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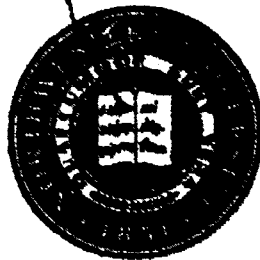
**Implicit Associational Responses Produced by Words in Pairs of  
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**Benton J. Underwood and Charles S. Reichardt**

**Northwestern University**

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**Abstract**

The purpose of this study was to determine if implicit associational responses (IARs) occur to individual words presented as pairs for associative learning. The occurrence of IARs was determined by a YES-NO recognition test, and IARs for words presented singly for study provided a base line. For all conditions, false recognitions to assumed IARs occurred; the magnitude was equivalent for words presented for study as pairs as for the same words presented singly. No evidence was found that IARs occurred during the testing phase.

Implicit Associational Responses Produced by Words in Pairs of  
Unrelated Words

Benton J. Underwood and Charles S. Reichardt  
Northwestern University

The question to which the present experiment was addressed was as follows: "Do implicit associational responses (IARs) occur to the members of pairs of unrelated words in a manner comparable to that for single words?" This question was prompted by two considerations. First, in verbal-discrimination learning, where pairs are presented for study, expectations based on the assumed occurrence of IARs have been given weak support at best (e.g., Kanak, Cole, & Eckert, 1972; Underwood, Reichardt, & Zimmerman, 1973). This could mean that, for whatever reason, when the subject is faced with pairs of words on a learning task the production of IARs to those words is depressed. Although IARs appear to occur to individual words in sentences (e.g., Hall & Crown, 1972), it does not necessarily follow that such production will occur with the words in pairs of unrelated words.

The second reason for conducting the experiment is a more general one, namely a concern with paired-associate learning. Most investigators seem to accept the notion that the learning of at least some pairs of unrelated words in a paired-associate list involves the use of natural-language mediators. Subject reports of such mediation have been far too frequent to dismiss the idea. Yet, there are some studies in the literature (e.g., Schwartz, 1969) which suggest that mediators in paired-associate learning do not occur with the spontaneity that

might be expected; instructions to the subject to seek them are often necessary for a clear influence to emerge. However this may be, there has been no test made of IARs to words in pairs and the present study will fill this gap.

This study utilizes false recognitions to detect IAR production. In the critical conditions, the subject was first presented pairs of words for study. Subsequently, his recognition for the individual words was tested, and included in the test was a high associate of one of the words of the study pairs. Thus, if the pair presented for study was spool-climb, the recognition test included the word thread which is a high associate of spool. The number of false alarms on these assumed IARs was compared with the number which occurred when the words were presented individually for study. Therefore, the first variable of interest was the method of presentation on the study list, pairs versus single words.

A second variable was instructional in nature. In one case subjects were told to associate the two words in the pair, just as would be true for paired-associate learning. In the other case, the instructions informed the subject exactly how he would be tested for each word as a single word. The effect that instructions have on the manner in which a subject goes about the learning is difficult to gauge, but it was believed that these different instructions represented two extremes of possible instructions.

A third variable was the position of the word in the pair to which

the assumed IAR occurred. In the pair spool-climb, the IAR to the nominal stimulus term was tested. However, tests for the same IAR were made when the inducing word occupied the nominal position of the response term (climb-spool).

Finally, the recognition test was so arranged as to be able to determine if IAR production occurred during the test phase.

#### Method

Materials. Forty pairs of words representing the stimulus word and the primary response to that word as observed in word-association procedures were brought together. The pairs were from the unpublished Connecticut norms. The primaries ranged from 47% to 91%, with the average being 65.47. For each stimulus word another word was found which had been given by no subject as a response to the stimulus word, and this word was paired with the stimulus term to represent unrelated pairs. Thus, climb had not been given by any subject to the word spool in the word-association procedure. These neutral words were always taken from the responses given to other stimulus words in the association tests.

The 40 sets of three words each (spool, thread, climb) constituted the critical words. Primary associates may be good candidates for false alarms whether their stimulus terms were or were not presented for study. It was necessary, therefore, to use primary associates as control words (C Words) in determining a base rate of false alarms against which to measure IAR-produced false alarms. The 40 sets were



divided randomly into two sets of 20 each. The pairs of words in one set were presented for study but not those in the other. The presumed implicit associates (e.g., thread) were tested for false recognition (E words) and the associates from the other set became the C Words. Across forms, both sets served both functions. The characteristics of the study lists may now be more precisely specified.

Study lists. It should be clear that in no case were known associated words presented for study. High associates to words presented for study were used only on the recognition test. The list of pairs presented for study included the 20 critical pairs of zero-associated words. Half the time the stimulus word for the primary associate was the left-hand or nominal stimulus term (S Term), and half the time the right-hand or nominal response term (R Term). Two neutral pairs were used at the beginning of the list and two at the end. In addition, to make the learning task longer, if not more difficult, 20 neutral pairs (neutral with regard to test plans) were included within the body of the list but these words were never tested. The 20 critical pairs were assigned randomly to positions within the list and the remaining 20 positions were filled with the neutral pairs.

