THE EFFECT OF FAMILIARIZATION WITH ELEMENTS OF COMPOUND STIMULUS ITEMS UPON THE SUCCESSFUL EMPLOYMENT OF ASSOCIATIVE STRATEGIES BY EDUCABLE RETARDATES

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ABSTRACT

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by Daniel B. Berch

Previous research employing the paired-associates (PA) task with educable retardates has shown that experimenter-induced-strategies can facilitate learning. However, one study has shown that retardates did not make optimal use of the strategy aids provided them.

The purpose of the present study was to determine if retarded children, given prior familiarization with relevant stimulus cues, could make maximally effective use of strategy aids in a PA task. One group received a "relevant differentiation" treatment. Four other groups were formed, each receiving one of the following treatments:

1) familiarization with elements from irrelevant stimulus items (irrelevant differentiation); 2) familiarization with the entire relevant stimulus items (relevant familiarization); 3) familiarization with the entire irrelevant stimulus items (irrelevant familiarization); and 4) no familiarization of any kind (control).

All groups were first given a practice task. Following this session, the experimental treatments were administered individually. Immediately after this task, the same PA task was presented to all Ss. The list contained eight dissyllabic pairs of low-high meaningfulness (M). All subjects were provided with strategy aids on one-half of the

pairs. Learning and test trials were presented alternately, and a recognition method was used on the test trials. After the learning task, S was asked to describe how he learned each pair. This session was tape recorded. Then a final task was administered in which each stimulus item from the PA list was divided into three elements and listed adjacent to the eight response items from the PA task. The subjects had to select the response term that was associated with each element. No time limit was imposed on this task.

The results demonstrated that: 1) aid was effective (as shown in previous studies); 2) differentiation training appeared to facilitate overall learning, whereas familiarization training appeared to inhibit learning; and 3) the results were inconclusive regarding the nature of the facilitative effect of differentiation training upon the successful employment of associative strategies in paired-associate learning.

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INTRODUCTION

Investigators have recently begun to utilize the paired-associates (PA) task as a tool for examining the learning process among the mentally retarded. The majority of these studies have employed common pictures for PA materials rather than printed words. At least three of these studies, with matching on CA, have found no significant difference between normals and retardates (Akutagwa & Benoit, 1959; Berkson & Cantor, 1960; Eisman, 1958). In one study using common pictures, however, normals learned more rapidly than retardates (Ring & Palermo, 1961).

Jensen (1965) attempted to induce verbal mediation in a PA task in order to determine if learning could be facilitated. Using common pictures, the experimenter (E) presented a phrase containing the stimulus and response items of the pair, e.g., "I threw a SHOE at the CLOCK." With subjects matched on MA, mediators were provided for half of the normals and half of the retardates. The phrase for each pair was given only on the first presentation of the pair. The results showed that normals were superior to retardates under all conditions, and that the mediators facilitated learning in both groups.

Davidson (1964), working with normal children, also attempted to induce verbal mediation in a PA task. Five experimental conditions were administered, with pictures used for PA materials. Three of these treatments consisted of the following: 1) pairs named by E and joined by one of seven prepositions -- over, under, onto, etc., 2)

pairs embedded in sentences employing the same prepositions used in 1), and 3) pairs named in the sentences used in 2) and in addition, pictures of the pairs as described by the sentences. The results showed that links formed by a single preposition were as effective in facilitating learning as links consisting of sentences and of pictures describing these sentences.

Martin, Boersma, and Cox (1965) conducted a study with college students in order to examine in detail what kinds of mediators or associative cues are reported in PA learning. From verbal reports collected at the conclusion of the learning task, they developed a strategy classification scheme consisting of seven categories. These categories were rank ordered along an apparent underlying continuum of cue complexity. Analysis of the data revealed an increasing relationship between complexity of the associative strategy reported and performance on the learning task.

In another study conducted by Martin, Boersma, and Bulgarella (1966), the types of associative strategies reported by mildly retarded children were compared to those reported by normal children matched on CA. The results showed that the normals' performance on the PA task was significantly better than that of the retardates. Analysis of the Ss' verbal reports indicated that the normals reported using more high level strategies, whereas the retardates reported more low level ones.

Martin, Cox, and Bulgarella (1966) devised a third study to determine in part if high level strategies given to normal children by

the E would facilitate their learning of a PA task. Materials consisted of dissyllabic pairs of low-high meaningfulness (M). The findings clearly showed that strategy aids resulted in better performance.

A further study by Martin (1966) was designed to examine whether the performance of educable retarded children on a PA task could be facilitated by providing them with high level strategy aids. The materials consisted of eight low-high M dissyllabic pairs. It was found that retarded Ss who received these aids learned significantly faster than unaided retardates and performed as well as unaided normals matched on CA. However, since the aided retardates did not perform significantly better than the unaided normals, Martin concluded that the retarded Ss did not make optimal use of the strategy aids.

In the Martin (1966) study, a stimulus differentiation task had been devised to distinguish aided Ss for whom aid was effective from those for whom it was not. The stimulus items were divided into three segments which appeared with their respective response words. One segment of each stimulus was the element which had been combined with the response to form the strategy. The results indicated that effectively aided Ss (those whose acquisition scores fell within the top third of the range of all scores) were able to differentiate relevant cues significantly better than Ss not effectively aided. It was concluded that the ability to differentiate visually the relevant

stimulus cue was an important factor in effective utilization of strategy aids.

The purpose of the present study was to determine if retarded Ss given prior familiarization training with relevant stimulus cues could make greater use of strategy aids than Ss not given such training. Studies which have examined the effects of familiarization of the stimulus members of paired-associates upon acquisition have revealed conflicting results (Goss, 1965).

Gannon and Noble (1961) conducted a study to investigate the hypothesis that familiarization is the sole basis of meaningfulness. Subjects from one of the treatment groups were presented with 20 independent, 1 sec. exposures of low M dissyllables which were subsequently used as stimulus members in a paired-associates list. During the familiarization trials, Ss pronounced each item as it was exposed. The results showed that familiarization with the stimulus items facilitated acquisition of the PA list.

