This study, concerned with imagery as a possible mediator of verbal associations, developed from prior investigations of the effect of word order on the learning of nouns and modifying adjectives. Lambert and Paivio (1956) found that lists of adjective-noun word groups were learned more easily when the nouns preceded rather than followed the adjectives. While contrary to expectations from English language habits, the finding was consistent with the interpretation that nouns function as conceptual "pegs" for their modifiers. Elaborating on this hypothesis, Paivio (1963) suggested that the efficiency of nouns as stimulus pegs may depend on their capacity to elicit imagery which can mediate recall of associates (cf. discussions of a memory system in which sensory images are used as associative aids; e.g., Miller, Galanter, and Pribram, 1960, pp. 134-138; Wallace, Turner, and Perkins, 1957). On the basis of this hypothesis and the assumption that concrete nouns evoke images more readily than abstract nouns, Paivio predicted that paired-associate (PA) learning of noun-adjective pairs would be easier with concrete rather than abstract nouns as stimuli; that is, the facilitating effect of noun concreteness was expected to be greater on the stimulus side of pairs, where the word's capacity to

arouse mediating imagery would be crucial although a positive effect of response concreteness was also expected on the basis of other learning data (e.g., Gorman, 1961). The results of one of two experiments supported the prediction, but the differential effect of noun concreteness on the stimulus side was slight in comparison with a strong main effect of this variable.

The expected effect may have been partly obscured in the above study by strong pre-experimental associative linkages between the nouns and adjectives. Accordingly, noun pairs were used to investigate the influence of word abstractness and imagery in the present research; stimulus and response abstractness were simultaneously varied. It was predicted that the four stimulus-response combinations constructed from concrete and abstract nouns would be learned in the order concrete-concrete (CC), concrete-abstract (CA), abstract-concrete (AC), and abstract-abstract (AA), in increasing order of difficulty, the predicted superiority of CA over AC pairs being particularly crucial to the imagery hypothesis. The image-evoking capacity of the nouns was also assessed by means of *S*'s ratings: it was expected that rated imagery (*I*) would be higher for concrete than for abstract nouns. In view of the potent influence of meaningfulness (*m*) on verbal learning (e.g., Underwood and Schulz, 1960), and Lambert's (1955) finding that concrete nouns exceed abstract nouns on this variable, *m* data were also obtained. Furthermore, since an aural mode of presentation was used

in the learning task, the words were rated on auditory familiarity.

### METHOD

#### Materials

The stimulus words consisted of 16 "concrete" nouns and 16 "abstract" nouns with frequencies of 50 or more occurrences per million according to Thorndike and Lorge (1944). The concrete nouns refer to denotable objects or things, whereas the abstract nouns lack comparable objective referents. All of the abstract nouns were ones categorized as abstract by Gorman (1961) on the basis of judgements. Not all of the concrete nouns used here were rated for abstractness in Gorman's study, but their denotative quality is unambiguous in each case. The concrete nouns are: String, Tree, Coffee, Dress, Shoes, House, Pencil, Garden, Wheat, Potato, Woman, River, Chair, Magazine, Flower, and Star. The abstract nouns are: Idea, Moment, Soul, Opinion, Effort, Freedom, Series, Health, Truth, Duty, Fate, Theory, Event, Fact, Virtue, and History.

A PA list consisting of 16 pairs was constructed from the words, such that the list included four pairs of each of the following combinations: CC, CA, AC, and AA. The pairing was random but for the restrictions that pairs comprised of words beginning with the same letter, or with obvious meaningful associations, such as Flower-Garden, were not permitted. A second list was constructed by recombining nouns from CC and AA pairs of the first list as CA and AC pairs in the second, and CA and AC pairs of the first list as CC and AA pairs in the second. A third and fourth list were created by reversing the stimulus-response position of the pairs in each of the above lists. The varied pairing controlled for possible biases favoring the learning of specific pairs.

#### Procedure

*Paired-Associate Learning.* The PA learning procedure involved auditory presentation of alternate learning trials (both stimulus and response members presented) and recall trials (stimulus members only presented) to four groups of 25-34 *S*s each. Each group learned a different one of the four arrangements of the basic PA list described above. Two groups were given 4 trials and two, 6 trials. The additional trials in the latter groups contributed no unique information and, to maintain uniformity, only four trials were considered in the analysis of the data.

