DOCUMENT RESUME

ED 113 688 CS 002 191

AUTHOR Underwood, Benton J.
TITLE Recognition Memory for Pairs of Words as a Function of Associative Context.
INSTITUTION Northwestern Univ., Evanston, Ill. Dept. of Psychology.
SPONS AGENCY Office of Naval Research, Washington, D.C. Personnel and Training Research Programs Office.
PUB DATE 75
NOTE 38p.

EDRS PRICE MF-$0.76 HC-$1.95 Plus Postage
DESCRIPTORS *Association (Psychological); Cognitive Processes; Educational Research; *Memory; *Paired Associate Learning; *Recall (Psychological); Recognition; Verbal Learning; *Word Recognition

ABSTRACT

The purpose of these studies was to test a theory of associative context (defined as the association between two words in a pair) on recognition memory. The theory states that culturally associated words in a pair and nonassociated words in a pair differ after a single study trial in terms of their frequency representation in memory. Two experiments were required to show that the use of mixed lists of associated and nonassociated pairs was not the appropriate way to study the effect of associative context on recognition memory. The third experiment provided no support for the theory. Recognition of associated and nonassociated pairs did not differ appreciably. The loss in recognition performance for single words taken from study pairs was the same for associated and for nonassociated pairs. Frequency judgments paralleled the results for recognition decisions in most aspects of the data. It was concluded that associative context, specified in terms of the strength of the association between two words in a pair, is not a critical factor in recognition performance. (Author)

Recognition Memory for Pairs of Words as a Function of Associative Context

Benton J. Underwood

Northwestern University

September 1975

Project NR 154-371
Sponsored by
Personnel & Training Research Programs
Psychological Sciences Division
Office of Naval Research
Arlington, Virginia
Contract No. N00014-67-A-0356-0033

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Recognition Memory for Pairs of Words as a Function of Associative Context		5. TYPE OF REPORT & PERIOD COVERED Technical Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Benton J. Underwood		8. CONTRACT OR GRANT NUMBER(s) N00014-67-A-0356-0033
9. PERFORMING ORGANIZATION NAME AND ADDRESS Psychology Department Northwestern University Evanston, IL 60201		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 61153N; RR 042-06 RR 042-06-01; NR 154-371
11. CONTROLLING OFFICE NAME AND ADDRESS Personnel and Training Research Programs Office of Naval Research (Code 458) Arlington, VA 22217		12. REPORT DATE September 1975
		13. NUMBER OF PAGES 30
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

associative context
recognition
mixed lists
associative strength

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The purpose of the studies was to test a theory of associative context (defined as the association between two words in a pair) on recognition memory. The theory states that culturally associated words in a pair and non-associated words in a pair differ after a single study trial in terms of their frequency representation in memory. Two experiments were required to show that the use of mixed lists of associated and nonassociated pairs was not the appropriate way to study the effect of associative context on recognition memory. The third experiments provided no support for the theory.

DD FORM 1473, 1 JAN 73 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-014-6601

unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

Recognition of associated and nonassociated pairs did not differ appreciably. The loss in recognition performance for single words taken from study pairs was the same for associated and for nonassociated pairs. Frequency judgments paralleled the results for recognition decisions in most aspects of the data. It was concluded that associative context, specified in terms of the strength of the association between two words in a pair, is not a critical factor in recognition performance.

Recognition Memory for Pairs of Words as a Function of Associative Context

Benton J. Underwood

Northwestern University

Recognition Memory for Pairs of Words as a Function of Associative Context*

This report was prompted by previous work (Underwood, 1974) which showed that recognition of two words in a pair associated by cultural usage (e.g., table-chair) was no better following a single study trial than was the recognition of pairs in which the words were not associated. Generally speaking, therefore, the concern is with the function of associative context in recognition memory. The specific purpose of the present studies was to test a theoretical account formulated after the above finding. It is obvious that a theory stemming from a null result can have meaning only if it leads to predictions of differences under certain conditions. The background for such predictions will now be developed.

The theoretical approach assumes that event frequency is fundamentally involved in recognition decisions. The evidence indicates that the memory system may assimilate frequency information about events abstracted from larger nominal events (Underwood, 1971). That such abstraction may occur in a laboratory task is shown by studies in which sentences are presented for study followed by frequency judgments on words from the sentences (e.g., Jacoby, 1972). Other evidence suggests that even the frequency of a syllable from a two-syllable word may have a representation in memory (Underwood & Zimmerman, 1973). It is not of moment for the

*The work of Charles S. Reichardt and Robert A. Malmi, who supervised the data collection, is gratefully acknowledged.

present argument that the abstracted frequency information in such cases may deviate considerably from true frequency; it is sufficient to note only that some frequency information is present for the abstracted event.

An examination will now be made of the distinguishable events when a subject is presented a pair of associated words (High Pairs) and a pair of nonassociated words (Zero Pairs) for study. The theory assumes that there are three sources of event frequency which may be represented in memory after study, namely, frequency for each word independently, and frequency of the pair as a unit. The magnitude of the latter phenomenal frequency will be directly related to the level of associative strength existing initially between the two words. Finally, it is assumed that the total frequency input to a pair will be constant for a pair regardless of the level of initial associative strength. This means that for Zero Pairs the frequency assimilation accrues largely to each word as a unit, with a minimum frequency for the pair as a unit. For the High Pairs, on the other hand, the pair as a unit accrues more frequency than does each word as a unit. The latter is equivalent to saying that the phenomenal frequency representation for a two-syllable word as a unit is greater than for the frequency representation of each syllable.

The language used above may seem a bit troublesome. Frequency increment, it would seem, can only occur by discrete steps. How is it possible, therefore, to sort a constant frequency input differentially among three events? There are a number of ways to rationalize this matter, but for the time being it is simply assumed that across subjects the phenomenal frequency for the High Pairs as a unit will be greater than for the Zero Pairs, and that the phenomenal frequency for each word in the Zero Pairs will be greater than for the High Pairs. Given these premises, the recognition of High and Zero Pairs could be equivalent. However, a simple manipulation leads to differential predictions for the two types of pairs. If, after presenting the pairs for study, recognition memory is tested for single words from the pairs, two outcomes must be observed to support the theory. First, the increase in errors (over pair recognition) must be greater for the High Pairs than for the Zero Pairs. This follows from the assumption that each word in the High Pairs has lower phenomenal frequency than does each word in the Zero Pairs. Second, frequency judgments for the single words must confirm the assumption about differential phenomenal frequency for the single words in the two types of pairs.

