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THE EFFECTS OF INTERPAIR AND INTRAPAIR ASSOCIATION AND INSTRUCTIONS ON VERBAL DISCRIMINATION LEARNING

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ABSTRACT

THE EFFECTS OF INTERPAIR AND INTRAPAIR ASSOCIATION AND INSTRUCTIONS ON VERBAL DISCRIMINATION LEARNING

by Eileen Eberlein

According to the predictions of the frequency theory of verbal discrimination (VD) learning, strong associations between the members of VD pairs should have the same effect as strong associations between correct (C) and incorrect (I) items in different pairs. In both cases the frequency difference is predicted to decrease, creating interference. This experiment was designed to test this prediction and to determine the effects of instructions about the associative relationships on VD performance.

Five groups of 16 subjects each were given 10 trials on a 12-pair VD list. In the Paired (P) conditions the items in each VD pair were strong associates. In the Unpaired (U) conditions the C item of each pair was strongly associated with the I item of another pair. Half the subjects in the P and U groups received instructions about the associative relationships; half did not. The Control group received a list in which all of the items were unrelated.

The performance of the U groups was significantly inferior to that of the Control and P groups, which did not differ significantly from each other. The instructions did not affect the total number of errors made. Though the interference found in the U conditions was consistent with the frequency theory, the lack of interference in the P conditions was contrary to frequency theory predictions. The results were interpreted as supporting the hypothesis of Barch, Lippman, and Whalen (1967) concerning the memory processes involved in VD learning.

Approved David C. Raskin
Committee Chairman

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INTRODUCTION

In the typical verbal discrimination (VD) task pairs of verbal items are presented to the subject, who is told that one item in each pair has been arbitrarily chosen as "correct" by the experimenter. On each trial the subject chooses one member of each pair and is informed by the experimenter as to the correctness of his choice.

The VD task has been used by several investigators to study the phases of the verbal learning process (Runquist & Freeman, 1960; Battig, Williams, & Williams, 1962). In these studies the VD task has been regarded as a simpler task which could be used to isolate variables and processes involved in the more complex paired-associate (PA) and serial tasks. However, the results obtained in a number of these studies indicate that both the processes involved in VD learning and the relationship between VD and PA or serial learning are more complex than was originally hypothesized. A number of conflicting results and complicating factors have been found, particularly in studies of transfer from VD to PA learning (Battig et al., 1962; Spear, Ekstrand, & Underwood, 1964; Young & Underwood, 1954).

One question concerning the processes involved in VD learning is whether any learning of the incorrect (I) item in a VD pair takes place independent of the knowledge or presence of the correct (C) item. Keppel (1966) and Battig et al. (1962) found that C items were remembered significantly better than I items. From an experiment involving transfer from one VD list to another, McClelland (1942) concluded that I items were not effectively learned independent of the C items. In a similar transfer experiment designed to answer this same question, Underwood, Jesse, and Ekstrand (1964) found initial positive transfer from one VD list to a second VD list in which the C items were the same as in the first list and also to a second list in which the I items were retained. However, in later trials performance on the list in which the I items were retained improved slowly and was surpassed by the performance of control subjects. In order to explain these results, Underwood et al. developed a frequency-discrimination hypothesis, which has been further elaborated and has become the major theory concerning the processes involved in VD learning.

According to this theory (Underwood et al., 1964; Ekstrand, Wallace, & Underwood, 1966), the cue for discrimination in VD learning is the subjective difference in frequency of occurrence of the C and I items within a pair. Frequency units are added to an item

whenever a subject sees, pronounces, or rehearses the item. As trials progress, the C items accumulate more frequency units than the I items as a result of the subject's rehearsal of the C item and the additional presentation of the C item in some feedback conditions. This increase in favor of the C item makes discrimination on the basis of differential frequency possible; the subject is able to choose either the most frequent (Rule 1) or least frequent (Rule 2) item in a pair.