In offering one interpretation of the results, the authors made reference to the concept of stimulus predifferentiation. They did not elaborate, however, on how it may have functioned in facilitating learning. On the basis of results from previous studies investigating stimulus predifferentiation, it is probably safe to assume that the authors believed familiarization resulted in an increase in the distinctiveness of the stimulus items. This distinctiveness reduced the probability of these stimuli being associated with incorrect response items.

Underwood and Schulz (1960) designed an experiment in which they tested the hypothesis that increasing amounts of familiarization with the stimulus units should increase the rate of PA learning. The stimulus and response items consisted of syllables of low-low M. Subjects received 1, 10, 20, or 40 familiarization trials at an exposure rate of 2 sec. per syllable, and Ss spelled each item aloud as it was presented. The findings revealed that familiarization of stimulus members consisting of less than 40 trials had no effect upon acquisition of the PA list, while 40 trials appeared to inhibit performance.

Underwood and Schulz concluded that inhibition may have resulted from a loss of differentiation between stimulus and response systems during the learning of the PA list. This loss could have occurred because during familiarization training, S became accustomed to giving the stimulus items of the list as "responses." Then as S learned the response items of the PA list and the strength of these items approached that of the stimuli as "responses," he may have confused the actual stimulus and response syllables of the list.

In order to test this loss-of-differentiation hypothesis, a second experiment was designed which employed essentially the same procedure used in the first experiment. Two groups received equal amounts of familiarization training with the same low M syllables, and these syllables were used as stimulus items in the PA task. One group's PA list also used low M syllables for response items, while the other group's list used low M dissyllables for response items. It was

reasoned that since the stimulus and response members of the syllable-dissyllable list belonged to different classes of verbal materials, the possibility for loss of differentiation would be minimized. Thus, the learning of this list had to be faster than the learning of the syllable-syllable list in order to support the hypothesis. Appropriate groups were employed to control for the different response terms. The results showed a nonsignificant difference between the experimental groups, thus leading to rejection of the hypothesis. There was neither facilitation nor inhibition following relevant stimulus familiarization.

Kanungo and Lambert (1963) also reasoned that during stimulus familiarization training, Ss become accustomed to giving the stimulus items of a PA list as "responses." They stated that familiarization of stimulus members "should promote the formation of word-word habits, i.e. positive reaction tendencies to connect verbal elements with themselves." From conventional transfer paradigms they derived the hypothesis that this treatment would result in negative transfer as compared with a control group receiving familiarization of words which were not used in the PA task.

Low M dissyllables were used for both stimulus and response items. During familiarization training the exposure rate was 1 sec. per item. The subject was asked to repeat each word aloud continuously for 15 sec. at a rate of three to four repetitions per sec. Immediately after the repetitions, S made his rating for that word on semantic differential scales. This procedure was repeated three times for each

of the stimulus words and once for each semantic scale. The S was then presented with the PA list. Results showed that the group receiving familiarization with actual stimulus items performed significantly lower than the group familiarized with irrelevant words. The authors concluded that the explanation of this inhibitory effect could not be attributed to a decrement in meaning of the low M stimuli, because the familiarization treatment did not produce any significant decrement in meaning as measured by the semantic differential.

This conclusion was supported in a study by Schulz and Thysell (1965). Employing both low and high M dissyllables, they found that neither 0, 5, nor 20 1-sec. familiarization trials had any effect upon the number of kinds of associations given during the production test. They concluded that presumed changes in the number or nature of the associations elicited by familiarized items cannot serve as the basis for an explanation of the effects of familiarization with these items upon subsequent performance in a PA task.

By familiarizing S with an element of a stimulus, this element should actually become the functional stimulus (Underwood, Ham & Ekstrand, 1962). In discussing the concept of cue selection, Underwood et al. stated that there may be a discrepancy between the nominal stimulus (the stimulus actually presented to S) and the functional stimulus (the component of the nominal stimulus which becomes the effective cue for response elicitation). Using word-color and trigram-color compounds for stimulus materials, they hypothesized that given two components of different classes as the nominal stimulus, the

more meaningful will become the functional stimulus.

The results showed that for the trigram-color compound, color, the more meaningful component, became the effective (functional) stimulus on a transfer test. For the word-color compound, words became the functional stimuli on the transfer test. The authors concluded, however, that the latter finding may have been due to a bias which Ss have toward dealing with verbal material rather than the higher meaningfulness of the words.

Cohen and Musgrave (1964) designed a PA study to investigate cue selection where the compound stimulus terms each consisted of two CVC (consonant, vowel, consonant) trigrams of known M value, and the response units were single letters. Four treatment groups were formed, each receiving one of the following four combinations of M values (H = high M, L = low M): HH, HL, LH, and LL. On the transfer task the component CVCs of the compound stimuli were presented singly.

The findings showed significantly better performance to high M than to low M CVCs. Although the main effect of position was non-significant, performance to low M CVCs previously given in the left-hand position in the compound stimulus was significantly greater than to high M CVCs in that position for both the LL and LH groups. It was concluded that in PA learning, where the stimulus term consists of two verbal components, cue selection is a function of meaningfulness of the individual component. In addition, the position of the individual component is an important variable if the component is of low M.

For the present study, it was assumed that in order to make optimal use of a syntactical strategy aid such as "map of the village" in learning a dissyllabic pair of low-high M (Zumap-Village), one must first be able to differentiate the more meaningful component "map." "Map" is the functional stimulus for optimal utilization of the associative strategy.

It is hypothesized, therefore, that 1) familiarization with the relevant meaningful stimulus element in a syntactical strategy will lead to maximally effective use of the strategy aid as measured by performance on the criterion task. This treatment (Relevant Cue Differentiation) will result in significantly better performance compared to a control condition in which strategy aids are given but not familiarization training.

On the basis of Kanungo and Lambert's study, it is hypothesized that 2) familiarization of the entire stimulus item (Relevant Familiarization) will interfere with differentiation of the stimulus components, resulting in the ineffective use of strategy aids and hence significantly poorer performance than the control condition.

