THE EFFECTS OF IMPLICIT ASSOCIATIONS AND INSTRUCTIONAL SET ON INTERLIST TRANSFER IN VERBAL DISCRIMINATION LEARNING

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ABSTRACT

THE EFFECTS OF IMPLICIT ASSOCIATIONS AND INSTRUCTIONAL SET ON INTERLIST TRANSFER IN VERBAL DISCRIMINATION LEARNING

by CAROL BOICE

This experiment was designed to determine whether implicit associations between words in successive lists of word pairs would be utilized as cues in responding in a verbal discrimination task. In addition, the importance of instructions in determining the set of the Ss was investigated.

Eighty introductory psychology students were first required to learn to a criterion of three errorless trials a list of 15 pairs of words, in which one word of each pair had been arbitrarily designated correct by E. They were then required to learn a second list which contained some words which were bidirectional or unidirectional associates of the correct words from the first list. For one experimental condition the associates in the second list were correct, for the other they were incorrect. A control group learned two unrelated lists. Half of the Ss in each experimental condition were instructed about the presence of the associates in the second list and informed that these words would be correct or incorrect, depending on the condition. The other

Ss were simply told they would be learning another list. All Ss were given 10 trials on list 2, and the number of errors per trial served as the measure of performance.

For the instructed Ss correct associate words in list 2 led to slight positive transfer while incorrect associates produced considerable negative transfer. The same effects occurred in the uninstructed conditions but were less pronounced. These differences between the groups were apparent on the first trial of the second list, and the error curves converged over the 10 trials. The set provided by the complete instructions was apparently crucial in determining the effects of the associate words, since the uninstructed Ss did not perform significantly differently from the control Ss. These findings were discussed in terms of a frequency hypothesis of verbal discrimination learning.

Approved David C. Raskin
Committee Chairman

Date August 9, 1966

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By

Carol Boice

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INTRODUCTION

Verbal discrimination has frequently been viewed as the first stage in a two process model of paired-associate and serial learning (Runquist and Freeman, 1960). As such it supposedly consists of a familiarization with the available responses. The second stage of the process involves learning the order of the responses or pairing each with the appropriate stimulus. From this model it has been hypothesized (Battig, Williams and Williams, 1962) that verbal discrimination (VD) experience with a list should facilitate paired- associate (PA) learning of the same words, since the first part of the process had already been accomplished before switching to the PA list.

Several studies have tested this hypothesis, but the results have been inconsistent. Battig, Williams and Williams (1962) report that they found no positive transfer from VD to PA learning, although VD words paired incorrectly for the PA list produced some negative transfer. A VD retention test indicated that more right words than wrong words were learned. On the other hand, Spear, Ekstrand and Underwood (1964) found not only negative transfer with inappropriate pairings but positive transfer with appropriate pairings on the PA list. They suggest that the differences between their results and those of Battig, Williams and Williams

may be due to the fact that Battig, Williams and Williams used nonsense syllables and Spear, Ekstrand and Underwood used low frequency words. With low meaningful pairs of nonsense syllables, VD involves recognition with very little association developing between syllables, but with meaningful word pairs a much stronger association develops between the words. This association between words resulted in positive transfer for appropriate pairs and negative transfer for inappropriate pairs on the PA task. It is clear, however, that the incorrect words were not independently learned in the VD list in either study.

McClelland (1942) tested the possibility that both correct and incorrect responses were learned, but incorrect words were forgotten more quickly. His Ss learned a VD list to a 15 out of 20 correct criterion and were then shifted, without being informed of the change, to a new list containing the words from list 1 paired with new words. Words correct on list 1 were still correct, and those that had been wrong were still wrong. On the second list, pairs with transferred wrong words were significantly more difficult to learn than those with transferred correct words. McClelland concluded that the only acquired response connected with the incorrect words was a weak avoidance--only the correct words were actually recognized and remembered. Similarly, Saltz (1964) has recently suggested that

learning a VD list may involve not only acquisition of the correct words but also an inhibition of the tendency to respond with the incorrect words.