Prior to the learning task, instructions were read to the *S*s and an example was presented. The

example consisted of reading aloud, once, four PAs comprised of words unrelated to those used in the actual experiment, following which the stimulus words alone were read and *S*s were asked to respond orally to each. They were told that on recall trials with the actual list they were to write their answers. Recording sheets, each of which contained a column of numbers, 1-16, were provided. The *S*s were told not to be concerned about spelling errors.

On each learning trial the pairs were read aloud in a monotone, approximately 2 sec between pairs. The stimulus words alone were then read at 8-sec intervals, allowing *S*s time to write the responses.<sup>2</sup> To avoid confusion in recording responses, the numbers indicating the ordinal position of items were also read aloud immediately preceding the stimulus words, e.g., one-history, two-pencil, etc. The items were presented in a different, randomly determined, serial order on each learning trial and each recall trial. Other than the time required by *S*s to turn to a new answer sheet after a completed trial, no specific intertrial interval was allowed.

In an attempt to eliminate errors of word recognition (in particular, "shoes" tended to be reported as "choose"), all but the first group of *S*s had the test words read to them once, in a random order, and spelled prior to the learning task. Such errors still occurred but they will not be considered separately in the present report inasmuch as they were relatively infrequent and preliminary attempts to adjust for them had no significant effects on the results, and the four different pairings of specific words presumably controlled for any systematic effect such errors might have had.

*Imagery.* Ratings of *I* were obtained from 26 *S*s who did not participate in the PA learning experiment. A fairly standard rating procedure was used (cf. Underwood and Schulz, 1960, Ch. 2), the material being presented in mimeographed booklets. The instructions defined sensory imagery and stressed that *S*s rate the words on the ease or speed of an aroused image. Two practice words were

<sup>2</sup> The 8-sec interitem interval may be regarded as a possible source of error in that it permits rehearsal which may differentially affect the four classes of items. Evidence that this is not the case comes from a more recent study (Paivio and Oliver, 1964), in which the effects of noun specificity-germally were investigated and found to be highly similar to the effects of abstractness reported here despite differences in procedure, i.e., items were presented on a memory drum rather than aurally, and with a 2- rather than 8-sec interitem interval on recall trials.

provided. Eight stimulus words appeared per page, each word accompanied by a rating scale representing five degrees of ease of imagery, ranging from "Very easy—image aroused immediately" to "Very difficult—image aroused after long delay, or not at all." The ratings thus constituted a crude measure of the latency of sensory images elicited by the words.

*Meaningfulness.* Data on *m* of the test words were obtained from 46 additional Ss; Noble's (1952) production method was closely followed. Instructions and stimulus materials were provided in a mimeographed booklet. Each stimulus word appeared on a separate page and was repeated 20 times in a vertical column. The ordinal arrangement of the 32 words in a booklet was randomly varied for different Ss. Sixty seconds were allowed for the written associations to each word.

*Auditory Familiarity.* Ratings of the auditory familiarity (*F*) of the test words were obtained from 14 male and 10 female Ss from one of the groups that had participated in the PA learning experiment about 4 weeks earlier. A 9-point scale, with 9 labeled "Extremely Familiar" and 1 "Extremely Unfamiliar," was drawn on the blackboard, and Ss were asked simply to rate words that were to be read to them on how familiar they were as spoken words according to the scale on the board. The words were numbered from 1 to 32 and each number and word was read aloud. To avoid visual exposure to the words, Ss wrote down only the number of each word and their numerical rating of its familiarity. A 5-sec rating interval was allowed per word.

#### Subjects

All data were obtained from adult Ss comprised mainly of elementary and secondary school teachers enrolled in university summer school psychology courses. A total of 117 participated in the PA experiment. In order to have an equal number (i.e., 25) in each of the four groups involved, 17 Ss were randomly eliminated from the sample. The final PA sample consisted of 51 males and 49 females. Data on *I* were obtained from a further group of 14 male and 12 female Ss; data on *m*, from 28 males and 18 females.

#### RESULTS

*Effect of Abstractness on Learning.* The results were highly similar for the four groups of Ss, and their data were pooled in the analyses. Inspection of plotted learning curves

(mean number of responses correctly recalled on each of four trials) for the different combinations of stimulus and response abstractness clearly indicated that there was no interaction over trials, and statistical analyses were done only on the total number of correct responses over the four trials. The means and standard deviations for each combination are presented in Table 1. It can be seen that the