In order to demonstrate that increasing the difference in frequency between the items in a pair facilitates performance and decreasing it interferes with performance, Ekstrand et al. (1966) performed an experiment using single lists. They found that when the same item was presented as the C item in two pairs, resulting in additional frequency units for the C items, VD learning was facilitated. When the same item was the I item in two pairs, the I items received additional units, the frequency difference between the C and I items was decreased, and interference occurred as predicted. Even greater interference was found when the same item was the C item in one pair and the I item in another pair. This was in accord with the prediction that a conflict in the frequency rule used, as well as a decreased frequency difference, would occur in that list.

A number of other studies have produced results which offer further support for the frequency theory. Raskin, Boice, Rubel, and Clark (in press) performed a transfer experiment designed to provide a more stringent test of the theory than the Underwood et al. (1964) experiment, and their results supported the theory. Dominowski's (1966) results concerning the effects of first trial guessing and type of feedback are consistent with the frequency theory, as are the findings of Erlebacher, Hill, and Wallace (1967) that C items are better retained than I items following VD learning. The studies of Lovelace (1964) and Kausler and Sardello (1967) also provide support for the frequency theory.

Ekstrand et al. (1966) also hypothesized that the frequencies of items can be manipulated by presenting strong associates of the items. They proposed that frequency units may be transferred between highly associated items by means of the implicit associative response (IAR). Their results supported this hypothesis. Though the effects were not as strong as those found with the use of identical items, the results showed that a list containing associated items as the C items in two pairs was easier to learn than a control list. A list in which an item was C in one pair and its associate was I in another pair was more difficult than the control list. Experiment II in the study of Raskin et al. (in press) also provides evidence that

frequency units may be transferred by means of IARs. The second list in this transfer experiment contained associates of C items from the first list. When these associates were correct, positive transfer resulted; when they were incorrect, negative transfer occurred. However, these differences were significant only when the subjects were informed about the associative relationships between the items in the two lists.

None of these studies has dealt with the effect of association between the C and I items in the same pair. Ekstrand et al. (1966) predicted, however, that similarity or associative relations between the items in a pair would have the same effect as similarity or association between the C and I items of different pairs, i.e., interference would result. Underwood and Viterna (1951) studied the effects of intrapair meaningful similarity of VD learning when interpair similarity was minimized. They concluded that the slight disadvantage for the high similarity list found in one comparison was due to differences in ability and that intrapair similarity had little effect on VD learning. Edwards (1966) used a four-choice VD task to study separately the effects of within-display and between-display similarity. He found that within-display similarity did not affect learning, while between-display similarity caused significant interference.

Several studies have compared the performance of normal and deaf adolescents on VD tasks in which intrapair similarity has been varied. Putnam, Iscoe, and Young (1962) found, contrary to frequency theory predictions, that highly meaningfully similar word pairs were easier to learn than unrelated pairs for both groups of subjects. The results of Youniss, Feil, and Furth (1965) showed no difference between similar and unrelated pairs for deaf adolescents, but greater difficulty with the similar pairs for normal adolescents and normal and deaf college students. On the basis of these results Barch, Lippman, and Whalen (1967) formed a hypothesis concerning the relation between level of linguistic development and the effects of intrapair similarity and association. They found that for children from the fourth to the eighth grade, pairs of highly associated items were easiest to learn, regardless of the age of the subject. These results are directly opposed to the predictions of the frequency theory.

The effects of intrapair association or similarity on VD learning are not yet clear. It was the purpose of the present experiment to test further the prediction of the frequency theory concerning intrapair associations, by comparing the effects of association between the C and I items in the same pairs with that of association between the C and I items of different pairs. The effect of instructing the

subjects as to the presence and nature of these associations was also studied, since Raskin et al. (in press) found instructions to be of considerable importance in VD transfer, particularly in the transfer of frequency units along associative dimensions.

METHOD

Subjects. — Eighty-two undergraduate students enrolled in an introductory psychology course at Michigan State University served in the experiment. Two Ss were discarded and replaced: one because he failed to understand the instructions, the other because he failed to cooperate. The Ss were assigned to the conditions in order of appearance at the laboratory, with males and females assigned separately so as to have the same proportion of each sex in all groups.