A fourth group receiving strategy aids will be given familiarization training with the meaningful elements of the stimuli which will not be used in the criterion task (Irrelevant Cue Differentiation). This group is included in the study in order to determine whether there is some general transfer involved in selecting high M components from irrelevant stimuli. If this treatment condition does produce

some general transfer, then performance on the criterion task ought to be facilitated when compared to the control group.

A fifth group receiving strategy aids will also be given familiarization training with the irrelevant stimulus items. These Ss will be familiarized with the entire stimulus item (Irrelevant Familiarization). This group is included in the study to control for the effect of familiarization with relevant items. If irrelevant familiarization produces a general set to connect each stimulus item with itself, performance on the criterion task should be inhibited when compared to the control group.

METHOD

Subjects

The Ss tested in this study were 80 educable retarded children selected from Junior Special B classes in the Detroit public schools. The criteria for initial assignment to these special classes were CA, 11-14, and IQ, 56-75. Mean CA of the Ss used in this study was 13-7 (range 11-4 to 15-5) and mean IQ was 71 (range 53-87).

In order to ensure Ss' ability to read the items, only children who had received a grade equivalent of 2.5 or higher on the reading subtest of either the Metropolitan, Iowa, or Stanford achievement tests were selected for the experiment. (See appendices for further description of Ss.)

Materials

For all Ss on the practice task, four dissyllabic pairs of low-high M were utilized. These pairs were: Lemur-Kitchen, Bodkin-Wagon, Holbut-Farmer, and Olpret-Balloon. The first two pairs consisted of items selected from Noble's (1952) list. Mean m values of the stimulus and response terms were 1.84 and 8.87 respectively. Constructed specifically for this task, the stimulus items of the last two pairs were designed to approximate Noble's low m paralogs. The high M response items were taken from second-grade readers.

For the criterion task, eight dissyllabic pairs of low-high M were constructed. These pairs were: Gokem-Uncle, Sagrole-Money, Tarop-Jelly, Zumap-Village, Flotsam-Army, Meardon-Insect, Binest-

Outside, and Lenear-Garden. The first six pairs were selected from Noble's (1952) list, with mean m values of the stimulus and response items, 1.39 (range 1.05 to 2.19) and 7.89 (range 6.57 to 9.43) respectively. The last two pairs in this list were also devised specifically for this task. The stimulus items were designed to approximate Noble's low m dissyllables, and the response items were selected from second-grade readers. Each stimulus selected for the criterion list contained a familiar word, thus making the pairs easily amenable to the construction of syntactical strategies.

A third list consisting of eight irrelevant stimuli was formed. These low M dissyllables were: Attar, Byssus, Delpin, Sumpage, Endore, Fardel, Standage, and Caratch. The first three items were selected from Noble's (1952) list. Mean m value was 1.48 (range 1.13 to 1.71). The last five items were selected from Cieutat's (1963) list and had a mean association value (a) of .64 (range .49 to .77). Each of these eight paralogs contains a familiar word, as do the stimulus items on the criterion list. All 16 stimulus items were selected because they possessed this attribute. Even though the stimuli were taken from two different sources, it was assumed that for retardates, differences in meaningfulness between the low M items from the two different lists would be negligible.

Separate test booklets were constructed for the practice task and the criterion task. They contained all the response items of the task on each page in a randomized order. Separate 2 x 2 inch slides were

prepared for the S-R pairs and for the stimulus items. A Kodak 700 Carousel projector with a Lafayette T-2K automatic timer was utilized for slide presentation. A tape recorder was used to collect Ss' verbal reports at the conclusion of the criterion task.

Procedure

PRACTICE TASK. All Ss were given the practice task in order to acquaint them with the paired-associate learning task and to enable assessment of the initial comparability of the treatment groups. The practice task was administered to groups of two to six Ss, depending upon the number of Ss that could be tested completely on the same day. The task was introduced to the Ss as a word game in which they were instructed to learn four associations.

Three learning (L) and three test (T) trials were given. A test trial was presented after each learning trial (LTLTLT). During the learning trials, each pair was presented automatically at a six sec. exposure rate with an interval of approximately .75 sec. between pairs. The exposure rate on the test trials was controlled manually so that Ss had as much time as they needed to respond. On all learning and test trials, E pronounced the items as they appeared on the screen. Slides for each learning and test trial were presented randomly. The remaining portions of the experiment were administered individually.

FAMILIARIZATION TASK. Each S was first given examples of all levels of associative strategies in order to facilitate collection of strategy information after completion of the criterion task. Following

discussion of associative strategies, each S received one of five familiarization treatments prior to the criterion task. The five experimental treatments were:

1) Relevant Cue Differentiation (RD) -- Each S was given an example of a paralog and was then shown that a familiar word was embedded in it. S was then given a relevant differentiation trial in which each of the stimulus items from the criterion list was projected on the screen. E pronounced each stimulus as it appeared on the screen and then pronounced the word embedded in it, e.g., Zumap-map. The embedded word of each stimulus was the first word of the syntactical strategy given for the pair (Zumap-Village) on the criterion task, e.g., map-map of the village. After the relevant differentiation trial, S was given a pronunciation trial in which E again pronounced each stimulus but this time S had to pronounce the embedded words. All Ss received two relevant differentiation trials and two pronounciation trials with a six sec. exposure rate for each item on all four trial. The same exposure rate was employed for all treatment conditions.

2) Irrelevant Cue Differentiation (ID) -- This group received the same instructions and the same treatment as the RD group. However, the list used in this treatment contained irrelevant stimuli. None of the embedded words in the irrelevant stimuli were contained in the syntactical strategies employed in the criterion task. Table 1 presents the irrelevant stimuli and the embedded words.

Table 1

The Irrelevant Stimuli and
Their Embedded Words

Irrelevant Stimuli	Embedded Words
attar	at
sumpage	page
delpin	pin
endore	end
standage	stand
byssus	by
caratch	car
fardel	far

3) Relevant Familiarization (RF) -- These Ss were given two relevant familiarization trials alternated with a pronunciation trial on the stimuli from the criterion list. The embedded word was neither pronounced nor pointed out to the S. On the relevant familiarization trials, E simply pronounced each stimulus and on the pronunciation trials S had to pronounce each stimulus after E.