TABLE 1  
MEAN TOTAL NUMBER OF CORRECT RESPONSES  
ON FOUR TRIALS AS A FUNCTION OF STIMULUS  
AND RESPONSE ABSTRACTNESS

Stimulus	Concrete		Abstract	
	Mean	SD	Mean	SD
Concrete	11.41	2.83	10.01	3.1
Abstract	7.36	3.40	6.05	3.1

combinations rank in the predicted order of difficulty: CC, CA, AC, and AA, recall being highest for CC pairs and lowest for AA pairs. To determine the relative effects of stimulus and response abstractness, the data were analyzed by a three-way analysis of variance for correlated means (McNemar, 1962), with stimulus abstractness, response abstractness, and Ss as bases of classification. The analysis showed that the effects of both stimulus and

response abstractness are highly significant; the *F* for the former being 299.47; for the latter, 36.87 ( $df = 1/99$ ,  $p < .001$ , in each case). It should be noted that, in support of prediction, the effect of stimulus abstractness is clearly greater, the variance attributable to its being more than 8 times the interaction of the two was not significant ( $F < 1.00$ ). Differences between pairs of means were also tested by individual *t* tests for correlated means. All differences are highly significant ( $p < .001$ ), the crucial comparison being that between CC and AC pairs. As predicted, recall was better for CA pairs.

*Relations Between Concreteness, I, m, l*

TABLE 2

MEAN SCORES FOR CONCRETE AND ABSTRACT NOUNS ON IMAGERY, MEANINGFULNESS, AND AUDITORY FAMILIARITY

Nouns	Imagery		Meaningfulness		Familiarity	
	Mean	SD	Mean	SD	Mean	SD
Concrete	4.70	.33	14.11	.90	7.70	.84
Abstract	2.90	.58	10.34	1.17	6.50	.56

and Learning. Mean values based on the sample of Ss contributing data on each variable were computed for *I*, *m*, and *F* for each of the 32 nouns. Since Noble (1963) reports that failure to follow his original criteria of response acceptability in scoring for *m* has little effect on the scale's precision, *m* scores in the present study were based on the unedited, total number of different associations given by each S. Imagery and *F* scores were based on 5- and 9-point scales, respectively, higher scores representing higher values of the attributes. The means of the average scores on *I*, *m*, and *F* for concrete and abstract nouns are presented in Table 2, where it can be seen that concrete nouns are higher than abstract nouns on each of the variables. The concrete-abstract difference is highly significant ( $p < .001$ ) in each case, the *t* ratios being 12.86 for *I*, 9.95 for *m*, and 6.67 for *F*. The difference is clearest for *I*, on which there is no overlap of scores for words of the two categories.

Product-moment correlation coefficients were also computed between mean scores for the three attributes. Imagery and *m* correlate  $.90$ , *I* and *F*,  $.76$ ; and *m* and *F*,  $.75$ . To determine the relations of these attributes to learning, correlations were computed between the mean scores on the attributes and mean recall scores (based on the data of all four groups of Ss) for each of the 32 items when the items served as stimuli, as well as when they served as responses. Recall scores correlated  $.74$ ,  $.75$ , and  $.54$  with stimulus *I*, *m*, and *F*, respectively; and  $.42$ ,  $.43$ , and  $.31$  with corresponding response attributes.<sup>3</sup> The

<sup>3</sup> For purpose of comparison, it may be noted that the point-biserial correlations between recall

correlations of stimulus attributes with learning are significantly higher than those of response attributes (in the case of *I* and *m*,  $p < .01$ ; in the case of *F*,  $p < .02$ ). It is clear from these data that *I* and *m* are completely confounded, but the relative contribution of *F* to performance could be determined by the partial correlations. With *F* held constant, the partial correlations of stimulus *I* and *m* with recall are  $.60$  and  $.61$ , respectively,  $p < .001$  in each case. Conversely, with either *I* or *m* constant, the correlation between stimulus *F* and recall is approximately zero. Thus, *F* can be ruled out as an effective stimulus variable. Since theoretical interest centered on the stimulus role of *I*, partial correlations involving response attributes were not considered.

#### DISCUSSION

The results of the study are clearly in accord with the predictions from the conceptual peg hypothesis, but, in view of the confounding of *I* and *m*, it is necessary to consider alternative interpretations involving those variables. Since PA studies have generally found the effect of response *m* to be greater than stimulus *m* (see Kothurkar, 1963; Nodine, 1963; Epstein, 1963; and the summary of earlier research by Underwood and Schulz, 1960), contrary to the relations reported here, it may be argued that the influence of *m* was overshadowed in this research by a more potent variable on the stimulus side. However, a reversal of the usual effect of *m* has also been found in other studies (Epstein and Streib, 1962; Goss,

scores and stimulus and response concreteness are  $.72$  and  $.37$ , respectively.