The most clearly elaborated hypothesis about VD learning has been presented by Underwood, Jesse and Ekstrand (1964) and Ekstrand, Wallace and Underwood (1966). This hypothesis is based on data collected in an experiment (Underwood, Jesse and Ekstrand, 1964) which differed from McClelland's (1942) in that 1) the Ss were informed of the changes made between the first and second lists, 2) the VD lists were not mixed (instead of introducing both correct and incorrect new words in list 2, the new items were either all correct or incorrect), and 3) Ss learned the first list to three successive errorless trials. The results indicated that replacing the incorrect words produced no performance decrement on the second list, and that replacing the correct words resulted in a small decrement on trial 1 of list 2 but extremely slow improvement over the 10 trials.

Underwood, Jesse and Ekstrand interpreted these these results as indicating that discriminations depend initially on the relative frequency of the members of the pairs. Each time S looks at, or responds with, a word one frequency unit is added to that word. On the first trial of list 2 the transferred word has more frequency units than the new word, but words that were correct on list 1 have more units than those that were

incorrect. This differential frequency provides a cue for responding. If the second list includes new wrong words the differential between the transferred correct words and the new words is maximal. Thus, there is no decrement on trial 1 of list 2 and each further trial only increases the difference by adding more units to the correct word than to the new word. When new correct words are introduced on list 2, there is a smaller but still substantial difference between the frequencies of the old and new words and the decrement is small. However, the trials on list 2 in this case add more units to the new than the old words and eventually differential frequency breaks down as a cue and the S must turn to some other means of making the discrimination. An analysis of VD learning data to determine if guessing correctly or incorrectly on trial 1 affected performance on following trials has provided moderate support for the frequency hypothesis (Dominowski, 1966).

Bousfield, Whitmarsh and Danick (1958) have suggested that the presentation of a verbal unit will elicit implicit associated responses related to the given unit, and such implicit associations have been shown to mediate positive transfer in PA learning (Bugelski and Scharlock, 1952; Russell and Storms, 1955). In VD learning associated words have been used to add frequency units to some of the words in the list (Ekstrand, Wallace and Underwood, 1966). When both words

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in an associate pair were correct in the VD task learning was facilitated, presumably because each time one word of the associate pair appeared a frequency unit was also added to the other word through implicit association. If the associated words were both correct and incorrect the association produced interference and performance was inferior to that of a control group which learned a list without any associate pairs. These effects, although significant, were small, and a group receiving incorrect associates did not differ from the control group.

Ekstrand, Wallace and Underwood did not inform their Ss of the presence of the associates in the VD list, and because these associations are apparently automatically produced this should not have affected the results. However, even when some identical words are used in two VD lists complete instructions may produce greater transfer than switching to the second list without instructions (Underwood, Jesse and Ekstrand, 1964; McClelland, 1942). This difference may have also been at least partly due to the fact that McClelland used a mixed list, but it seems probable that set factors are important. Schwartz (1963), for example, discusses the importance of instructional set in PA learning, pointing out that such learning is not fixed by the classical types of variables, but is also influenced by the set Ss are given.

This experiment attempted to test the frequency

hypothesis of VD learning by using implicit association to manipulate the differential frequency between words on trial 1 of a second list constructed partly of words which were associates of words from a first VD list. The importance of instructional set in this type of task was also investigated.

THE

METHOD

Subjects - The Ss in this experiment were 80 undergraduate students enrolled in an introductory psychology course at Mighigan State University. None had previously participated in a verbal learning study. One S who failed to learn the first list after 25 trials was excluded from the experiment.

Materials and Apparatus - Part of the words used in constructing the VD lists for this study consisted of 10 bidirectional and 10 unidirectional associate pairs. These pairs were taken from Bilodeau and Howell (1965) and Mink (1957) and are presented, with their associative strengths, in Appendix A. The remainder of the words were from Bilodeau and Howell (1965) and were not associated with words in the associate pairs or each other (no associative value was greater than .04).