4) Irrelevant Familiarization (IF) -- This group received the same treatment as the RF group but with the irrelevant stimuli.

5) Control (C) -- This group received no familiarization of any type.

The Ss were randomly assigned to these five conditions.

CRITERION TASK. Following the experimental treatment, the same task was administered to all Ss. A total of five learning and five test trials were presented. The learning and test trials were alternated. A six sec. exposure rate was used for each learning trial. No time limit was imposed on the test trials.

All Ss were instructed that E would give them some associative strategies, and that they should try to use these strategies to help them learn which words went together. One-half of each treatment group received syntactical strategies on four of the eight pairs (A pairs), and the other half of each group received the same type of aids on the other four pairs (B pairs). Aids were given on the first three trials only. The A and B pairs and their respective strategy aids are presented in Table 2.

ASSOCIATIVE STRATEGY TASK. Immediately following the criterion task, each S was again shown the eight criterion pairs separately and was asked to describe how he learned each pair. This session was tape recorded.

DIFFERENTIATION TASK. After strategy collection, each S was given a sheet of paper containing two columns. The right-hand column consisted of all eight response items, and the left-hand column consisted of 24 elements contained in the stimulus items from the criterion list. Three elements from each stimulus were selected, one of which consisted of the embedded word used in the syntactical strategy, e.g., Sagrole-

Table 2

The A and B pairs of the Criterion Task and the Strategy Aid Given for Each Pair

	Word-Pairs	Strategy Aids
A Pairs	Gokem-Uncle	Go to uncle
	Sagrole-Money	Roll of Money
	Binest-Outside	Nest is outside
	Tarop-Jelly	Tar is like jelly
B Pairs	Lenear-Garden	Near the garden
	Zumap-Village	Map of the village
	Flotsam-Army	Sam is in the army
	Meardon-Insect	Don's insect

sag, gro, role. The 24 elements were arranged so that no three elements of a stimulus appeared successively. S was instructed to select the word on the right which was associated with each element on the left. No time limit was imposed on this task.

RESULTS

The five treatment groups did not differ significantly at the .05 level on CA, IQ, or reading achievement. In order to determine the initial comparability of the five groups on a paired-associates task, the practice task data were subjected to a 1 x 5 analysis of variance. The analysis yielded a nonsignificant F ratio (.23, df = 4/75, $p > .25$) indicating that the groups did not differ significantly prior to the introduction of the experimental treatments. The means and standard deviations of the total number of correct responses for the five groups on the practice task are presented in Table 3.

Table 3

Means and Standard Deviations of the Total Number of Correct Responses on the Practice Task

	Groups				
	RD	ID	RF	IF	C
Mean	5.88	5.81	5.63	5.38	5.25
S.D.	2.63	1.60	2.28	2.33	2.27

The criterion task data of all groups except control were subjected to three 2 x 2 x 2 factorial analyses of variance. The factors were: 1) Stimulus -- Relevant, Irrelevant; 2) Type of familiarization -- Differentiation, Familiarization of nominal stimulus; 3) Aided

pairs -- A, B. A separate analysis was carried out on the total number correct, number correct on aided pairs, and number correct on unaided pairs. The results from the analysis of total number correct are summarized in Table 4. The main effect of type of familiarization was significant beyond the .05 level indicating that differentiation was superior to familiarization of the entire word.

Table 4

Summary of Analysis of Variance for Total Number of Correct Responses on the Criterion Task

Source		df	MS	F
A:	Stimulus	1	6.25	____
B:	Type of Familiarization	1	451.57	6.62*
C:	Aided pairs	1	105.07	1.54
A x B:	Stim x Type Famil.	1	56.25	____
A x C:	Stim. x Aided pairs	1	240.25	3.52
B x C:	Type Famil. x Aided pairs	1	1.56	____
A x B x C:	Stim. x Type Famil. x Aided pairs	1	20.24	____
Error:	Within treatments	56	68.21	____
	Total	63		

* Significant beyond the .05 level

The results from the analysis of number correct on aided pairs are summarized in Table 5. Familiarization of the nominal stimulus was again shown to be significantly inferior to differentiation. The nonsignificant main effect of aided pairs suggested that if strategy aids did facilitate learning, they were equally effective for both sets of aided pairs.

Table 5

Summary of Analysis of Variance for Number of Correct Responses on Aided Pairs

	Source	df	MS	F
A:	Stimulus	1	.25	—
B:	Type of Familiarization	1	105.07	5.38*
C:	Aided pairs	1	56.25	2.88
A x B:	Stim. x Type Famil.	1	30.25	1.55
A x C:	Stim. x Aided pairs	1	39.06	2.00
B x C:	Type Famil. x Aided pairs	1	.77	—
A x B x C:	Stim. x Type Famil. x Aided pairs	1	2.54	—
Error:	Within treatments	56	19.52	—
	Total	63		

* Significant beyond the .05 level

The results from the analysis of number of correct responses on the unaided pairs are summarized in Table 6. On the unaided pairs also, differentiation was significantly better than familiarization of the nominal stimulus. The nonsignificant main effect of aided pairs indicated that the two sets of unaided pairs were of equal difficulty.

Further analysis of the difficulty level of the A and B pairs was performed for the control group with the use of a *t*-test. Half the Ss were aided on the A pairs and half on the B pairs. The resulting *t* value comparing the mean number of total correct responses did not approach significance at the .05 level. This finding permitted the pooling within each treatment group of Ss aided on A and B pairs.

Table 6

Summary of Analysis of Variance for Number of Correct Responses on Unaided Pairs

	Source	df	MS	F
A:	Stimulus	1	9.00	___
B:	Type of Familiarization	1	121.00	5.66*
C:	Aided pairs	1	7.56	___
A x B:	Stim. x Type Famil.	1	4.00	___
A x C:	Stim. x Aided pairs	1	85.56	4.00
B x C:	Type Famil. x Aided pairs	1	3.06	___
A x B x C:	Stim. x Type Famil. x Aided pairs	1	7.57	___
Error:	Within treatments	56	21.39	___
	Total	63		

* Significant beyond the .05 level

The criterion data were then subjected to three 1 x 5 analyses of variance. The means and standard deviations of the number of correct responses for the groups on the aided pairs are presented in Table 7. The analysis of these data revealed a nonsignificant F ratio (1.91, df = 4/75, $p > .05$).