Nordine, Gregory, Taub, and Kennedy, 1962; Mandler and Campbell, 1957), and the present study may simply represent a further instance in which stimulus  $m$  had more weight. This unusual effect might be explained by a two-stage analysis of PA learning (cf. Underwood and Schulz, 1960). Most PA studies on the effect of  $m$  have used relatively meaningless material, at least as low- $m$  items, and response learning has accordingly been a major factor. In the present study, all items were familiar words, response learning was presumably at a minimum, and the results may reflect primarily the influence of  $m$  during the associative phase of learning (cf. Epstein and Streib, 1962). However, this analysis still does not explain why the relation to  $m$  was greater on the stimulus side. Epstein (1963), for example, suggested that if the necessity for response learning were eliminated, the effects of stimulus and response  $m$  should be equivalent, not that the former should be greater.

A further problem with  $m$  is the general lack of a firm theoretical basis for any effect of  $m$  in PA learning. One possible approach, associative probability, generates the paradoxical prediction that an increase in  $m$  should increase the probability of both correct and incorrect (interfering) interitem connections (cf. Underwood and Schulz, 1960, pp. 44; Winer, 1963). A study by Postman (1962) indicates that pre-experimental associative probability can have both effects, but his findings also show that this variable significantly influences learning and retention when word frequency of stimuli is low but not when it is high. Since only high frequency words were involved in the present experiment, associative probability as a possible basis for the effect of  $m$  is weakened. Finally, while associative probability might conceivably explain the superiority of CC over AA pairs, it is difficult to see how it could account for the CA-AC difference. In view of these difficulties with  $m$ , it seems reasonable to

consider alternative explanations of the findings, particularly ones based on the concept of imagery.<sup>4</sup>

The assumed effect of  $I$  on learning could be interpreted in terms of acquired distinctiveness based on denotative meaning. Saltz (1963) found support for an acquired distinctiveness variable, cognitive differentiation in a relevant PA learning study in which the availability of color cues accompanying each verbal stimulus was varied by presenting them during learning but not recall trials or vice versa. Color differentiation was found to facilitate learning even when the color could not readily be used as a cue. The pertinent feature of Saltz's study here is that the procedure provided an opportunity for color sensations to be conditioned to the verbal stimuli, which may thereby have acquired distinct denotative or "concrete" meaning (cf. Phillips, 1958). Similarly, the effect of abstractness in the present study could be interpreted as cognitive differentiation resulting from prior association of concrete words, but not abstract words, with specific objective referents: by virtue of the denotative meanings thus acquired, concrete nouns may suffer little interference from other nouns.

It was possible to test the above interpretation of the present findings by using associative overlap, i.e., the numbers of associative words have in common, as an index of distinctiveness. Winer (1963) found PA learning difficulty to be directly related to associative overlap among stimulus items. If the same relation holds in the present study, greater overlap would be expected among abstract rather than concrete nouns. An associative

<sup>4</sup> Direct evidence against  $m$  as the effective variable was obtained in the more recent study by Paivio and Oller (1964; see footnote 2) on the effect of stimulus and response generality:  $I$ , but not  $m$  of stimulus members correlated significantly with recall scores. However, stimulus specificity was also superior to  $I$  as a predictor of recall.

overlap score, based on the total number of associates a given noun had in common with the other 15 members of the same (concrete or abstract) class, was derived for each noun from the associations of a random sample of 20 of the 46 Ss that contributed the data in this study. The overlap scores of the two classes of nouns do not differ significantly. Furthermore, a product moment correlation of  $-.21$  between overlap scores of stimulus terms and mean recall scores, although appropriate in sign, is also insignificant. Thus, distinctiveness, defined in terms of associative overlap, does not explain the effect of abstractness on learning.<sup>5</sup>

The conceptual-peg theory assumes that  $I$  affects learning, not via differentiation, but directly through facilitation of the linkage between members of pairs. Such an interpretation is consistent with recent discussions of images as conditioned sensations which can function as mediators (e.g., Mowrer, 1960; Staats, 1961). Concrete nouns presumably elicit such mediators readily and are therefore particularly effective as cues for associated response items. Differentiation might be involved in addition, based possibly on vividness of associations rather than properties of stimulus or response members alone. Jenkins (1961, pp. 74-75), for example, commenting on the mnemonic system involving associating imagery, suggests that if the associations are bizarre, i.e., unlike any others, they protect items from interference from other items. It should be noted, however, that the mediation involved in such a technique, as well as