Four different lists were constructed, each consisting of 15 pairs of words. Lists 1A and 1B contained 10 pairs of words that were comprised of a word from one of the associate pairs (5 unidirectional and 5 bidirectional in each list to control for possible differential effects of directionality) and a nonassociate word. For both groups the associate words were designated correct. The other five pairs, which were added to increase the length of the list contained two nonassociate words. List 1C was composed of 15 pairs of nonassociate words. In an effort to keep these three lists as comparable as possible the same nonassociate words

appeared in all three lists, although 10 additional pairs were necessary to complete list 1C.

List 2, which was the same for all Ss, also contained 15 pairs, 10 of which were composed of the second halves of the associate pairs. For each of these pairs the associate of a 1A word was coupled with the associate of a 1B word, and the associate of the 1A word was always correct. The other five pairs in list 2 consisted of 10 new nonassociate words. For the unidirectional pairs, the stronger response word always appeared in the second list.

The lists were presented on an MTA 100 Scholar, modified for presentation of a continuous loop and with the off/on control mounted on a clipboard so E could control the machine from a position behind the S. The window on the machine was reduced in size and divided so that there were four 1" x 3/4" windows. Three of these were always covered so S could see only one list at a time.

Procedure and Instructions - Each pair of words was presented, with one word typed directly above the other for a two second period. Next, the correct word appeared alone in the window for two seconds. A two second ITI followed presentation of all 15 pairs, and during this period a row of asterisks appeared in the window. There were two randomly arranged rotations of

each list and each word appeared once on the top and once on the bottom for the two rotations.

Ss were assigned to one of five groups in order of their appearance for the experiment. After being seated in front of the teaching machine, all Ss were read identical instructions describing the task, which was simply to learn which word in each pair was correct (see Appendix B). Each S then learned the appropriate first list to a criterion of three successive errorless trials. At this point the card covering the second list was moved to cover the list S had just learned, and S was read one of two different sets of instructions.

All the Ss who had learned list 1C and half of those who had learned 1A or 1B received minimal information about list two as follows:

> The second part of the experiment is similar to the first. You will be asked to learn a new list of words which will be presented in exactly the same way as the first list. Once again, please tell me which word you think is correct before it appears alone. This time we will stop after 10 trials.

The remainder of the 1A and 1B Ss were given the following detailed instructions about the relation between the words in the first and second lists:

> The second part of the experiment is similar to the first. You will be asked to learn a new list of words which will be presented in exactly the same way as the first list. Some of these new pairs of words will contain words that are associated with the words that were correct in the first list. By associated, I mean any kind of connection between the words. For example, they can be synonyms

"ocean-sea", opposites "boy-girl", or words that commonly appear together "salt-pepper". These associated words that will appear in this next list will always be correct (incorrect). Do you understand?

Once again, please tell me which word you think is correct before it appears alone. This time we will stop after 10 trials.

The performance measure used was the number of errors per trial for the 10 second-list trials.

The design of the experiment, thus, involved the two variables of Instructions and Correctness of associates on list 2, each of which had two levels which were combined factorially giving the following four experimental groups with 16 Ss in each:

I-AC -- Instructed with second-list associates correct.

I-AW -- Instructed with associates wrong.

U-AC -- Uninstructed about relation between first and second lists with associates correct.

U-AW -- Uninstructed with associates wrong.

In addition there was a control group (C) with 16 Ss who learned two unrelated VD lists. There were 9 male and 7 female subjects in each of the five groups.

RESULTS

The mean number of trials to the criterion of three successive errorless trials on the three first lists ranged from 7.93 to 8.81, with an overall mean of 8.22. An analysis of variance indicated that these differences were not significant ($F = .44$, d.f. = 2, 79). Apparently the different lists were of comparable difficulty.

For all analyses on list 2 responses on the five pairs that contained nonassociate words were not included since they were used merely as filler pairs to increase the length of the list.