A rather comprehensive study was undertaken to test these expectations. A quite unexpected outcome disallowed the theoretical tests. A second experiment was performed to solve the problem raised by the first, and then a third was necessary for the theoretical decisions. In the interest of brevity, the first experiment will be described briefly, followed by a detailed report of the other two experiments.

First experiment. Twenty-four critical stimulus words were found for each of which there was a homonym, a primary associate, a low associate, and a zero associate. The homonyms and the low associates were of secondary interest for the central problem. Across four forms for different groups of subjects, each of the four classes of response terms for a stimulus term was used once in the study list. A given subject had six pairs of each class in the study list plus 12 other neutral pairs which occurred twice, and 12 which occurred three times each. The pairs were presented at a 3-second rate for study with a paced recognition test at the same rate. On the recognition test six new pairs were included for each of the four classes of response terms, and the neutral pairs given frequencies of two and three were also tested. Of course, the experiment included groups who were tested on single words from the pairs. However, the critical finding concerns the recognition tests for the High and Zero Pairs.

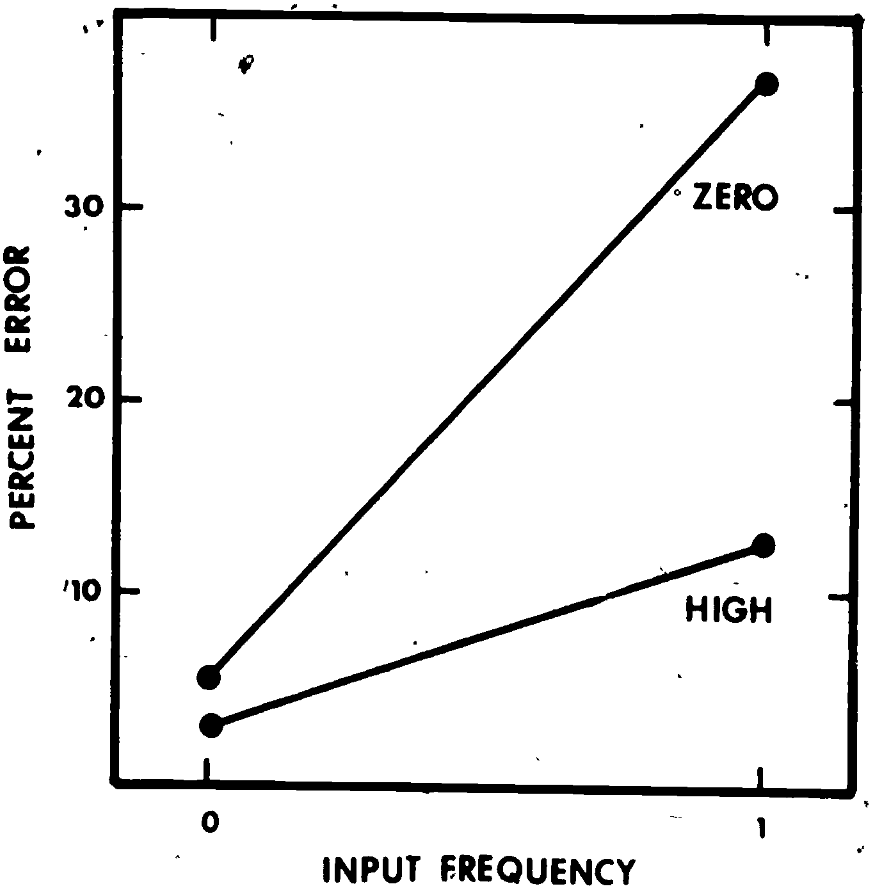

Figure 1. Recognition performance as a function of input frequency and associated (High) and nonassociated (Zero) word pairs.

This finding appears as Figure 1 in which the input frequencies 0 and 1 (new and old) are plotted on the baseline, and the percent errors (false alarms and misses) are shown on the ordinate.

The obvious fact shown by Figure 1 was that pair recognition was not equivalent for the Zero and High Pairs. For the misses, the difference between 12.5% for the High Pairs and 36.7% for the Zero Pairs was highly reliable, _t_ (39) = 5.80, σdiff based on raw scores, .25. Of the 40 subjects, only four had fewer errors on the Zero Pairs than on the High Pairs. The results were in direct contradiction to an earlier study (Underwood, 1974; Experiment VI) in which recognition was not statistically different for the two types of pairs. That the finding in Figure 1 was not a statistical aberration was shown by the results of another condition in which the subjects made frequency judgments of the pairs. When these results were scored in terms of misses (assigning a value of zero to a pair that had been presented for study) and false alarms (assigning a positive value for a pair that had not been presented for study) the difference was much the same as in Figure 1.

The procedures for the two experiments producing contradictory outcomes were examined in an attempt to identify the interacting variable or variables which must have been involved. As noted earlier, in choosing High and Zero Pairs from word-association tables, only stimulus words were allowed which also had homonyms. It seemed possible that the imposition of this restriction on the choice of stimulus words, a restriction that was not imposed in the choice of pairs for the earlier experiment, may have resulted in a set of High and Zero Pairs which were different in some critical way from the pairs used earlier.

The second possibility related to a difference in list structure. In the earlier study the subject studied a list of 50 pairs, 25 of which were High Pairs (if five homonym pairs are included) and 25 Zero Pairs. In the present study there were only six High Pairs and six pairs of homonyms. In addition, there were six pairs of low associates (frequency of one in word-association tables), six Zero Pairs, and 24 unrelated pairs. Thus, in the present study, the proportion of obviously related pairs was less than in the earlier study. It is possible that for this reason, or for some other reason, the subjects in the present study selectively rehearsed the six High Pairs, even to the extent of displacing the rehearsal to pairs seen earlier in the list. If this was occurring, it should be reflected in the results for the group of subjects assigned the task of making frequency judgments for the pairs. The data showed that the mean frequency judgments for the High Pairs was .99, for the Low Pairs, .81. Of the 40 subjects in this group, only five assigned higher frequency ratings to the Zero Pairs than to the High Pairs.

The problem implied in the above discussion is the problem of mixed lists, although in this case the two lists in question differ only in the degree of mixing. Bruder and Silverman (1972) had earlier questioned the use of mixed lists for recognition studies, suggesting that subjects may displace rehearsal and thereby spend more time on difficult than on easy items. Actually, their data did not give strong support to the supposition. Still, it is possible that in the earlier study in which Zero and High Pairs were found to be equivalent in recognition the subjects may have selectively rehearsed the Zero Pairs at the expense of the High Pairs, or that in the present study the High Pairs were rehearsed at the expense of the Zero Pairs. The only definitive way to rule out such possibilities is to use unmixed lists.