Table 8 presents the means and standard deviations of number correct on the unaided pairs. The analysis of these data yielded a nonsignificant F ratio (1.73, df = 4/75, $p > .05$).

The means and standard deviations of total number correct are presented in Table 9. The analysis of total number correct revealed a nonsignificant F (2.05, df = 4/75, $p > .05$); however, the means of the groups are in the expected direction. Compared to the performance

Table 7

Means and Standard Deviations of the Number of Correct Responses for the Five Groups on the Aided Pairs of the Criterion Task

	Groups				
	RD	ID	RF	IF	C
Mean	16.44	14.94	12.50	13.75	15.31
S.D.	3.37	4.06	5.33	4.82	4.01

Table 8

Means and Standard Deviations of the Number of Correct Responses for the Five Groups on the Unaided Pairs of the Criterion Task

	Groups				
	RD	ID	RF	IF	C
Mean	13.56	13.81	10.31	11.56	11.69
S.D.	4.46	4.04	5.35	4.69	3.70

of the control group, RD is the highest group and RF the lowest.

In order to determine if the groups differed in rate of learning, an analysis of variance, Lindquist Type 1 design, was computed

(Lindquist, 1953). The results are summarized in Table 10. The main effect of trials was, of course, significant and is of little interest. However, the significant interaction term indicated that the performance of all groups did not increase at the same rate. Performance

Table 9

Means and Standard Deviations of the Total Number of Correct Responses for the Five Groups on the Criterion Task

	Groups				
	RD	ID	RF	IF	C
Mean	30.00	28.75	22.81	25.31	27.00
S.D.	6.65	7.75	10.00	8.65	5.91

curves, presented in Figure 1, show that the RD group was near asymptote by the third trial. This suggested a ceiling effect which may have minimized differences among groups.

To investigate this hypothesis of a ceiling effect, the total number of correct responses on the first three trials were subjected to a simple 1 x 5 analysis of variance. This analysis yielded an F value of 2.46 which approached significance at the .05 level (critical value = 2.49). Thus it appears that differences among groups were minimized by a ceiling effect.

In order to determine whether aid was effective, the criterion

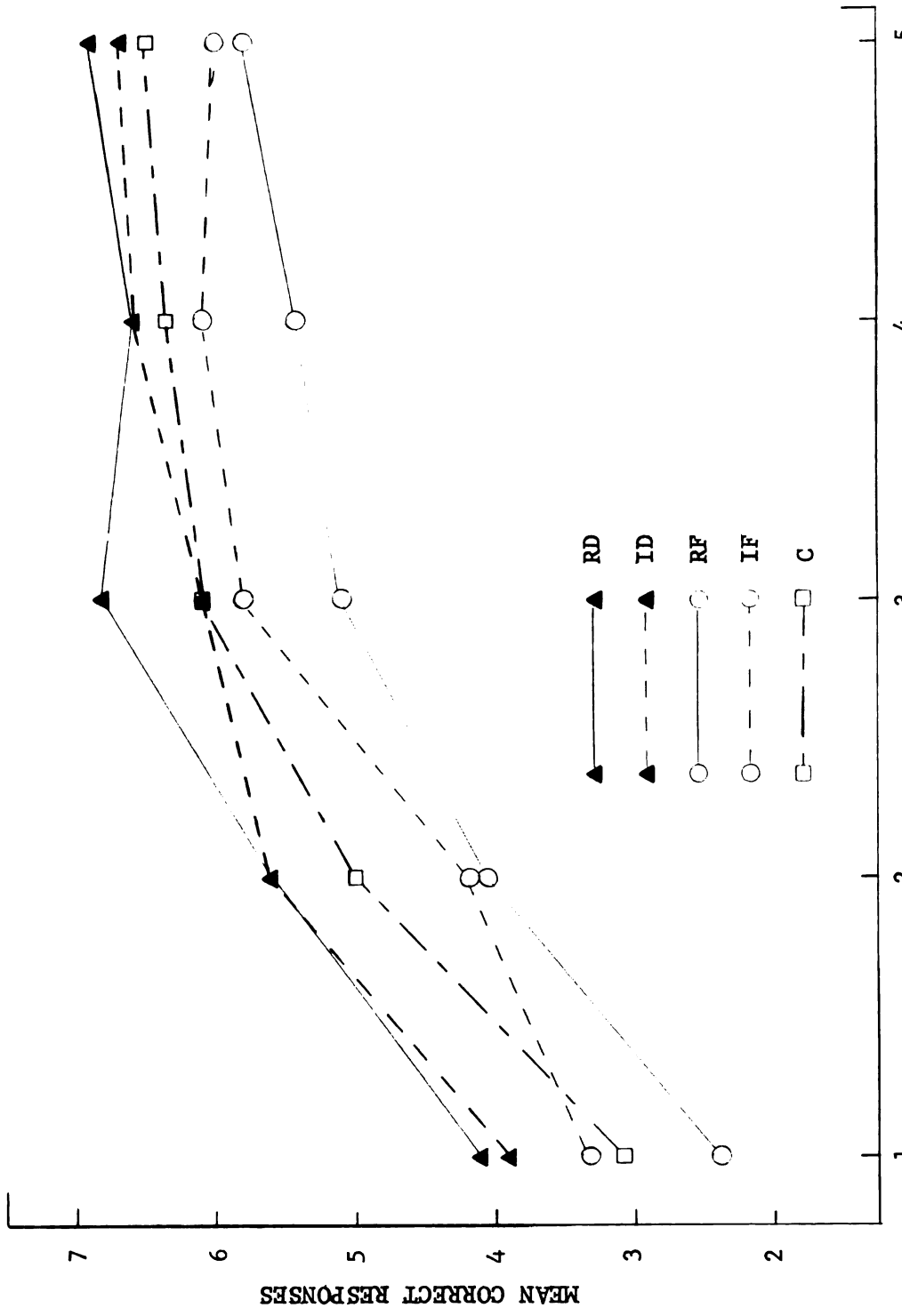


Fig. 1. Mean number total correct responses on criterion task.