Comparison of experimental groups -- To determine the effects of the Association and Instruction variables the control Ss were excluded and the four experimental groups were compared. An analysis of variance (Table I) indicated that the correctness of the associate words in list 2 had a significant effect on performance ($p < .01$). Although the main effect of the Instructions variable was not significant ($F < 1.0$), the Instructions x Association interaction was significant beyond the .01 level. Thus, the effect of the instructions was to accentuate the differences between the AC and AW conditions.

Inspection of Figure 1 will clarify the nature of the significant Trials x Instructions and Trials x

Table I. Summary of Analysis of Variance Comparing the Four Experimental Groups on Performance on List 2.

Source	d.f.	Mean Square	F
Between Ss			
Association (A)	1	49.0	22.3*
Instructions (I)	1	.50	.23
A x I	1	22.8	10.4*
Error	60	2.2	
Within Ss			
Trials (T)	9	99.9	153.7*
T x A	9	2.7	4.2*
T x I	9	3.7	5.7*
T x A x I	9	1.1	1.7
Error	540	.65	

*$p < .01$

Association interactions. Aside from the first two trials, the I-AW group made considerably more errors than the other three groups, and did not reach the performance level of the other groups in the 10 second list trials. The I-AC group, on the other hand, made fewer errors than the other groups although this difference was small and disappeared when the U groups reached the same, nearly errorless, level of performance on trial 4.

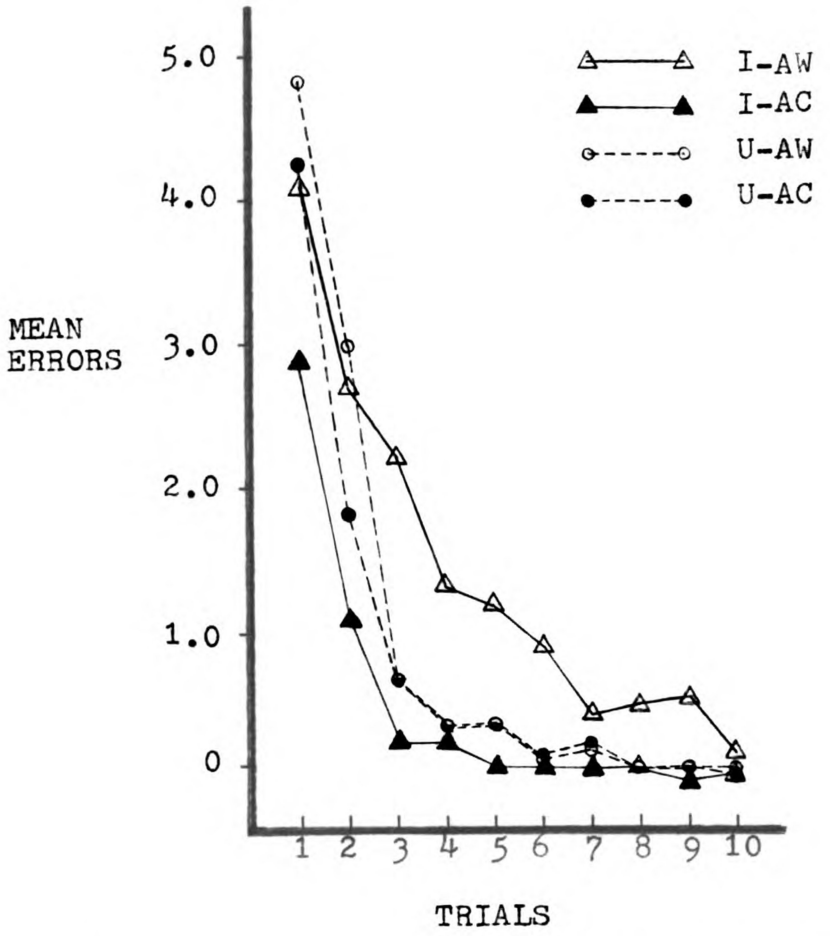

Figure 1. Mean errors for the four Experimental groups on List 2.