Design. — Five groups of 16 Ss each were established on the basis of the associative relations between the items on the lists and whether or not they were instructed as to this relationship. In the Paired (P) conditions the items in a pair were highly associated. In the Paired-Instructed (P-I) condition the Ss were instructed about these associations, while in the Paired-Not Instructed condition (P-NI) they were not. In the Unpaired (U) conditions the C items of each pair were highly associated with the I items of different pairs. These Ss were also subdivided on the basis of instructions about these associative relationships into the Unpaired-Instructed (U-I) and

Unpaired-Not Instructed (U-NI) groups. The Control group received a list in which the items were not related.

Materials. — The associate pairs used in constructing the lists, obtained from the Russell and Jenkins (1954) and Bilodeau and Howell (1965) norms, were: queen - king, sweet - sour, high - low, hot - cold, hard - soft, tall - short, hammer - nail, sky - blue, eat - food, ice - cube, green - grass, and table - chair. The remaining items, used in the unrelated lists, were chosen from the same sources.

Each of the lists constructed consisted of 12 word-pairs. The VD pairs in the P lists were the 12 associate pairs listed above. The lists for the U conditions contained the same items, but the two members of each associate pair were presented in different VD pairs. One member of each associate pair was the C item in its VD pair, and the other member of the associate pair was the I item in its VD pair. The lists for the Control condition were constructed by pairing one member of each of the associate pairs with an unrelated item. For half of the Control group one item from each associate pair was used, and for the other half, the other item from each pair was used. For all the lists used in this experiment two sublists were constructed so that half the Ss received one item from each pair as the C item, and the other half received the other item from each pair as the C

item. The lists are presented in Appendix A. Each list was presented in two different random orders. Each item appeared once above and once below the other item on the two rotations.

Procedure. — The lists were presented on a Stowe memory drum. Each pair of items, with one word typed above the other, was presented in the window for 2 sec., and the C item from the pair was then presented alone for 2 sec. The intertrial interval consisted of a 2 sec. blank. All Ss were seated at a table and were read identical instructions, which told them to learn which word in each pair was correct and encouraged them to guess on the first presentation. The Ss in the P-NI, U-NI and Control conditions received only these instructions. The P-I and U-I Ss received further instructions which explained that the items on the list were associates and gave examples (items not used on any lists) of associated words. The P-I Ss were told that each pair would consist of associated items. The U-I Ss were told that the associates would not be presented together and were given the information that if an item was correct in its pair, its associate would appear in another pair and would be incorrect, and vice versa. The instructions for all groups are presented in Appendix B. All Ss were run for 10 trials.

RESULTS

The performance of the five groups as measured by the mean number of errors made on the 10 trials is shown in Figure 1. After the first trial the performance of the U groups was consistently poorer than that of the P and Control groups. A one-way analysis of variance performed on the mean total errors for the five groups (Table 1) showed that the groups were significantly different,

Table 1. -- Summary of Analysis of Variance Comparing the Mean Total Errors for the Five Groups.

Source	d.f.	Mean Square	F
Experimental Conditions	4	247.19	6.01*
Error	75	41.14	

*$p < .01$

$F(4, 75) = 6.01$, $p < .001$. A Duncan Multiple Range Test (Edwards, 1960) on these means (Table 2) indicated that the P and Control groups performed significantly better than the U groups ($p < .05$).