Table 10

Summary of Lindquist Type 1 Analysis of Variance for the Five Groups on Total Number of Correct Responses

	Source	df	MS	F
A:	Groups	4	25.76	2.05
	Error (a)	75	12.56	
B:	Trials	4	126.48	1149.82***
A x B:	Groups x Trials	16	32.36	294.18***
	Error (b)	300	.11	
	Total	399		

*** Significant beyond the .001 level

task data were subjected to another Lindquist Type 1 analysis of variance. The factors were: 1) Groups -- RD, ID, RF, IF, C; 2) Pairs -- Aided, Unaided. The results are summarized in Table 11. The significant main effect of pairs indicated that aid was effective. The interaction term, however, was also singificant. A graphic representation of the interaction is presented in Figure 2. It can be observed from Figure 2 that although the ID group was the third highest on the aided pairs, this group performed better than the other groups on the unaided pairs.

To investigate further this finding, learning curves were plotted for each group comparing the levels of performance on aided and unaided pairs. These curves are presented in Figure 3. Of particular

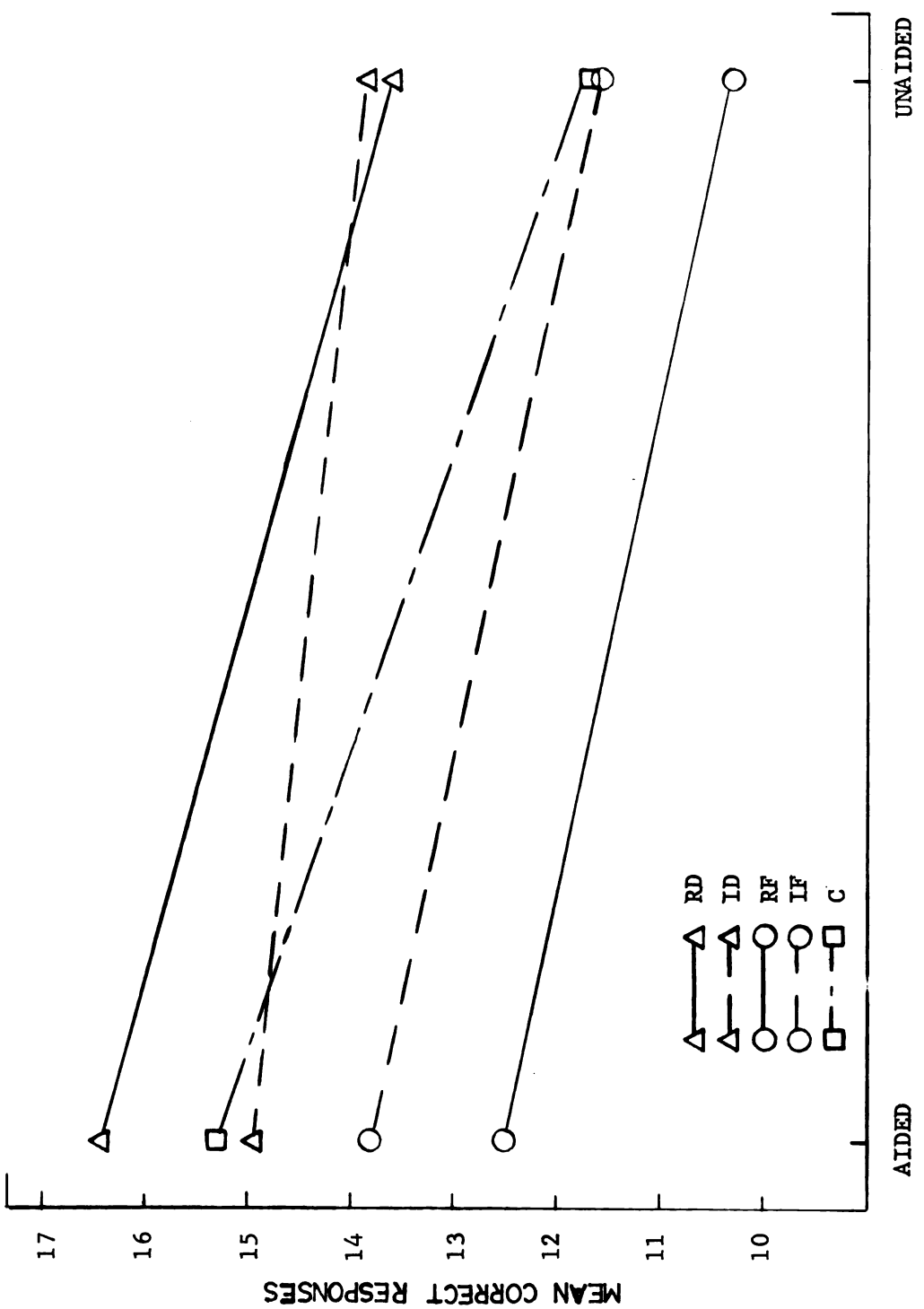


Fig. 2. Mean number correct responses on aided and unaided pairs on criterion task.

Table 11

Summary of Lindquist Type 1 Analysis of Variance for the Five Groups on Number of Correct Responses for Aided and Unaided Pairs

	Source	df	MS	F
A:	Groups	4	72.20	2.33
	Error (a)	75	30.99	
B:	Pairs	1	230.39	44.74***
A x B:	Groups x pairs	4	56.67	11.00***
	Error (b)	75	5.15	
	Total	159		

*** Significant beyond the .001 level

interest is the fact that only the ID group showed approximately the same level of performance on the aided and unaided pairs. This finding suggests that the irrelevant differentiation training may have resulted in general transfer to the stimuli of the unaided pairs, thus aiding the formation of high level strategies for use in learning these associations.

To assess the reliability of two judges' independent ratings of the verbal reports, a Spearman rank order correlation coefficient was computed for each pair from 40 of the Ss. The coefficients ranged from .89 to .99 indicating high agreement between the judges. A total strategy score was then computed from each S's verbal report for the unaided pairs. This score was obtained for an S by summing the

strategy ratings assigned to each of the four unaided pairs. For example, if an S reported using four 7 level (syntactical) strategies, his total strategy score would be 28.

