

Mediated Semantic Compatibility in Associative Learning

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This experiment investigated how association formation varies with the semantic compatibility of the verbal units to be associated. Sixteen *Ss* first associated meanings with nonsensical disyllables. The disyllables were then presented in sentence frames, which were either semantically compatible or incompatible with their acquired meaning. Later associative recall of sentence nouns to the disyllable cue was 3.5 times higher when the disyllable had been presented in a compatible than in an incompatible sentence frame. This finding supports the role of comprehensibility in promoting association formation.

If you had to learn either the pair GOJEY-PLOW or the pair GOJEY-PURSE, you would probably learn them at about the same rate. Since the disyllable is meaningless, it is a matter of indifference whether it is paired with PLOW or with PURSE. You would be similarly indifferent if these pairs were learned embedded in sentences such as

- (1) The GOJEY pulled the heavy PLOW,
- (2) The GOJEY jingled in the leather PURSE.

In reading such quasisentences, you will notice a strong impulse to assign some specific "semantic interpretation" to the nonsensical disyllable. The semantic selectional restrictions of the verb and verb-phrase impose a probable set of semantic features onto the disyllable in the subject-position. Thus, the GOJEY in (1) is expected to be some concrete, large, strong object capable of independent motion (e.g., a horse or tractor), whereas the GOJEY in (2) is expected to be some small concrete object capable of emitting sound, probably metallic (e.g., a dime or bell).

But suppose that prior to studying these sentences, you had been taught to associate particular meanings with these disyllables. If

GOJEY has a meaning, then the pairings in (1) and (2) are no longer a matter of indifference. If you had learned that GOJEY meant "a large strong object capable of motion" (or "a horse"), then sentence (1) is compatible with that meaning whereas sentence (2) is incompatible with it. Alternately, if you had learned that GOJEY meant "dime," then sentence (2) is compatible whereas (1) is incompatible with that prior meaning.

The issue hinges on the intersection of (a) the set of semantic features previously associated to GOJEY, with (b) the set of selectional restrictions imposed on GOJEY by sentence frames (1) or (2). If these feature-sets overlap, then the sentence frame will be appropriate to the meaning, the resulting quasisentence should be comprehensible, and you should have no trouble remembering that GOJEY appeared in a sentence which mentioned a PLOW. On the other hand, if the set of selectional features imposed by the sentence frame is violated by the features previously associated to the disyllable, then the quasisentence is incomprehensible, has no significant semantic reading (is "anomalous"), and should produce only minimal learning of the GOJEY-PLOW association. Thus, whether sentence (1) will be learned well or poorly will be *mediated* via the semantic features associated previously to the disyllable.

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The experiment to be reported was primarily concerned with testing this predicted difference in cued recall for pairs embedded in "Compatible" vs. "Incompatible" sentences. Several subsidiary variables were also studied for incidental interests. One variable was whether the disyllable acquired its meaning by being paired with a list of features (properties, predicates) or with a single concept (noun). These two definitional modes were expected to be equivalent in their influence on the later learning of the disyllables in the sentence frames. The second subsidiary variable was how *S* treated the quasisesntences as he studied them during the second phase of the experiment. Some *Ss* merely read and studied each sentence; other *Ss* read each sentence and then had to supply some logical continuation for it, telling what might happen next after the episode described in the quasisesntence. It was hoped that the continuation task would require greater comprehension of the sentence and would therefore exaggerate the later difference in recall between compatible and incompatible sentences.

METHOD

Design

The *Ss* first learned meanings for 20 disyllables, 10 paired with single noun concepts and 10 with three features each. Thereafter, *Ss* studied 20 quasisesntences like (1) for one trial. Half the disyllables of each definitional type occurred in a "Compatible" sentence frame and half in an "Incompatible" frame. Half of the *Ss* merely read aloud and studied the sentences, whereas the other half read aloud and supplied a logical continuation of each quasisesntence. A cued recall test followed the study trial; *S* was cued with the disyllable and was required to recall the object noun (e.g., recall PLOW to the cue GOJEY).