<sup>5</sup> It may be noted that associative overlap scores of concrete stimuli, considered separately, correlate ( $r = .14, p < .01$ ) with recall, whereas the relation for abstract stimuli is only  $+0.02$ . This finding suggests an interfering effect among concrete nouns due to associative overlap, but it does not clarify the differential effect of concrete and abstract nouns on learning. Adjusted indices of associative overlap, which take into account the greater mean number of associates elicited by concrete nouns, also failed to account for the PA learning data.

in the present study, could be entirely verbal. Concrete nouns may simply be more effective in eliciting verbal mediators, which subjects are known to use as memory aids (see Jensen and Kowler, 1963; Underwood and Schulz, 1960, pp. 296-300). It is a challenge to experimental ingenuity to determine unequivocally whether nonverbal symbolic factors may also function in this capacity, as it has been assumed in this research.

## SUMMARY

Subjects were given alternate learning trials (auditory presentation of pairs) and recall trials (presentation of stimuli) on a list of paired-associates composed of concrete and abstract nouns. On the assumption that concrete nouns are superior to abstract nouns in their capacity to elicit sensory images, and that imagery can mediate the formation of an associative connection between members of a pair, it was expected that learning would be particularly facilitated with the concrete nouns as stimuli. Thus, the predicted learning difficulty of four stimulus-response combinations was as follows: concrete-concrete, concrete-abstract, abstract-concrete, and abstract-abstract, in increasing order of difficulty. Analysis of recall scores strongly supported that prediction.

The words were also rated on the ease with which they arouse sensory images. As expected, the concrete nouns were consistently rated higher than abstract nouns on this attribute. Other data indicated that the concrete nouns were also higher in associative meaningfulness and auditory familiarity and that the three measured attributes of the words were substantially correlated. Several possible interpretations of the findings were considered.

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## Reversal of Meaning as a Variable in the Transformation of Grammatical Sentences<sup>1</sup>

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### METHOD

**Subjects.** A sample of 24 Ss was drawn from a population of senior undergraduates and journalists, selected for the verbal fluency required to perform the tasks without undue stress or error. The first 12 Ss became Group I, the second, Group II, with no obvious systematic differences in the composition of groups or place and time of testing.

**Tasks.** There were four tasks, each requiring conversion of a list of 16 sentences according to rules involving either a negative or passive transformation (or their inverse) and resulting in the reversal or nonreversal of sentence meaning. The task rules also involved the changing of words within each sentence to opposite or synonymous forms. In the experimental context a single negative transformation ( $T_n$ ) or word change to the opposite ( $W_o$ ) reversed the meaning of a sentence, while a single passive transformation ( $T_p$ ) or word change to synonymous form ( $W_s$ ) left the meaning unchanged. Two reversals of meaning within the same sentence cancelled each other and left the total meaning unchanged.

Group I Ss performed tasks each involving one transformation and one word change (1WC tasks), the conjunction of  $T_n$  and  $W_s$  or of  $T_p$  and  $W_o$ , rules resulting in a reversal of sentence meaning (MC conditions), and the conjunction of  $T_n$  and  $W_o$  or of  $T_p$  and  $W_s$  rules resulting in no meaning change (M $\bar{C}$  conditions). Group II Ss performed similar tasks, each involving one transformation and two word changes (2WC tasks).

Rules and effects on meaning for all tasks are shown in Table I.

**Materials.** A 6 × 4-inch sketch showed a male child painting the inside of a house and a female child painting the outside, with a male adult standing beside a red car and a female adult beside a blue car. The male child was labeled *boy-brother* and the female, *girl-sister*; the adults were labeled *man-father* and *woman-mother*.

The hypothesis of the present study is that semantic and syntactic controls function interdependently during the process of sentence construction, with the developing meaning of a sentence being monitored at the same time that grammatical anomalies are avoided.

The relevance of both semantic and syntactic variables has been demonstrated in the perception of strings of English words (Miller and Isard, 1963) and in their recall (Marks and Miller, 1964). Syntactic factors alone have been the focus of studies investigating the aptness of Chomsky's (1957) transformational system of grammar as a model for the psychological process of sentence generation.

Such studies (Miller, 1962; Mehler, 1963) have indicated additivity in the time required to perform or process complex grammatical transformations; for example the estimated time to convert an active-positive "kernel" sentence into passive-negative form is roughly the sum of the estimated times for separate passive and negative transformations. The present study aims at testing whether the relative time involved in making passive or negative transformations (or their inverse) is independent of their effect on the meaning of the transformed sentence.

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