In order to determine the relationship between performance on the unaided pairs and the complexity of strategies reported for these pairs, three Spearman rank order correlation coefficients were computed between number of correct responses on the unaided pairs and total strategy score for these pairs. Because the analysis of variance for number correct on the unaided pairs revealed a significant difference between the combined differentiation groups and the combined familiarization groups, a separate coefficient was computed for each of these combined groups and the third computed for the control group. The coefficient for the differentiation groups was .14; for the familiarization groups, .34; and for the control group, .53. The latter two were significant beyond the .05 level indicating a significant positive relationship between complexity of reported strategy levels and performance on the unaided pairs.

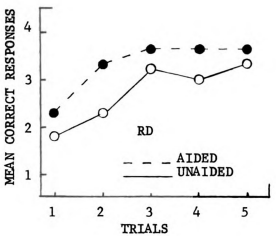
When differentiation training was compared with familiarization training, the results based upon total number of correct responses, number correct on aided pairs, and number correct on unaided pairs all revealed that differentiation training resulted in significantly better performance than familiarization training. Because the control condition was excluded from these analyses, three separate 1 x 3 analyses of variance comparing the control group, the combined differentia-

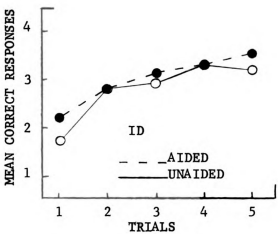
tion groups, and the combined familiarization groups were performed. The F values for total number correct and number correct on unaided pairs were significant beyond the .05 level. The F value for the aided pairs approached significance at the .05 level.

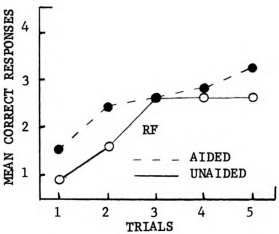
Duncan's multiple range test (Winer, 1962) was used to investigate further the significant findings obtained for two of the three dependent variables. The results of both analyses indicated that the differentiation and familiarization treatments differed significantly from each other ($p<.05$), but that neither treatment differed significantly from the control condition.

To investigate further the significant difference between the combined differentiation and familiarization groups on total number correct and number correct on the unaided pairs, the data from the differentiation task were subjected to two factorial 2 x 2 x 2 analyses of variance. The factors were: 1) Stimulus -- Relevant, Irrelevant; 2) Type of familiarization -- Differentiation, Familiarization of nominal stimulus; 3) Aided pairs -- A, B. One analysis was computed for number of correct responses on the elements of all pairs, and the other was computed for number correct on elements of the unaided pairs. It was hypothesized that if Ss from the differentiation groups successfully selected out embedded words which were used as cues for syntactical strategies, then they should have performed significantly better than the familiarization groups on the differentiation task.

Both analyses revealed no significant difference between the







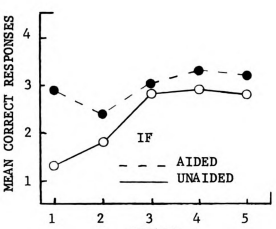
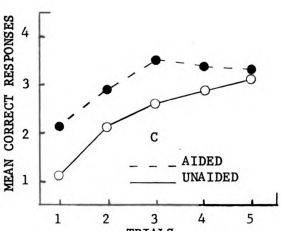


Fig. 3. Mean number correct responses on aided and unaided pairs for the five groups.



differentiation and familiarization groups. This result suggested that on the basis of the differentiation task data, the superior performance of the combined differentiation groups on the criterion task cannot be accounted for by a greater ability, resulting from training, to respond correctly to embedded elements in the stimulus items.

DISCUSSION AND CONCLUSIONS

On the basis of the nonsignificant F value obtained from the 1 x 5 analysis of variance for total number correct on the criterion task, the experimental hypotheses were not supported. However, the factorial analysis computed for the first three trials only yielded an F value which approached significance at the .05 level. Considering this result along with the near asymptotic performance of the RD group by the third trial, it appears that differences among groups were possibly minimized by a ceiling effect. Although neither the combined differentiation groups nor the combined familiarization groups differed significantly from the control, these combined groups differed significantly from each other on total number correct, number correct on aided pairs, and number correct on unaided pairs. Because the differentiation groups were superior to the control group and the familiarization groups were inferior to the control, it appears that differentiation training facilitated learning whereas familiarization training with the nominal stimulus inhibited learning.

Analysis of the data obtained from the differentiation task produced some puzzling results. Two Spearman rank order correlation coefficients were computed between the number of correct responses on the unaided pairs on the criterion task and the number of correct responses on the unaided pairs on the differentiation task. One coefficient was computed for the combined differentiation groups and the other for the combined familiarization groups. The resulting correlation for the differentiation groups was .57, which was sig-

nificant beyond the .001 level. The correlation for the familiarization groups was .60, which was also significant beyond the .001 level. These correlations indicate that a significant amount of the variance on the unaided pairs of the criterion task can be accounted for by the Ss' performance on these pairs on the differentiation task.

The differentiation task was originally devised in order to provide additional evidence regarding the mechanism involved in the successful employment of associative strategies. It was assumed that if Ss from the differentiation groups successfully constructed syntactical strategies for the unaided pairs, they should have performed significantly better than the familiarization groups on the differentation task. Yet when performance on the unaided pairs on the differentiation task was examined, there was no significant difference between these combined groups. In fact, the performance of the Irrelevant Differentiation group on the unaided pairs was lower than than of any other condition.

Further analysis of the criterion task data showed that although strategy aids facilitated learning of the aided pairs for all groups, the ID group performed almost as well on the unaided pairs. The superior performance of the ID group on the unaided pairs of the criterion task may be interpreted as a result of general transfer in that a tendency for selecting out embedded words developed during ID training and transferred to the stimuli of the unaided pairs. But analysis of the differentiation task data did not support this interpretation.