The U groups generally fell between the two I groups with the U-AC group having made slightly fewer errors than the U-AW.

A Duncan multiple range comparison (Winer, 1962), of these experimental groups indicated that all four groups were significantly different from each other ($p < .01$) (Table II).

Uninstructed and control groups -- Learning curves comparing the U-AC and U-AW groups with the Control group

Table II. Summary of Multiple Comparisons between Experimental Groups Using Duncan's Multiple Range Test.

Group	I-AC	U-AC	U-AW	I-AW
Total Errors	76	128	156	225
I-AC	--	52*	80*	149*
U-AC		--	28*	97*
U-AW			--	69*

*$p < .01$

on List 2 learning are shown in Figure 2. An analysis of variance, summarized in Table III, indicated that these groups were not significantly different from each other, but that the Trials x Association interaction was significant beyond the .01 level. On trial 1 of list 2 both the U-AC and U-AW groups showed some negative transfer when compared to the C group, but these differences had disappeared by trial 3.

Instructed and control groups -- A comparison of the I-AC, I-AW, and C groups is shown graphically in Figure 3. Analysis of variance yielded an F value for the Association main effect that was significant beyond the .01 level. The summary of this analysis appears in Table IV. Again the Association x Trials interaction was significant, with the I-AC group showing positive transfer on trial 1 and the I-AW group showing not only

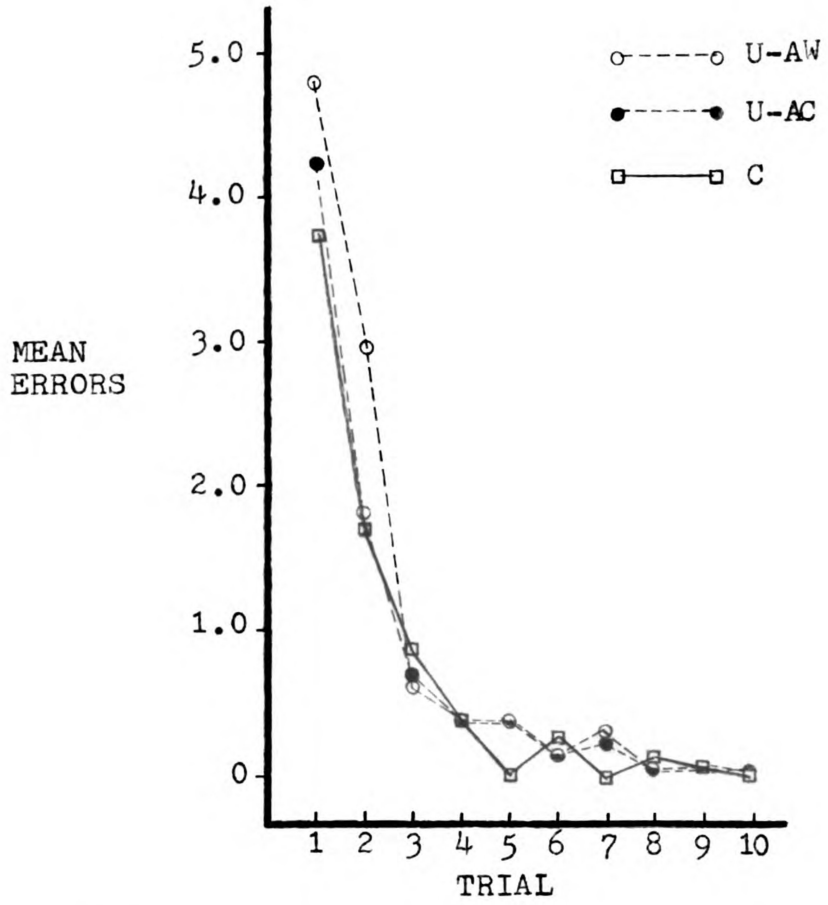

Figure 2. Mean errors for U and C conditions on List 2.