When the study list consisted of single words, the words in the pairs were simply ordered sequentially, hence an 88-word list resulted.

In order to have each critical stimulus term serve as an R Term and as an S Term, and in order to have the two sets used in the study lists half the time and as C-Word sources half the time, four forms

were required for the study lists.

Test Lists. The test list consisted of 80 words presented singly, with the subject requested to make a YES-NO decision on each. These 80 words consisted of the 20 E Words (presumed IARs to words presented for study), 20 C Words (presumed IARs to words not presented for study), and the 40 words constituting the critical words which were presented either in pairs or as single words during the study list. Thus, on the test, there were 40 true old words, and 40 true new words, although, of course, the latter included IARs to study words.

The ordering of the test list was such that the IAR inducing stimulus words, e.g., spool, were tested half the time before the IARs (thread) were tested, and half the time the reverse was true. This allowed a determination of any influence of test-produced IARs on performance. Within this restriction, the order of the words on the test list corresponded to, but was not exactly the same as the order on the study list. This tended to keep the retention interval equivalent for all words in the study list. Within the test order, C Words were interspersed randomly. Two test forms were necessary, one for each of the two groups of 20 sets of critical words.

Procedure, instructions, subjects. The 44-pair study list was presented at a 4-sec. rate on a memory drum; the 88-word study list at a 2-sec. rate so that total study time was equivalent for both types of lists. The instructions prior to learning differed for the four groups as follows:

**Pair-A.** This group of subjects was presented pairs of words for study, with instructions to associate (A): "A list of pairs of words will be presented to you on this machine. You are to learn these pairs by associating or connecting the words in each pair. After you have seen all of the pairs, you will be tested; but I will tell you more about the test after you have studied this list."

**Single-A.** This group of subjects was presented single words under instructions to associate word. "A list of words will be presented to you on this machine. You are to learn these words by associating or connecting the words in the list to each other. After you have seen all of the words, you will be tested; but I will tell you more about the test after you have studied the list."

**Pair-NA.** The subjects in this group were given what will be called nonassociative (NA) instructions: "A list of pairs of words will be presented to you on this machine. After you have seen this list you will be tested. On the test, a list of single words will be presented. Your job will be to decide which are old words, that is, words which occurred in the study list. For each word, you should respond 'YES' if it was presented in the study list and 'NO' if it was not presented. You will be required to respond to each word, guessing if necessary."

**Single-NA.** The instructions were the same as for Pair-NA except that they were told a list of words was to be presented rather than a list of pairs of words.

All groups were given YES-NO instructions prior to the test, these being essentially repetitions of the instructions given prior to study to the NA groups. The subjects were informed that they must make a decision for each word within the 3-sec. period allowed. In the few cases where a subject did not respond, the word was shown again after all others had been shown and a decision requested.

There were 40 undergraduate students placed in each of the four groups by a block-randomized schedule which included forms. Forms were a balancing variable and will not be included in the analyses since their inclusion did not change any decisions concerning the influence of the major variables.

### Results

False recognitions. The critical data consist of the number of false recognitions made to the E and C Words. These are shown in Table 1, organized with regard to instructions and whether the study list consisted of pairs or of single words. The values represent means for 40 subjects where each subject was given 20 E Words and 20 C Words. The statistical analyses which will become a part of the evaluation of the data in Table 1 also included the variable of whether the IAR was tested before or after the inducing word. However, the effect of this variable will be considered later.

The first fact to be noted is that more errors were made on E

Words than on C Words by the subjects in all of the four groups,  $F(1, 156) = 39.72, p < .01$ . This finding is taken to indicate that false recognitions were produced as a consequence of IARs occurring during the study of the list. However, neither instructions nor the nature of the study list had an influence, the  $F$ s in both cases being less than one. As may be noted, the difference between the means for the E and C Words was roughly constant for all four conditions; this was reflected in the lack of interaction ( $F < 1$ ) among the three variables. However, the interaction between instructions and type of study list (summing across E and C Words) was significant,  $F(1, 156) = 6.47, p < .02$ . With A instructions, more false alarms occurred when the words were presented singly during study than when presented in pairs, and the opposite was true following the NA instructions. It should be repeated that these conditions influence false alarms on C and E Words alike; there is no evidence that IARs were reduced when words were presented as pairs for study, nor any evidence that instructions influenced the number of IARs. These two variables did influence the tendency to accept new words as old, but the influence was equivalent for the E and C Words.

IAR effects on test. Half the E Words were tested before their eliciting stimulus was tested, and half were tested following the test for the eliciting stimulus. If the same IAR was produced by the eliciting stimulus during the test as during the study, more false recognitions on the E words should occur when the eliciting stimulus

Table 1

Mean Number of False Recognitions for Each of the Eight Combinations of Three Variables: Pair versus Single Words in Study List; Associative (A) versus Nonassociative Instructions (NA), and C versus E Words. The Standard Deviations are Shown in Parentheses.