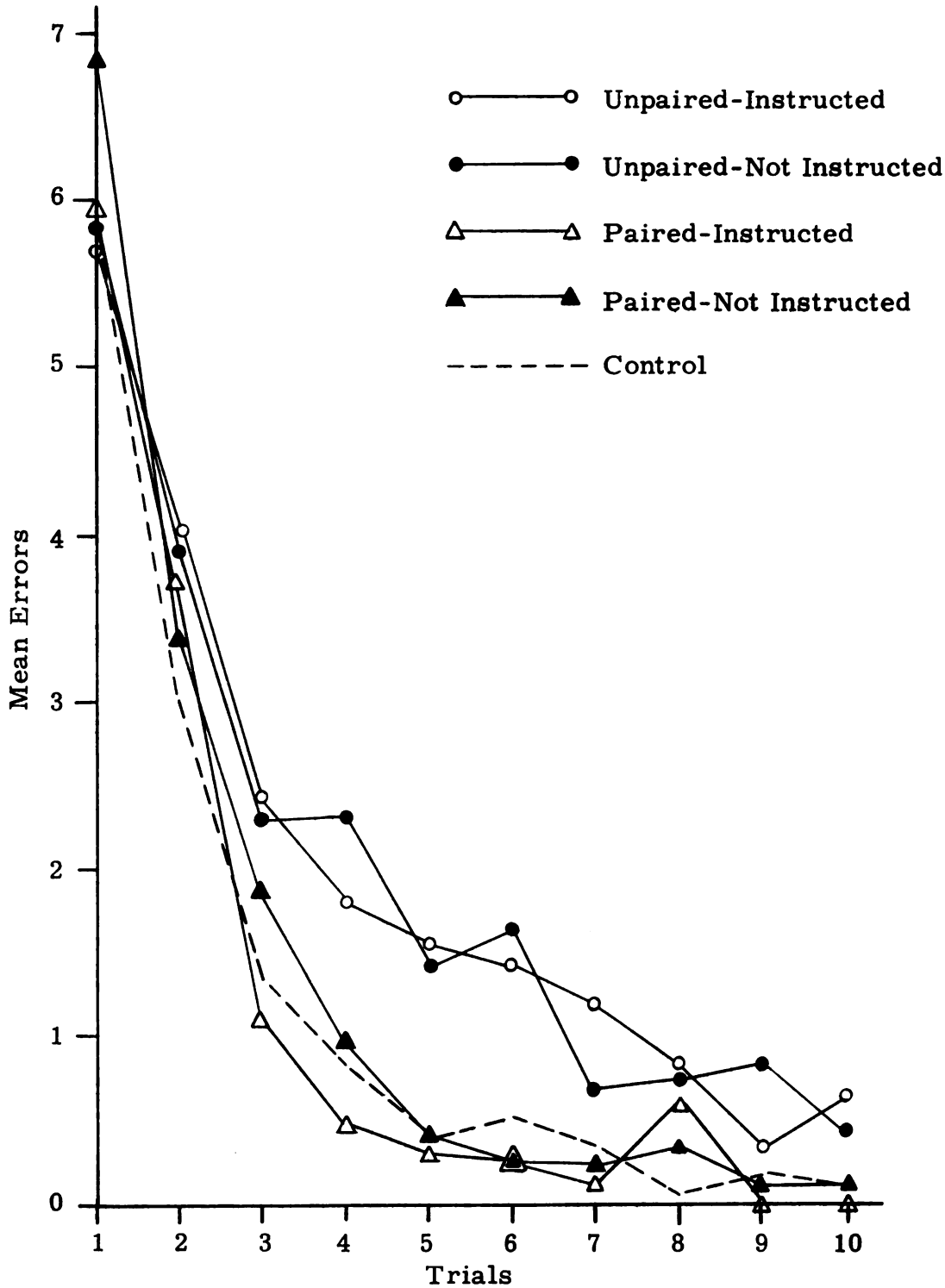

Figure 1. -- Mean Errors per Trial for the Five Groups.

Table 2. -- Mean Total Errors and Standard Deviations for the Five Groups and the Results of the Duncan Multiple Range Test.

Group									
P-I		Control		P-NI		U-I		U-NI	
Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
12.12	4.30	13.69	4.06	14.31	5.13	20.25	8.36	20.56	7.71

Note: Any two means underlined by the same line are not significantly different.

None of the other differences was significant. To further assess the effects of the experimental conditions, a 2 × 2 analysis of variance was performed on the error scores of the four experimental groups (Table 3). This showed the main effect of Pairing of Associates to

Table 3. -- Summary of Analysis of Variance Comparing the Mean Total Errors for the Four Experimental Groups.

Source	d.f.	Mean Square	F
Between Ss			
Pairing (P)	1	413.28	18.77**
Instructions (I)	1	12.50	.57
P × I	1	6.10	.28
Error (b)	60	22.02	

**$p < .001$

be highly significant, $F(1, 60) = 18.77$, $p < .01$. The Pairing × Instructions were both nonsignificant ($F < 1$). Thus, the lists in which the associates were paired were significantly easier for the Ss to learn than the lists in which the associates were presented in different pairs, and instructions to the Ss did not significantly affect their total errors.