Table III. Summary of Analysis of Variance Comparing the Uninstructed and Control Groups.

Source	d.f.	Mean Square	F
Between Ss			
Association (A)	2	2.8	1.83
Error	45	1.6	
Within Ss			
Trials (T)	9	89.9	145.5*
T x A	18	1.6	2.5*
Error	405	.63	

*$p < .01$

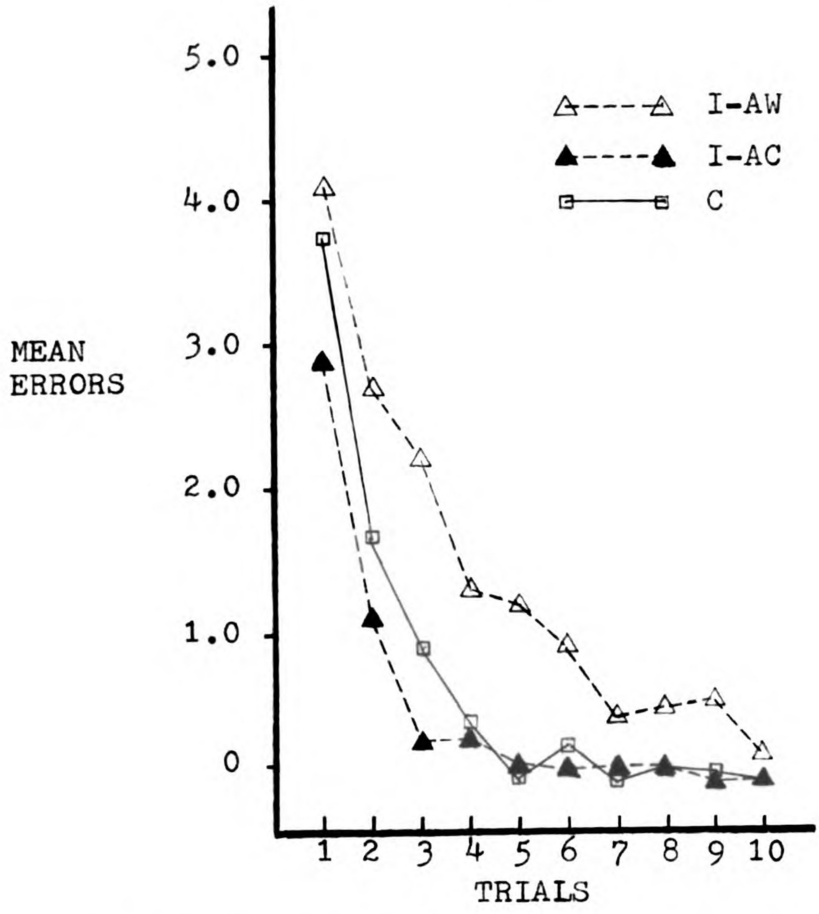

Figure 3. Mean errors for C and I conditions on List 2.

Table IV. Summary of Analysis of Variance Comparing the Instructed and Control Groups.

Source	d.f.	Mean Square	F
Between Ss			
Association (A)	2	37.5	21.6*
Error	45	1.7	
Within Ss			
Trials (T)	9	57.3	91.0*
T x A	18	1.6	2.5*
Error	405	.63	

*$p < .01$

initial negative transfer, but also a continued inferior performance over the 10 list 2 trials when compared to the I-AC and C groups.

First trial differences -- The nature of the significant Association x Trials interactions can be further clarified by an analysis of the number of errors on trial 1 for each group. This analysis was significant beyond the .05 level (Table V).

Table V. Analysis of Variance of Number of First Trial Errors for All Groups.

Source	d.f.	Mean Square	F
Between Groups	4	7.7	2.9*
Error	75	2.6	

*$p < .05$

A Duncan multiple range comparison (Winer, 1962) revealed that only the first trial difference between the I-AC and U-AW groups was significant (Table VI). As has already been mentioned, the I-AC group was the only one to show positive transfer when compared with the C group. The U-AW group, in addition to being unaware of the presence of the associates, was unable to use any cues that might have been unverbalized because the contingencies were reversed. As a result this group made the greatest number of errors on trial 1.