Two possible interacting variables have been suggested to account for the discrepancy in the results for recognition of High and Zero Pairs: (1) different samples of associates, and (2) mixed lists. In Experiment 2, both possibilities were tested.

Experiment 2

Method

Lists. One set of lists (Set I) was the same as that used in the first experiment. This set consisted of 24 High Pairs and 24 Zero Pairs, both types of pairs having the same stimulus terms.

To illustrate, three of the High Pairs were bread-butter, not-now, beet-red, and the corresponding Zero Pairs were bread-soul, not-seek, beet-steady. A second set (Set II) was made up of completely different High and Zero Pairs. It will be remembered that all of the stimulus terms used in Set I had homonyms; of the 24 stimulus terms making up Set II, only three had homonyms. The response terms (right-hand terms) for the Zero Pairs were selected from the responses produced to other stimulus words in word-association tables (several sources), and were chosen to have varying numbers of letters and varying frequencies to approximate the characteristics of the response terms for the High Pairs.

Procedure and subjects. The four unmixed lists (Set I, High and Zero Pairs; Set II, High and Zero Pairs) were presented to four independent groups of subjects. Each pair was presented for 3 seconds on a memory drum for the study trial. The subjects were fully informed of the nature of the recognition test before the study list was presented, and these instructions were repeated just prior to the test. Two primacy pairs were used in each list but these were not tested. The YES-NO recognition test consisted of 48 pairs. This was made up of the 24 pairs given on the study trial and 24 new pairs from the other set.

A random order of study was determined for the 24 pairs and this order was used for both the High and Zero lists. On the test, the six old pairs from the first quarter of the study list were randomly mixed with six new pairs and presented as the first quarter of the test list. The other three quarters of the study list were handled in the same manner. This allowed the retention interval between study and test to be roughly equivalent for all pairs. The test was paced at a 3-second rate. As each pair was presented the subject was required to make a YES-NO decision, guessing if necessary.

There were 30 college students assigned to each of the four lists by a block randomized schedule.

Results

The results are plotted in Figure 2 for each set separately. As can be seen, for both sets the errors (false alarms and misses) were a little more frequent for the Zero Pairs than for the High Pairs. However, statistically speaking, none of the differences was reliable using the .05 confidence level. In making the tests, the raw sum of the misses and false alarms was used as the response measure. The $F(1, 116)$ for Zero-High was 1.89, for Set I versus Set II, 2.56, and for the interaction, 2.56, $MS_e = 10.58$. A comparison between Figures 1 and 2 shows that the major change resulting from the use of unmixed lists was the large reduction

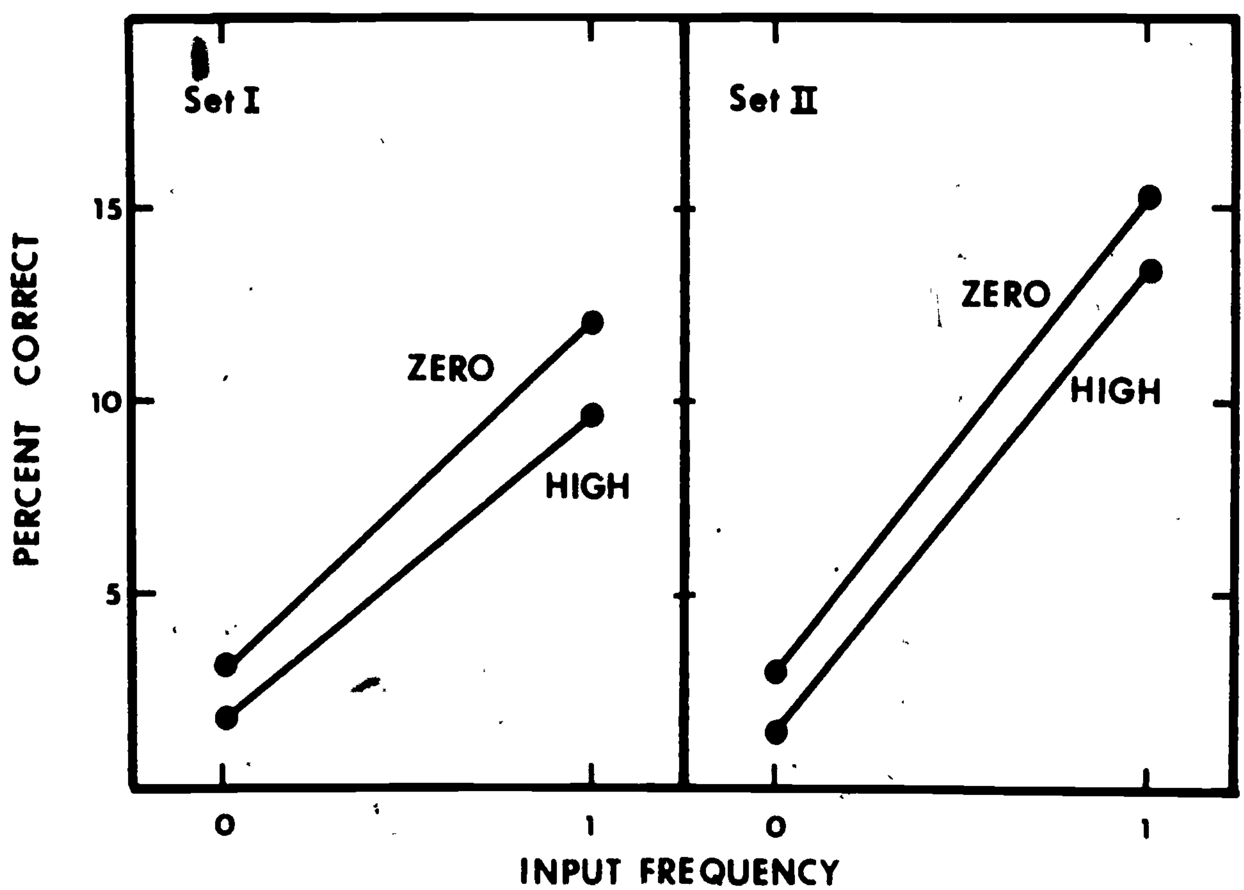

Figure 2. Recognition performance for two different sets of associated and nonassociated word pairs.

in errors on the Zero Pairs.