The recurring problem in the interpretation of the results of this experiment pertains to the contradictory findings obtained from the criterion and differentiation tasks. The results, however, of the differentiation task may have been confounded by the lack of a time limit imposed upon this task. It is possible, therefore, that Ss from the familiarization groups had enough time to reconstruct the entire stimulus items, thus not having to respond solely to the individual elements. Once the stimulus was reconstructed, Ss from the familiarization groups had equal opportunity to select the correct response items as Ss from the differentiation groups.

This hypothesis can be tested by using a differentiation task in which the exposure rate of each stimulus element as well as the time allotted to respond to it would be limited. This task would then be administered to a group composed of RF and IF subjects. Another group composed of the same types of Ss would be given the differentiation task used in the present study. Better performance on the task not imposing a time limit would provide support for the preceding hypothesis.

In conclusion, this experiment has shown that: 1) aid was effective (as demonstrated in previous studies): 2) differentiation training appears to facilitate overall learning, whereas familiarization training appears to inhibit learning; and 3) the results are inconclusive regarding the nature of the facilitative effect of differentiation training upon the successful employment of associative strategies in paired-associate learning.

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A P P E N D I C E S

APPENDIX A

MEANS AND STANDARD DEVIATIONS OF CA FOR THE FIVE GROUPS

	Groups				
	RD	ID	RF	IF	C
Mean	13.5	13.9	13.5	13.6	13.7
S.D.	.95	.68	1.06	.83	.90

APPENDIX B

MEANS AND STANDARD DEVIATIONS OF IQ FOR THE FIVE GROUPS FROM THE DETROIT TESTS OF LEARNING APTITUDES

	Groups				
	RD	ID	RF	IF	C
Mean	67	70	73	72	70
S.D.	4.20	6.22	5.12	4.44	6.34
N	10	11	12	10	13

MEANS AND STANDARD DEVIATIONS OF IQ FOR THE FIVE GROUPS FROM THE STANFORD-BINET SCALE

	Groups				
	RD	ID	RF	IF	C
Mean	69	75	77	73	53
S.D.	5.62	4.51	7.32	5.34	—
N	6	5	4	5	1

Two Ss had IQ scores from the WISC: 77, IF groups and 70, C group. One S from the control group had a score of D from the CTMM.

APPENDIX C

MEANS AND STANDARD DEVIATIONS OF READING ACHIEVEMENT GRADE EQUIVALENTS FOR THE FIVE GROUPS FROM THE METROPOLITAN ACHIEVEMENT TESTS

	Groups				
	RD	ID	RF	IF	C
Mean	3.4	3.3	3.1	3.3	3.2
S.D.	.72	.58	.44	.72	.45
N	15	14	15	14	15

MEANS AND STANDARD DEVIATIONS OF READING ACHIEVEMENT GRADE EQUIVALENTS FOR THE FIVE GROUPS FROM THE IOWA TESTS OF BASIC SKILLS

	Groups				
	RD	ID	RF	IF	C
Mean	4.1	3.2	__	3.3	5.0
S.D.	__	.92	__	1.06	__
N	1	2	__	2	1

One subject had a reading achievement score from the Stanford Achievement Test: 3.5, RF group.

APPENDIX D

INSTRUCTIONS FOR THE PRACTICE TASK

Will you put your booklets on your desk and listen while I explain what we're going to do. We're going to play a word game. I'm going to to show you two words on the screen. The first word is what a man from another country would say; the second word is how we would say it. This is an example: (The pair, GILSUN MORNING, is projected on the screen in front of the group.) Gilsun is what the man from another country would say; morningis what we say. (Children repeat pair orally.) Who can tell me how a man from another country might say "Good morning?"

The word GILSUN and the word MORNING always go together. If I show you the word GILSUN, you will always know what word goes with it. Open your booklet to the first page. I will show you the word GILSUN on the screen. Can you find the word on the page that goes with it? If you can, draw a circle around it. If you can't find it, wait and I'll read the words to you.

Did you all circle the last word, MORNING? Now we're going to look at some more words that the man from another country would say. I'll say the words for you as they come on the screen. Then we will try to see if we can remember which words went together. Watch the screen and listen...

Now we will see if we can remember which words went together. I'll show you the first word, and I want you to find the word that goes with it on your paper. Open your booklet to page 1. When I show

you the word on the screen, find the word that goes with it. Draw a circle around it and then turn the page. If you can't find the word, wait and I'll read the words for you.

APPENDIX E

INSTRUCTIONS FOR THE FAMILIARIZATION TASK

RD and ID -- I am going to show you some more words on the screen that a man from another country would say. When each word comes on the screen I will say it, and then I will say one part of the word. For example, here is the word, INCARN. (E shows this on a card.) I would say INCARN-IN. Do you see how I got "IN?" I and N are two letters of the word, INCARN. After I do this for all the words, I will want you to say the part of the word that I said before. Do you have any questions?

RF and IF-- I am going to show you some more words on the screen that a man from another country would say. I will say the words for you as they come on the screen. After I show you all the words once, I will want you to say each word after I say it. Do you have any questions?

APPENDIX F

INSTRUCTIONS FOR THE CRITERION TASK

Do you remember what we did this morning? You had some time to learn a list of words that go together, and then you circled the right answer in your booklet. Then I showed you some tricks you could use that would help you learn which words go together.

Now you are going to do the same as you did this morining, but with different words. When we go through this list, I will give you some tricks like the ones I showed you. Try to use these tricks to help you learn which words go together. Do you have any questions?

APPENDIX G

INSTRUCTIONS FOR STRATEGY COLLECTION TASK

I'm going to show you once more the words that you were learning. This time, though, I want you to tell me how you learned them. There are many tricks you could have used, or you might not have used any on some pairs. Let's go through these words and you try to tell me any tricks you used.

APPENDIX H

INSTRUCTIONS FOR THE DIFFERENTIATION TASK

Here is a list of the same words you have been seeing on the screen, but the words from another country are broken up into parts. I want you to look at each part here (E points), and then pick out the word from this list (E points to response terms) that you think goes with the part. When you find the word, put the number that is next to that word on the line. Do this for each part. Guess if you're not sure. You may use each of these numbers more than once. Do you have any questions?