Single Words				Pairs of Words			
A		NA		A		NA	
C	E	C	E	C	E	C	E
3.58	4.58	2.65	4.03	2.23	3.63	3.48	4.98
(2.98)	(2.85)	(2.53)	(2.86)	(2.40)	(2.66)	(2.71)	(3.45)

was tested first than when tested second. The differences were as expected by this conception, but again the effect must be evaluated by also looking at changes during the test in the false alarms to the C Words. Thus, to conclude that false recognitions were increased during the test as a consequence of IAR elicitation earlier in the test requires that the increase in false alarms for the C Words not be as great as was the increase for the E Words. This interaction was not present ( $F = .96$ ). Thus, the increase in the number of false alarms occurring across the testing phase was general.

S Term versus R Term. For half the pairs during study the eliciting word for the IAR was in the stimulus position, for the other half it was in the response position. The results for the two groups of subjects presented pairs for study were analyzed to determine the effect of this variable. The mean number of false recognitions to IARs to the S Terms (2.16) was slightly larger than for the number of false recognitions to IARs of R Terms (2.12), but this difference was not reliable, ( $F < 1$ ).

Old words. The old words consisted of the 20 words presumed to elicit IARs and the 20 neutral words with which they were paired, or which occurred in succession when the words were presented singly. The number of misses on these old words varied between 28.47 and 33.13, but there was no reliable statistical difference as a function of the major variables, nor did these variables interact in determining the misses.

The performance on the old words indicates a complete absence of context effects. Words studied in pairs but tested as single words were not different on the number of misses from words presented singly and tested singly. Furthermore, instructions to associate words had no appreciable influence on misses. The variation that occurred as a consequence of the between-groups manipulation was primarily limited to the false alarms.

As discussed above, there was no evidence that IARs were elicited by the critical-stimulus words during testing. Another rough test of the possible elicitation of IARs during the test can be made by examining the number of misses on the critical-stimulus words. Although normative data are not available on the backward associations (e.g., thread to spool), it seems beyond doubt that bidirectional associations existed for many of the pairs. Therefore, when the IAR word was tested, it could have elicited its stimulus word. If the latter were tested after the IAR word, the number of misses should have decreased. Procedurally, this involves a comparison of misses during the two halves of testing for the critical-stimulus words. The data showed some increase in misses from the first half to the second half. The neutral old words showed little change from the first half to the second half. Because these neutral words could be considered as control words for the influence of IAR production during testing on the critical-stimulus words, it must be concluded that there is no evidence that the IAR words elicited their stimulus words during testing. It is not clear



why the critical-stimulus words showed an increase in misses across the test, whereas the neutral old words did not.

### Discussion

The possibility that IARs are less likely to occur in studying pairs of words than in studying single words seems to have been thoroughly discredited by the outcome of the experiment. The acceptance of this conclusion requires a concomitant acceptance of the false-recognition method as a means of indexing the occurrence of the IARs at the time of study. In terms of the introductory comments, two implications follow from the finding.

First, the failure of IAR expectations to be supported in verbal-discrimination learning cannot reasonably be attributed to the lack of IAR production. It might be argued that the present procedures did not adequately match the situation faced by subjects given a verbal-discrimination task. That is, had we presented pairs for study, with a right and wrong word in each pair, with the usual instructions for verbal-discrimination learning, a test for IARs following a single trial might have given negative evidence on IAR production. We choose to believe that learning behavior cannot show such explicit isolation or specificity for relatively naive subjects, although we may be wrong in this belief. It should be pointed out that the number of false recognitions found in the present study is small in an absolute sense. It may well be that other discriminative information (e.g., frequency) produced by the verbal-discrimination task is of such

magnitude as to essentially swamp any information present due to IARs.

Second, the results indicate that theoretical thinking about paired-associate learning, in which IARs to the individual words enter as a part, has clear empirical support -- if anyone felt that such support was needed.

The results showed differences in number of false alarms among the four groups as seen in the interaction between instructions and type of presentation during study. We have not been able to formulate a coherent account of these differences. Criterion differences among the groups would not account for the findings because the number of misses was essentially uninfluenced by the two variables. As noted earlier, the instructional variable was introduced because we wanted subjects to associate the two words in the pairs in one case, and the other instructions were devised to minimize associative-learning attempts. But just how the subject went about his task under the non-associative instructions is not known.

From a broad point of view relative to the elicitation of IARs, there is one disturbing finding, namely, the failure to find any evidence that IARs were produced during the testing. Thus, we must support Cramer's (1970) conclusion that IAR production during testing is minimal, or at least not detectable by the methods available. It still remains possible that a subject can "turn off" IAR production, or, it is possible that a study phase followed by a distinct test phase is responsible for a reduction in the amount of implicit semantic

elaboration which is presumed to occur during study. If this does occur, the reasons are not apparent to us.

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