It should be noted that the instructions given the U-I group not only explained that the items would be associates, but also informed the Ss that if an item was correct, its associate would be incorrect, and vice versa. This information could have been used on the first trial to determine the C item in any pair containing an associate of a word which had appeared earlier in the trial. On the lists used in the U-I group, 8 of the 12 pairs contained associates of items presented earlier, and S could have responded correctly on these pairs on the basis of the information given in the instructions. However, the mean number of errors on Trial 1 was 6.75 for the U-I group and 6.88 for the U-NI group. Thus, the Ss either ignored the instructions and simply guessed on Trial 1, or interference already was taking place and cancelled any advantage from the instructions.

DISCUSSION

The finding that strong associations between the C and I items in different pairs created significant interference is in accord with the frequency theory. This result is similar to that of Ekstrand et al. (1967) though their AB condition and the present U condition differed slightly: in the U condition each item in the VD pair was associated with an item in another pair while in Ekstrand et al.'s AB condition one item from each pair was associated with another item and the other item in the pair was not related to any other item on the list. Contrary to frequency theory predictions, the results showed that strong associations between the members of a pair did not create interference. This finding is similar to the results of Underwood and Viterna (1951) concerning intrapair similarity and those of Edwards (1966) on between-display similarity.

Instructions given to the Ss about the associative relationships present in the list did not affect the total errors or interact with the Pairing variable. The effects produced by the presence of associates in the list appeared without these instructions, as they did in the study of Ekstrand et al. (1966). Apparently instructions are necessary

for associations to affect learning only when the associated items are presented in two different lists (Raskin et al., in press).

The frequency theory cannot be used to explain the differing effects of intrapair and interpair C and I item associations found in this experiment. According to the theory, whether the associates are in the same or different pairs, the RR to one item is likely to be confused with the IAR made to its associate, and the C to I frequency ratio will be decreased. Interference should result in either case. The results of this experiment seem to indicate that while a subject may use differential frequency as a cue in VD learning, something other than a simple discrimination on a frequency basis must take place. There is evidence that associations develop between the members of a VD pair. Battig et al. (1962) and Spear et al. (1964) found that from 17% to 33% correct associations were made in recall tests and few subjects failed to produce any correct associations. Keppel (1966) found even greater evidence for the formation of associations in a recognition test following VD learning.

Spear et al. (1964) inferred that associations developed chiefly as a result of the two units in a pair appearing contiguously in the VD task, and it has been assumed (Underwood et al., 1964) that the VD task does not require the learning of associations between the items. The frequency theory does not deal at all with the

formation of intrapair associations or with any relations other than the development of a differential frequency between the items during VD learning.

However, the fact that intrapair associations do form in VD learning may indicate that the relations which develop between members of a pair are an important part of the VD process. The model of VD learning proposed by Barch et al. (1967) takes this into account. According to their hypothesis S attempts to reduce the memory load by "tagging" or "coding" one member of each VD pair as correct and then collapsing the pair and this tag together for memory storage. When tested on the pair, the subject searches for and retrieves the collapsed unit, unfolds it, and inspects it to find the tagged C item. In this model the combining of the members of a pair is an important part of the process, and any relations conflicting with the intrapair relation interfere with the combining process. As a result, the tag for the correct item may be lost before the pair can be stored; or the members of the pair may have to be stored separately, leaving the tag highly susceptible to interference. The ease of combination for any pair depends on the strength of the intrapair relation as compared to alternative relations for the items. Thus, strong preexisting relations between the items of a pair should facilitate the combining process, while strong interpair relations should interfere with the collapsing of the items.