It appears beyond reasonable doubt that an unmixed list may give quite a different assessment of the influence of a task variable than that given by a mixed list. Selective rehearsal in studying the mixed list seems to be the likely cause, although no direct evidence of this was obtained. In any event, the results of Experiment 2 are quite comparable to those found in the earlier published study (Underwood, 1974) which prompted the post hoc theory. The purpose of Experiment 3 was to test this theory, using unmixed lists in all conditions.

Experiment 3

The theory predicts that following the study of Zero and High Pairs, recognition of single words from the pairs will be better for Zero than for High words, and that these differences will also be reflected in frequency judgments for the individual words. However, to obtain the complete picture, recognition and frequency judgments were also obtained on pairs. A total of eight conditions was required. Study of a list of High Pairs was followed by one of four tests: frequency judgments or pairs, recognition tests of the pairs, frequency judgments of single words from the pairs, and recognition tests of single words from the pairs. The same four tests were given following the study of the Zero Pairs.

Method

Lists. The 48 High Pairs and 48 Zero Pairs of Sets I and II of Experiment 2 constituted the lists. From the 48 pairs of each type, 24 were chosen randomly to form the study lists. The random selection was based on the stimulus terms so that a random choice automatically included the High and Zero Pairs having the same stimulus terms. From the remaining 24 stimulus terms, 12 were chosen randomly to constitute pairs given multiple repetitions in the study list, four each at frequencies 2, 3, and 4. The remaining 12 stimulus terms identified the new pairs for the test list.

The study lists involved 62 positions. Two pairs were used as primacy buffers and were not tested. Twenty-four positions were used for the critical pairs, each presented once. The remaining 36 positions were required for the 12 pairs given multiple repetitions. Repeated pairs were distributed systematically across the list, i.e., pairs occurring twice appeared once in each half, pairs occurring three times appeared once in each third, and pairs occurring four times, once in each quarter. These positions were assigned initially, following which the 24 critical pairs were assigned to the remaining positions.

Some additional comments should be made about the nature of the High Pairs. When tests were made on single words taken from these pairs, the so-called stimulus word was always used. This has the distinct advantage that precisely the same words were used for the singles tests for High and Zero Pairs. However, it leads to the possibility that on the tests in which single words are used following the study of High Pairs the subject may generate associates. The decision on the single word might be made by generating the correct associate (paired with the stimulus term on the study list) and thereby simulate pair testing. Two steps were taken to minimize this possibility. First, the tests were made at a paced, 3-second rate so that time available for generation was minimal. Second, the associated pairs represented a number of types of associates. Within the lists were conceptual associates (e.g., pear-fruit), opposites or antonyms (e.g., peace-war), synonyms (e.g., coarse-rough), parallel associates, (e.g., cup-saucer), and others difficult to categorize (e.g., sheep-lamb). It was believed that such a variety of types would further prevent the subject from successfully using a generation procedure. Finally, the association value varied widely, from 5% (flower-pretty) to 69% (saucer-cup). This in part resulted from the requirement imposed in the earlier experiment that a stimulus term have a homonym, but was intentional in constructing Set II used in Experiment 2. This wide variation in association value also provides a test of recognition performance as a function of associative strength.

The test lists consisted of the 48 High or Zero Pairs or the 48 stimulus words from the 48 pairs. The test order corresponded roughly to the study order as a consequence of randomizing within study quarters to determine the test order. The 12 new pairs (or single words from the new pairs where appropriate) were assigned three to each quarter of the test lists.

Procedure and subjects. The study list was presented at a 3-second rate. The instructions requested that the subjects associate the two words in each pair in preparation for a memory test. Instructions for the test were not given until after the study phase. On the tests the subjects made: (1) YES-NO decisions on pairs, or (2) a frequency estimate of each pair, or (3) YES-NO decisions on single words, or (4) frequency estimates of single words. All of these tests were conducted at a 3-second rate on the memory drum. If a subject failed to respond within the 3-second period (which happened rarely), the experimenter returned to the item for a decision after finishing the remainder of the list.

Each of the eight conditions was represented by 40 college-student subjects assigned to conditions by a block randomized schedule.

Results

Recognition. The theory predicts that there will be a greater increase in recognition errors (misses) between pair recognition and single-word recognition for High Pairs than for Zero Pairs. The data are plotted in Figure 3 for the items presented once for study. Two tests of the prediction may be made from the data of Figure 3. One test arises from the groups who made recognition decisions, the other from the groups who made frequency judgments. As described earlier, a recognition measure may be derived for the latter groups by identifying a miss when the subject assigned a zero to an item which had been presented for study, and identifying a false alarm when the subject assigned a positive value to a new item. To support the predictions the differences in misses between the two lines with filled circles (High Pairs and singles from High Pairs) must be greater than the differences in misses between the two lines with unfilled circles (Zero Pairs and singles from Zero Pairs). The results give no support to the expectation, either from the data based on recognition decisions or from those based on frequency judgments. The statistical evidence for this will be presented before other characteristics of the results are pointed out.