Materials

The 20 CVCVC disyllables had meaning-ratings of less than 2 in Noble's (1952) norms. None were defined as words in Webster's dictionary. The corresponding 20 meanings were composed by first selecting 20 concrete nouns and then producing three discriminating features or attributes for each of these concepts. For example, for some *Ss*, KUPOD could mean "lamp" or could be assigned the three features "has electrical

cord, an incandescent bulb, a shade." For a given *S*, 10 of the disyllables were paired with 10 noun concepts and 10 with the feature-triplets corresponding to the remaining 10 concepts.

The 20-sentence frames in the second part of the experiment were simple declaratives of the form: Article - CVCVC - Verb - Article - Adjective - Concrete Noun, as illustrated by sentence (1). Five of the 10 disyllables previously defined by single nouns were placed in sentence frames compatible with their meaning, whereas five disyllables were placed in incompatible frames. The 10 disyllables defined by attribute-triplets were similarly assigned, half to compatible and half to incompatible sentence frames. There were thus four within-list conditions, each exemplified by five sentences. Counterbalanced across *Ss* were the meanings and definitional types of particular disyllables as well as the specific sentence frames in which they occurred.

Procedure

Initial training of the CVCVC meaning associations was by the anticipation method using flashcards at a 3:3-sec rate. A correct response was defined as giving the correct noun or all three correct features to the disyllable. A total of 18 acquisition trials were scheduled. If any item attained a criterion of five successive correct anticipations before 15 trials, it was dropped out of the active deck. If all items met this criterion and were dropped (93% did before the fifteenth trial), training was polished off by three more postcriterion trials on all pairs. If some items had still not met this drop-out criterion by their fifteenth trial, then the final three trials on all pairs ensued nonetheless.

Following vocabulary acquisition, the sentence-learning trial commenced. Sentences were exposed at a 7-sec rate in the window of an MTA Scholar teaching machine. The CVCVC in the subject position and the concrete noun in the object position of each sentence were capitalized for emphasis. The recall tests followed after 42 sec of instructions. The disyllables were shown at a 7-sec rate and *S* tried to supply the object noun of the sentence in which that disyllable had occurred, e.g., given GOJEY to recall PLOW from sentence (1). The cues occurred in the same order as had their input sentences, thus insuring a constant lag between their study and test. No feedback was given for the test responses.

Subjects

The *Ss* were 16 Stanford students fulfilling a service requirement for the Introductory Psychology course. These were divided into two groups, each composed of four males and four females, assigned to either read or to read and continue the quasisesntences. The $\frac{1}{2}$ *Ss*

were tested individually. Detailed instructions informing *S* of the various tasks were given before and during the experiment.

Scoring

Since interest centered on the effect upon recall of the compatibility in meaning between the disyllable and its sentence frame, we decided in advance to consider recall results only for those disyllables which had met the stringent criterion of vocabulary acquisition (Later sentence recall for noncriterion disyllables averaged only 4%, well below that for criterion disyllables). The vocabulary acquisition criterion was met by 98 and 87% of the noun *vs.* attribute-triplet pairs, respectively. For obvious reasons, the attribute-triplet responses were harder to learn than the single noun responses. However, noncriterion disyllables were evenly assigned to be in Compatible or Incompatible sentence-frames, so elimination of such pairs introduces no bias into that comparison.

RESULTS AND DISCUSSION

A first finding is that the manner of definition of the criterion disyllable—whether by a simple noun or by a list of features—had no significant influence on later learning of the sentence in which that disyllable occurred. This variable also did not enter into any significant interactions. In principle, conditions could be arranged to reveal a reliable difference between these definitional types (e.g., in retrieval latencies), but they were equivalent under the present conditions. The reader should recall, however, that only items meeting the learning criterion were entered into this comparison.