In their experiment with children Barch et al. (1967) found that strong intrapair associations produced facilitation of VD learning. They predicted that college students would have more potential alternative links for each item, which would decrease the relative influence of the intrapair relation as compared to alternative relations. Thus, strong intrapair associations would be expected to produce less facilitation for college students than for younger children. Barch et al. did predict that intrapair associations would produce enough facilitation to counteract any tendency to confuse or interchange the items of a pair. Therefore, associated pairs would be at least as easy to learn as unrelated pairs for college students. The present experiment indicates that a list with strong intrapair associations is as easy to learn as a list with unrelated items. In accordance with the model of Barch et al., a list containing associations between C and I items in different pairs was found to be more difficult to learn. If the present study had employed the alternating study-trial test-trial procedure used by Barch, et al. (1967) rather than the anticipation method, the facilitation might have been more pronounced. The study-trial test-trial procedure would allow the hypothesized collapsing and unfolding processes to occur on separate trials. In the anticipation procedure both would have to

occur during the presentation of each pair, and the possibilities for interference in the memory processes would be greater.

The Barch et al. model does not account for all of the previous results which have been explained by the frequency theory. The transfer phenomena (Underwood et al., 1964; Raskin et al., in press) as well as the finding that strong associations between C items in different pairs (Ekstrand et al., 1966) facilitate learning, cannot be explained by differences in ease of combination of the pairs but it does appear that at least in cases in which discrimination on the basis of frequency breaks down, other factors make a great deal of difference in VD performance.

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APPENDICES

APPENDIX A

LISTS

Paired

Sublist 1		Sublist 2	
hot	cold	hot	cold
sky	blue	sky	blue
table	chair	table	chair
sweet	sour	sweet	sour
hard	soft	hard	soft
eat	food	eat	food
ice	cube	ice	cube
high	low	high	low
hammer	nail	hammer	nail
green	grass	green	grass
queen	king	queen	king
tall	short	tall	short

Unpaired

Sublist 1		Sublist 2	
hot	soft	hot	soft
sky	food	sky	food
table	nail	table	nail
sweet	low	sweet	low
hard	short	hard	short
eat	blue	eat	blue
ice	grass	ice	grass
high	cold	high	cold
hammer	chair	hammer	chair
green	cube	green	cube
queen	sour	queen	sour
tall	king	tall	king

Control

Sublist 1		Sublist 2		Sublist 3		Sublist 4	
mutton	sky	mutton	sky	arm	low	arm	low
pretty	hard	pretty	hard	flower	food	flower	food
smoke	cube	smoke	cube	scissors	hot	scissors	hot
water	hammer	water	hammer	eagle	tall	eagle	tall
swift	high	swift	high	infant	queen	infant	queen
shoulder	table	shoulder	table	stomach	green	stomach	green
blossom	eat	blossom	eat	light	sweet	light	sweet
cut	sour	cut	sour	lamb	blue	lamb	blue
bird	short	bird	short	girl	chair	girl	chair
baby	king	baby	king	tobacco	ice	tobacco	ice
ache	grass	ache	grass	thirsty	nail	thirsty	nail
heavy	cold	heavy	cold	fast	soft	fast	soft

APPENDIX B

INSTRUCTIONS

In this experiment, we are interested in the way people learn to discriminate between words. In the window on the machine a list of words will be presented. First a pair of words will be presented for 2 seconds. Your task is to guess which word in the pair is correct. Since one word in each pair has been chosen arbitrarily as correct, you will be guessing at first. Please choose one of the words anyway. After the pair has been presented for 2 seconds the correct word will be shown to you for 2 seconds. As we go over the list again try to remember which word in each pair was correct. There are 12 of these pairs on the list, and we will go through the list 10 times. Please be sure to tell me which word in each pair you think is correct before the correct word appears alone in the list. Do you have any questions?

Paired-Instructed (P-I) Group:

Each pair of words on this list is a pair of words which are associated with each other. By associated, we mean any kind of connection between the words. They may be synonyms like "ocean - sea"; opposites, like "man - woman"; or words that often appear together, like "salt - pepper."

Unpaired-Instructed (U-I) Group:

This list of words is made up of words which are associated with each other. By associated, we mean any kind of connection between the words. They may be synonyms like "ocean - sea"; opposites, like "man - woman"; or words that often appear together, like "salt - pepper." These associated words are not paired with each other on the list. That is, one word will be in one pair and the word associated with it will be in another pair. But if one of the words is correct in one pair, say, "boy," then when the pair containing "girl" appears, "girl" will be wrong. If "boy" is wrong, then "girl," when it appears, will be correct.

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