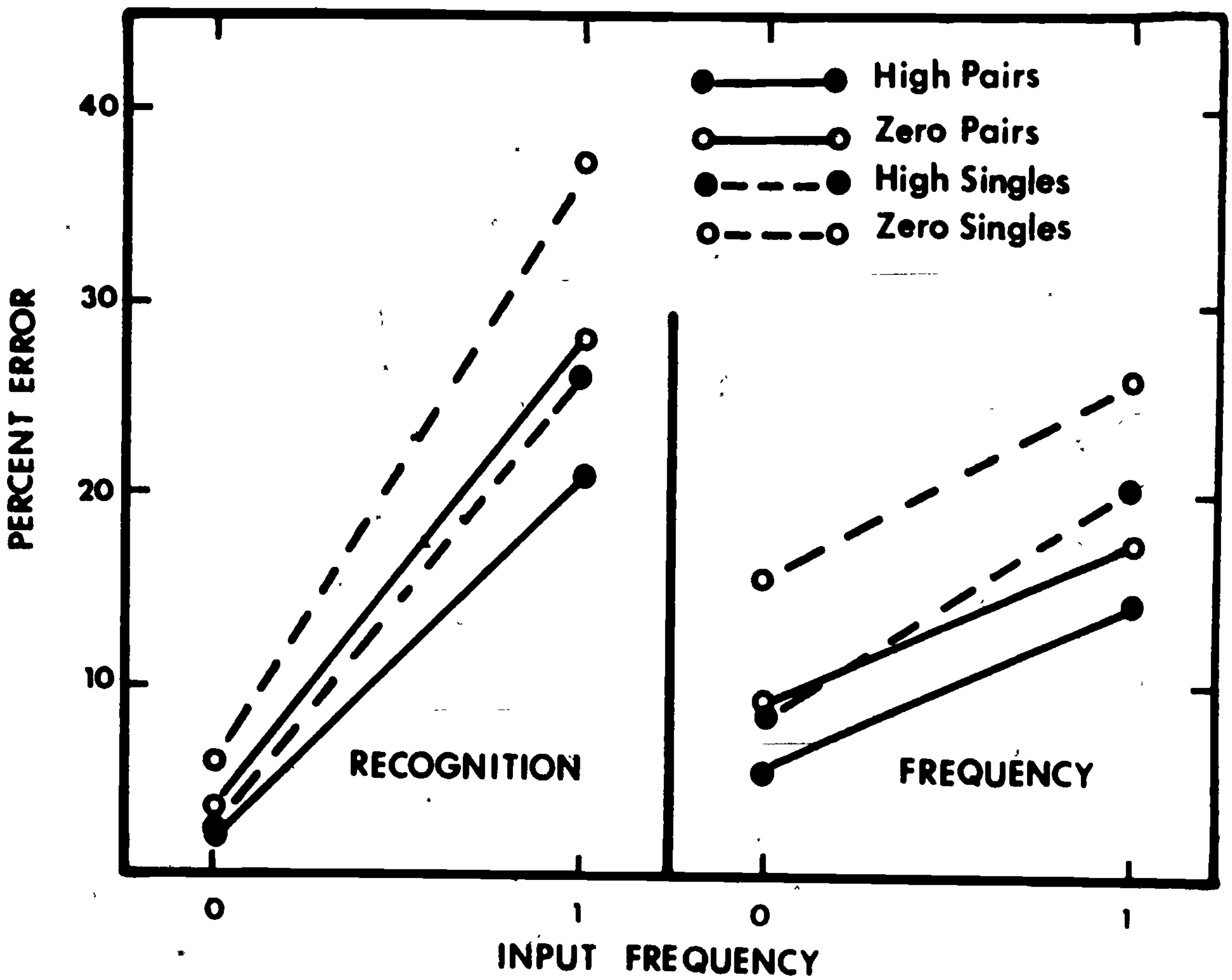

Figure 3. Errors in recognition performance and in frequency estimates for associated and nonassociated word pairs and for single words taken from the pairs.

One measure used for analysis was the sum of the misses and false alarms. The analysis was performed on raw errors, and because there were only half as many new items as old, the number of false alarms was doubled for each subject. With three independent variables (Zero-High, pair-single, recognition-frequency) only two reliable sources of variance were found and both were main effects, namely, Zero-High ($\underline{F}$ = 27.03) and single-pair ($\underline{F}$ = 23.56), both evaluated with 1 and 312 df, MS_e = 20.59. As is apparent in Figure 3, recognition was better for High than for Zero Pairs, and better for pairs than for singles.

Strictly speaking, the theory makes predictions only for misses, not for false alarms. No conclusion changed, however, when the analysis included only misses except that more misses occurred with recognition than with frequency judgments.

As noted, more errors were made on Zero Pairs than on High Pairs. This would seem to be in contradiction to the results of Experiment 2 where statistically there was no difference between the pair types. However, if only the scores for the pairs are used, for either recognition or for frequency judgments, the difference between Zero and High Pairs is not reliable. Nevertheless, in all experiments reported here the errors have always been less for High Pairs than for Zero Pairs so that a difference of relatively small magnitude seems to be a reliable effect.

Figure 1 shows that the slopes of the lines for the frequency judgments scored as recognition decisions are appreciably less than are those for recognition. Comparatively speaking, more false alarms and fewer misses occur for frequency judgments than for recognition, although total errors do not differ. This confirms earlier results (Underwood, 1974) and, as discussed in this earlier publication, may be interpreted as differences in the criterion (beta) set by the subjects in the two situations.

Frequency judgments. According to the theory under scrutiny, the frequency information accruing to a pair on the study trial may be identified with each word independently and with the pair as a unit. It was assumed that phenominal frequency would be higher for individual words in Zero Pairs than for those in High Pairs, but that the reverse would be true for the pair as a unit. Therefore, there should be less reduction in the frequency judgments between pairs and singles for Zero Pairs than between pairs and singles for High Pairs. The basic analysis was made on pairs presented once. The mean judgments were .98 and .95 for Zero and High Pairs, respectively, and .96 and .91 for the corresponding judgments on single words from the pairs. An analysis of these four means showed that neither of the variables nor the interaction approached statistical reliability. The largest F (Zero versus High) was 1.37, (1, 156), MS_e = 4.41. These data indicate that the decrement in recognition performance between tests for pairs and tests for single words was not accompanied by a decrement of comparable statistical magnitude in the mean frequency judgments.

It can be argued that the variability of frequency judgments for items presented an equal number of times is a more appropriate measure of the disturbance of frequency information than is the mean judgment. A standard deviation for the judgments of the 24 items presented once was calculated for each subject in the four groups making frequency judgments. These standard deviations were treated as raw scores. The means were .52 and .45 for the Zero and High Pairs, respectively, with the corresponding means for the single words being .68 and .51. The change in variability between pair judgments and single-word judgments is opposite to theoretical expectations in that the increase in variability is greater for Zero than for High Pairs. However, the difference was not reliable statistically. The analysis showed the Zero-High variable to be reliable ($\underline{F}$ = 15.14) as was the increase from pairs to singles ($\underline{F}$ = 13.14), 1 and 156 $\underline{df}$, $MS\underline{e}$ = .035, but the interaction was not ($\underline{F}$ = 2.86).

It will be remembered that 12 pairs were given multiple repetitions during study, four at each of three frequency levels (2, 3, 4). An inspection of the mean frequency judgments for these High and Zero pairs showed them to be essentially equivalent. However, it is of more interest to examine the frequency judgments of the single words taken from the 12 pairs. As a response measure, product-moment correlations were calculated between the input or true frequency and the judged or phenomenal frequency of the 12 items for each subject. Each correlation was assigned a z' and the means of the two groups tested statistically. Although the t (1.76) indicated that the difference was not reliable, it was in the opposite direction predicted by the theory, the retransformed mean r being .43 for Zero Pairs and .56 for High Pairs. It must be concluded that there is no evidence in the frequency judgments in support of the theoretical expectations.

Errors by items. The number of misses made on each of the 24 items presented once was determined for each condition by summing across subjects within conditions. Again, when frequency judgments were made a miss was identified when a frequency of zero was assigned, thus corresponding to a NO in recognition.