The result of primary interest is the way recall relates to the compatibility of the meanings of the disyllable-sentence pairings, and to *S*'s manner of processing the quasentence during study. The percentages of correct recall of the object noun to the disyllable cue are shown in Table 1 for the four conditions. The compatibility variable has obviously had a very large main effect on recall, with the Compatible combinations being recalled about four times better than the Incompatible combinations, $F(1, 14) = 78, p < .005$. So the main variable of interest, mediated semantic compatibility,

TABLE 1
MEAN ADJUSTED PERCENTAGES OF CORRECT RECALL^a

Manner of processing	Consistency of Sentence Stem	
	Compatible	Incompatible
Read	.64	.22
Read and continue	.66	.16

^a Percentages are conditionalized upon the disyllable having met the criterion of vocabulary acquisition.

has clearly produced the intended effect and it is of appreciable magnitude.

The subsidiary variable, of continuation *vs.* reading the study sentences, produced essentially null results. This "sentence processing" variable was not involved in any significant main effects or interactions. Earlier experiments by Bobrow and Bower (1969) which showed facilitating effects of the "continuation" strategy (which presumably promoted sentence comprehension) had used incidental learning of actual sentences, and such *Ss* were compared to controls using a "rapid, multiple reading" strategy which probably detracted from the richness of any semantic interpretation given to the sentence. With such procedural differences, the lack of a "continuation" effect in the present experiment is not surprising and perhaps brings into sharper focus the salient factors in the previously positive result.

As noted above, we obtained a very strong effect on associative learning of mediated semantic compatibility. The effect, and its magnitude, are significant in two respects. First, although prior demonstrations (e.g., Rohwer & Levin, 1968) of the effect of anomaly on sentence recall support a correlation between comprehensibility and recall, one could not strictly rule out a natural-language "co-occurrence frequency" explanation of those findings. That is, in those experiments, sentences such as "the girl sings" might have been remembered better than anomalous sentences such as "the hat sings" because, regardless of how rare is the former sentence, it or similar strings are surely more

frequent in natural discourse than is the latter sentence. This problem is avoided completely in the present experiment, of course, by the use of nonsense disyllables in sentence frames.

A second, significant aspect of our experiment is procedural: With this procedure or a slight generalization of it, one could study associative learning as a function of the *degree* of compatibility of the semantic features previously assigned to two forms. That is, semantic feature-lists of varying numbers of identical features could be associated to disyllables before *S* is asked to learn pairs of the nonsense forms. By means of such research the ease of associating compatible *vs.* incompatible (“anomalous”) semantic concepts in sentences might come to be viewed as a consequence of laws governing associations among names of feature lists.

We have labeled this phenomenon “mediated compatibility,” although the traditional mediation paradigm (see Jenkins, 1963) which exactly parallels our case is not obvious. On the surface it resembles an A–B, A–C paradigm with the equations A = the disyllable, B = its semantic-feature list, and C = the verb–phrase of the sentence frame. But this does not capture the basis for the differential transfer. Rather, one must infer that the sentence-frame, the C-term above, contains within it associations (call them B′) to some features of the B-term. Thus, the paradigm may functionally resemble a three-stage paradigm A–B, B′–C, A–C, where the middle link B′–C is

inferred to be in *S*’s linguistic repertoire and where an intermediary B–B′ link is assumed to operate during the third phase. In these terms, the Compatible sentence frame is one in which B and B′ are closely related, whereas for the Incompatible frame they are unrelated.

The reader will note that a “control baseline” was missing in this experiment. This would be provided by a third set of disyllables on which *S* had been familiarized but with no associated meaning before they were presented in sentence frames for learning. With such control disyllables one could decide whether the effect in Table 1 represents facilitation of learning in the semantically compatible condition, interference with learning in the semantically anomalous condition, or both of these effects. Our guess is that both effects are present.

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