Three different sets of four correlations are given in Table 1. The first set deals with the relationships between errors by items for recognition and for frequency judgments. There were four pairs of conditions from which this relationship was calculated. For example, the first entry of .67 represents the relation-

Table 1

Various Relationships Between the Errors made on the 24 Items Presented Once. The Entries are Product-Moment Correlations (With 22 df, r of .40 is reliable at the .05 level)

Recognition x Frequency Judgments	
High Pairs	.67
Zero Pairs	.69
High Singles	.80
Zero Singles	.64

Pairs x Singles	
Recognition High	.76
Recognition Zero	.39
Frequency High	.59
Frequency Zero	.50

High x Zero	
Recognition Pairs	-.07
Recognition Singles	.53
Frequency Pairs	-.20
Frequency Singles	.33

ship between the errors on the 24 High Pairs when tested under recognition and under frequency judgments. The second set asks about the commonality in error frequency by items when the two variables are pair tests and tests of single items. The third set relates errors for High and Zero Pairs, the rationale being that for Pair Tests the High and Zero Pairs had the same left-hand terms but different right-hand terms, whereas on the singles test, the single words were identical for Zero and High Pairs.

Looking at the correlations between frequency judgments and recognition decisions it is seen that the relationship is quite uniformly high. This supports previous findings (e.g., Underwood, 1974) and indicates that item difficulty is much the same for recognition and for frequency judgments. The second set of correlations (Pairs x Singles) indicates some correspondence in error frequencies for pairs and for single words taken from those pairs. The third set of correlations relates errors on High and Zero Pairs. For pair judgments there is essentially no relationship indicating that the left-hand word (common to Zero and High Pairs) had no control of the errors when the right-hand word varied. Even when tested as a single word the left-hand members did not exert a strong common influence.

Finally, the error frequency for the 24 items may be related to the normative associative strength of the High Pairs. There was no relationship. The correlation between associative strength and misses for the 24 pairs was -.06 and .00 for pair recognition and pair frequency judgments, respectively.

Discussion

The results of the third experiment have completely failed to support the theoretical idea that phenomenal frequency information may differ for the single words and for the pairs as a unit in associated and nonassociated pairs presented for study. The tests appear to have been appropriate ones, particularly in view of the close relationships shown between frequency judgments and recognition decisions in most aspects of the data.

It now appears with some certainty that associative context is not a variable of importance in determining performance on recognition task when associative context is defined in terms of culturally developed associations plus the additional associative development which would occur on a single trial. The evidence will be summarized.

1. Although the performance on the High Pairs is always a little better than that on the Zero Pairs, even this small difference may be attributed to factors other than associative strength. For example, the response terms in the two types of pairs must necessarily be different and may be responsible for the small effects obtained. The fact that more false alarms tended to

occur on Zero Pairs than on High Pairs (e.g., Figure 2) suggest some difference in recognizability that may be independent of the interword association.

2. Breaking or eliminating the so-called associative context by testing single words had no greater effect on the High Pairs than on the Zero Pairs. If the intactness of associative context is a substantial controlling factor in recognition performance, the High Pairs should have shown the greater decrement.

3. There was no relationship between the strength of the culturally developed associations and recognition performance within the High Pairs.

Such evidence makes it extremely difficult to speak of associative context as being represented by associations developed among items within a task, or, if so, it must be viewed as an all or none matter in which level or degree of association is not involved. That there is a true deficit in recognition resulting from the elimination of one of the words from a study pair at the time of test seems beyond doubt; it has been a fairly universal finding, including the findings of the present experiments. This fact clearly requires some theoretical account but it seems prudent at this point to resist the temptation to develop further post hoc hypotheses.

It is possible that culturally developed associations do not provide the proper vehicle for studying associative context. Perhaps laboratory developed associations would give a different decision. The difficulty with this approach is that in developing such associations the learning of items per se would be so high that few recognition errors would be made even after long retention intervals (e.g., Ellis & Shumate, 1973).

Finally, it seems useful to emphasize that once again the use of mixed lists to study the influence of a task variable has proven to be a misleading approach.

References

Bruder, G., & Silverman, W. Effects of semantic and phonetic similarity on verbal recognition and discrimination. Journal of Experimental Psychology, 1972, 94, 314-320.

Ellis, H. C., & Shumate, E. C. Encoding effects of response belongingness and stimulus meaningfulness on recognition memory of trigram stimuli. Journal of Experimental Psychology, 1973, 98, 70-78.

Jacoby, L. L. Context effects on frequency judgments of words and sentences. Journal of Experimental Psychology, 1972, 94, 255-260.

Underwood, B. J. Recognition memory. In H. H. Kendler and J. T. Spence (Eds.), Essays in neobehaviorism. New York: Appleton-Century-Crofts, 1971.

Underwood, B. J. The role of the association in recognition memory. Journal of Experimental Psychology Monograph, 1974, 102, No. 5, 917-939.

Underwood, B. J., & Zimmerman, J. The syllable as a source of error in multisyllable word recognition. Journal of Verbal Learning and Verbal Behavior, 1973, 12, 701-706.

DISTRIBUTION LIST

Navy

4 Dr. Marshall J. Farr, Director
Personnel & Training Research Programs
Office of Naval Research (Code 458)
Arlington, VA 22217

1 ONR Branch Office
495 Summer St.
Boston, MA 02210
ATTN: Research Psychologist

1 ONR Branch Office
1030 East Green St.
Pasadena, CA 91101
ATTN: E. E. Gloye

1 ONR Branch Office
536 South Clark St.
Chicago, IL 60605

1 Office of Naval Research
Area Office
207 West 24th St.
New York, NY 10011

6 Director
Naval Research Laboratory
Code 2627
Washington, DC 20390

12 Defense Documentation Center
Cameron Station, Bldg. 5
5010 Duke St.
Alexandria, VA 22314

1 Special Assitant for Manpower
OASN (M&RA)
Pentagon, Room 4E794
Washington, DC 20350

1 LCDR C. J. Theisen, Jr., MSC, UNS
4024
Naval Air Development Center
Warminster, PA 18974

1 Chief of Naval Reserve
Code 3055
New Orleans, LA 70146

1 Navy Personnel Research & Development Center
Code 9041
San Diego, CA 92152
ATTN: Dr. J. D. Fletcher

1 Dr. Lee Miller
Naval Air Systems Command
AIR-413E
Washington, DC 20361

1 Commanding Officer
U.S. Naval Amphibious School
Coronado, CA 92155

1 Chairman
Behavioral Science Dept.
Naval Command & Management Div.
U.S. Naval Academy
Luce Hall
Annapolis, MD 21402

1 Chief of Naval Education & Training
Naval Air Station
Pensacola, FL 32508
ATTN: Capt. Bruce Stone, USN

1 Mr. Arnold Rubinstein
Naval Material Command (NAVMAT 03424)
Room 820 Crystal Plaza #6
Washington, DC 20360

1 Commanding Officer
Naval Medical Neuropsychiatric
Research Unit
San Diego, CA 92152

1 Director, Navy Occupational Task
Analysis Program (NOTAP)
Navy Personnel Program Support Activity
Bldg. 1304, Bolling AFB
Washington, DC 20336

1 Dr. Richard J. Niehaus
Office of Civilian Manpower Management
Code 06A
Washington, DC 20390

1 Department of the Navy
Office of Civilian Manpower Management
Code 263
Washington, DC 20390

1 Chief of Naval Operations (OP-987E)
Dept. of the Navy
Washington, DC 20350

1 Superintendent
Naval Postgraduate School
Monterey, CA 93940
ATTN: Library (Code 2124)

1 Commander, Navy Recruiting Command
4015 Wilson Blvd.
Arlington, VA 22203
ATTN: Code 015

1 Mr. George N. Graine
Naval Ship Systems Command
SHIPS 047C12
Washington, DC 20362

1 Chief of Naval Technical Training
Naval Air Station Memphis (75)
Millington, TN 38054
ATTN: Dr. Norman J. Kerr

1 Commanding Officer
Service School Command
U.S. Naval Training Center
San Diego, CA 92133
ATTN: Code 3030

1 Dr. William L. Maloy
Principal Civilian Advisor for
Education & Training
Naval Training Command, Code 01A
Pensacola, FL 32508

1 Dr. A. F. Smode, Staff Consultant
Training Analysis & Evaluation Group
Naval Training Equipment Center
Code N-00T
Orlando, FL 32813

1 Dr. Hanns H. Wolff
Technical Director (Code N-2)
Naval Training Equipment Center
Orlando, FL 32813

1 Chief of Naval Training Support
Code N-21
Bldg. 45
Naval Air Station
Pensacola, FL 32508

1 Dr. Robert French
Naval Undersea Center
San Diego, CA 92132

1 Navy Personnel R&D Center
San Diego, CA 92152

5 Navy Personnel R&D Center
San Diego, CA 92152
ATTN: Code 10

1 D. M. Gragg, CAPT, MC, USN
Head, Educational Programs Development Dept.
Naval Health Sciences Education & Training Command
Bethesda, MD 20014

Army

1 Headquarters
U.S. Army Admn. Center
Personnel Admn. Combat Development Activity
ATCP-HRO
Ft. Benjamin Harrison, IN 46249

1 Armed Forces Staff College
Norfolk, VA 23511
ATTN: Library

1 Director of Research
U.S. Army Armor Human Research Unit
Bldg. 2422 Morade St.
Fort Knox, KY 40121
ATTN: Library

1 Commandant
U.S. Army Infantry School
ATTN: ATSH-DET
Fort Benning, GA 31905

1 Deputy Commander
U.S. Army Institute of Admn.
Fort Benjamin Harrison, IN 46216
ATTN: EA

1 Dr. Frank J. Harris
U.S. Army Research Institute
1300 Wilson Blvd.
Arlington, VA 22209

1 Dr. Ralph Dusek
U.S. Army Research Institute
1300 Wilson Blvd.
Arlington, VA 22209

1 Mr. E. F. Fuchs
U. S. Army Research Institute
1300 Wilson Blvd.
Arlington, VA 22209

1 Dr. L. H. Nawrocki
U. S. Army Research Institute
1300 Wilson Blvd.
Arlington, VA 22209

1 Dr. J. E. Uhlaner, Tech. Director
U. S. Army Research Institute
1300 Wilson Blvd.
Arlington, VA 22209

1 Dr. Joseph Ward
U. S. Army Research Institute
1300 Wilson Blvd.
Arlington, VA 22209

1 HQ USAREUR & 7th Army
OCDSOPS
USAREUR Driector of GED
APO New York 09403

Air Force

1 Research Brancy
AF/DPMYAR
Randolph AFB, TX 78148

1 Dr. G. A. Eckstrand (AFHRL/AS)
Wright-Patterson AFB
Ohio 45433

1 Dr. R. L. Morgan (AFHRL/AST)
Wright-Patterson AFB
Ohio 45433

1 AFHRL/DOJN
Stop #63
Lackland AFB, TX 78236

1 Dr. Martin Rockway (AFHRL/TT)
Lowry AFB
Colorado 80230

1 Major P. J. DeLeo
Instructional Tech. Branch
AF Human Resources Lab.
Lowry AFB, CO 80230

1 AFOSR/NL
1400 Wilson Blvd.
Arlington, VA 22209

1 Commandant
USAF School of Aerospace Medicine
Aeromedical Librayr (SUL-4)
Brooks AFB, TX 78235

1 Dr. Sylvia R. Mayer (MCIT)
Headquarters Electronic Systems Div.
LG Hanscom Field
Bedford, MA 91730

1 Capt. Jack Thorpe, USAF
Flying Training Div. (HRL)
Williams, AFB, AZ 85224

1 AFHRL/PE
Stop 63
Lackland AFB, TX 7[illegible]6

Marine Corps

1 Mr. E. A. Dover
Manpower Measurement Unit (Code MPI)
Arlington Annex, Rm. 2413
Arlington, VA 20380

1 Commandant of the Marine Corps
Headquarters, U. S. Marine Corps
Code MPI-20
Washington, DC 20380

1 Director, Office of Manpower Utilization
Headquarters, Marine Corps (Code MPU)
MCB (Bldg. 2009)
Quantico, VA 22134

1 Dr. A. L. Slafkosky
Scientific Advisor (Code RD-1)
Headquarters, U. S. Marine Corps
Washington, DC 20380

1 Chief, Academic Dept.
Education Center
Marine Corps Development & Education Command
Marine Corps Base
Quantico, VA 22134

Coast Guard

1 Mr. J. J. Cowan, Chief
Psychological Res. Branch (G-P-1/62)
U. S. Coast Guard Headquarters
Washington, DC 20590

1 Lt. Col. Henry L. Taylor, USAF
Military Asst. for Human Resources
OAD (E&LS) ODDR&E
Pentagon, Rm. 3D129
Washington, DC 20301

1 Mr. W. J. Stormer
DOD Computer Institute
Washington Navy Yard, Bldg. 175
Washington, DC 20374

1 Col. Austin W. Kibler
Advanced Research Projects Agency
Human Resources Research Office
1400 Wilson Blvd.
Arlington, VA 22209

1 Dr. Harold F. O'Neil, Jr.
Advanced Research Projects Agency
Human Resources Research Office
1400 Wilson Blvd., Rm. 625
Arlington, VA 22209

1 Helga L. Yeich
Advanced Research Projects Agency
Manpower Management Offic3
1400 Wilson Blvd.
Arlington, VA 22209

Other Government

1 Dr. Eric McWilliams, Program Manager
Technology & Systems, TIE
National Science Foundation
Washington, DC 20550

1 Dr. A. R. Molnar
Technological Innovations in Education
National Science Foundation
Washington, DC 20550

1 Dr. M. S. Smith, Asst. Acting Director
Program on Essential Skills
Natl. Institute of Education
Brown Bldg. Rm. 815
19th & M St., N.W.
Washington, DC. 20208

Miscellaneous

1 Dr. Scarvia B. Anderson
Educational Testing Service
17 Executive Park Dr., N.E.
Atlanta, GA 30329

1 Dr. John Annett
The Open University
Milton Keynes
Buckinghamshire
ENGLAND

1 Dr. Richard Snow
Stanford University
School of Education
Stanford, CA 94305

1 Dr. G. V. Barrett
University of Akron
Dept. of Psychology
Akron, OH 44325

1 Dr. B. M. Bass
University of Rochester
Management Research Center
Rochester, NY 14627

1 Dr. David G. Bowers
University of Michigan
Institute for Social Research
Ann Arbor, MI 48106

1 Mr. K. M. Bromberg
Manager - Washington Operations
Information Concepts, Inc.
1701 N. Fort Myer Dr.
Arlington, VA 22209

1 Dr. R. P. Carver
School of Education
University of Missouri
Kansas City, MO 64110

1 Century Research Corporation
4113 Lee Highway
Arlington, VA 22207

1 Dr. A. M. Collins
Bolt Beranek & Newman, Inc.
50 Moulton St.
Cambridge, MA 02138

1 Dr. H. P. Dachler
University of Maryland
Dept. of Psychology
College Park, MD 20742

1 Dr. Rene' Dawis
University of Minnesota
Department of Psychology
Minneapolis, MN 55455

1 ERIC
Processing & Reference Facility
4833 Rugby Ave.
Bethesda, MD 20014

1 Dr. Victor Fields
Montgomery College
Dept. of Psychology
Rockville, MD 20850

1 Dr. Edwin A. Fleishman
American Institutes for Research
Foxhall Square
3301 New Mexico Ave., N.W.
Washington, DC 20016

1 Dr. Ruth Day
Yale University
Dept. of Psychology
New Haven, CT 06520

1 Dr. Robert Glaser, Director
University of Pittsburgh
Learning Research & Development Center
Pittsburgh, PA 15213

1 Dr. Robert Vineberg
HumRRO Western Div.
27857 Berwick Dr.
Carmel, CA 93921

1 LCol CRJ Lafleur, Director
Personnel Applied Research
National Defence HQ
Ottawa K1A OK2 Canada

1 Dr. H. J. Hamburger
University of California
School of Social Sciences
Irvine, CA 92664

1 Dr. M. D. Havron
Human Sciences Research, Inc.
7710 Old Spring House Rd.
West Gate Industrial Park
McLean, VA 22101

1 HumRRO
Division No. 3
P.O. Box 5787
Presidio of Monterey, CA 93940

1 HumRRO
Division No. 4, Infantry
P.O. Box 2086
Fort Benning, GA 31905

1 HumRRO
Division No. 5, Air Defense
P.O. Box 6057
Fort Bliss, TX

1 Dr. Lawrence B. Johnson
Lawrence Johnson & Assocs., Inc.
200 S Street, N.W., Suite 502
Washington DC 20009

1 Dr. M. S. Katz
MITRE Corp.
Westgate Research Center
McLean, VA 22101

1 Dr. Steven W. Keele
University of Oregon
Dept. of Psychology
Eugene, OR 97403

1 Dr. David Klahr
Carnegie-Mellon University
Dept. of Psychology
Pittsburgh, PA 15213

1 Dr. Alma E. Lantz
University of Denver
Denver Research Institute
Industrial Economics Div.
Denver, CO 80210

1 Dr. R. R. Mackie
Human Factors Research, Inc.
6780 Cortona Dr.
Santa Barbara Research Park
Goleta, CA 93017

1 Dr. D. A. Norman
University of California, San Diego
Center for Human Information Processing
LaJolla, CA 92037

1 Mr. Brian McNally
Educational Testing Service
Princeton, NJ 08540

1 Mr. A. J. Pesch, President
Eclectech Associates, Inc.
P.O. Box 178
North Stonington, CT 06359

1 Mr. Luigi Petrullo
2431 N. Edgewood St.
Arlington, VA 22207

1 Dr. Joseph W. Rigney
Behavioral Technology Laboratories
University of Southern California
3717 S. Grand
Los Angeles, CA 90007

1 Dr. L. L. Rosenbaum, Chairman
Montgomery College
Dept. of Psychology
Rockville, MD 20850

1 Dr. G. E. Rowland
Rowland & Co., Inc.
P. O. Box 61
Haddonfield, NJ 08033

1 Dr. A. I. Siegel
Applied Psychological Services
404 E. Lancaster Ave.
Wayne, PA 19087

1 Dr. C. H. Stone
1428 Virginia Ave.
Glendale, CA 91202

1 Mr. D. J. Sullivan
725 Benson Way
Thousand Oaks, CA 91360

1 Dr. D. J. Weiss
University of Minnesota
Dept. of Psychology
Minneapolis, MN 55455

1 Dr. Anita West
Denver Research Institute
University of Denver
Denver, CO 80210

1 Dr. K. N. Wexler
University of California
School of Social Sciences
Irvine, CA 92664

1 Dr. A. F. Kanarick
Honeywell Inc.
2600 Ridge Parkway
Minneapolis, MN 55413

1 Carl R. Vest, Ph.S.
Bettelle Memorial Institute
Washington Operations
2030 - M Street, N.W.
Washington, DC 20036

1 Dr. R. A. Kaufman
United States International Univ.
Graduate School of Leadership &
Human Behavior
Elliott Campus
8655 E. Pmerada Rd.
San Diego, CA 92124