Table VI. Summary of Multiple Comparisons on Number of First Trial Errors for All Groups Using Duncan's Multiple Range Test.

Group	I-AC	C	I-AW	U-AC	U-AW
Total Errors	47	60	65	68	77
I-AC	--	13	18	21	30*
C		--	5	8	17
I-AW			--	3	12
U-AC				--	9

*$p < .05$

Bidirectional vs. unidirectional associates -- The number of errors on bidirectional and unidirectional associates for each group is shown in Table VII.

Table VII. Number of Errors on Bidirectional and Unidirectional Associates for the Experimental Groups.

Group	Bidirectional	Unidirectional
I-AC	41	35
I-AW	100	125
U-AC	57	71
U-AW	86	70

An analysis of variance (Table VIII) indicated that the Association x Instructions x Directionality interaction was significant ($p < .01$). Examination of Table VII suggests that the unidirectional associations were stronger than the bidirectional associations in that the unidirec-

Table VIII. Summary of Analysis of Variance Comparing Bidirectional and Unidirectional Associates.

Source	d.f.	Mean Square	F
Between Ss			
Association (A)	1	24.48	22.5*
Instructions (I)	1	.23	.21
A x I	1	11.43	10.5*
Error	60	1.09	
Within Ss			
Directionality (D)	1	.23	.72
Trials (T)	9	46.59	145.6*
A x D	1	0.00	0.0
A x T	9	1.79	5.6*
I x D	1	.34	1.1
I x T	9	2.34	7.3*
A x I x D	1	2.91	9.1*
A x I x T	9	.50	1.6
A x D x T	9	.27	.84
I x D x T	9	.27	.84
A x I x D x T	9	1.85	5.78*
Error	1140	.32	

*$p < .01$

tional associates led to fewer errors in the I-AC group and more errors in the I-AW group. This trend, however, was reversed for the uninstructed groups.

DISCUSSION

Generally the effects of manipulating frequency by implicit association were in line with predictions that could be made on the basis of the frequency hypothesis of Underwood, Jesse and Ekstrand (1964). If implicit associations occurring to words on list 1 were effective in producing differential frequencies of the words on list 2, this difference should have been apparent on the first trial of list 2. On trial 1 of list 2 the large frequency differential between the new and associate words should make discrimination relatively easy. When the associate words are correct on list 2 performance should be nearly perfect, if the associates are incorrect a slight decrement might be expected. Over the 10 trials on list 2 the group with the correct associates should make almost no errors, but if the associates are incorrect the frequency differential between the correct and incorrect words should decrease and finally reverse. This group, then, should make few errors on trial 1, an increasing number of errors on the next several trials as discrimination becomes more difficult, and finally should begin to improve slowly as the correct words build up more frequency units than the incorrect words.

This is essentially what did happen, except that the initial decrement for all four experimental groups was

greater than was predicted. It is probable that this first trial decrement was due to the failure of some of the implicit associations to occur in each S. Simply considering the associative strengths of the pairs (all less than .75), it is unlikely that all the associate words would be effective in eliciting an association in any given S. The fact that the instructed groups made fewer errors on trial 1 of list 2 than either of the uninstructed groups suggests that this might be the case. That the U-AW group made more errors on trial 1 than the other groups can be explained as the result, not only of failures to associate, but of having also to learn that the contingencies were reversed.

As expected, the I-AC appeared to show some positive transfer, although the difference between the I-AC and C groups on the first trial did not reach significance. The U-AC group did not show any significant transfer effects, but after three trials performance for both AC groups and the C group was nearly perfect. Elimination of errors was significantly slower for the I-AW group than for the other groups, but the increase in errors after trial 1 predicted by the frequency hypothesis did not occur. It is likely, however, that this effect was masked by the large initial decrement, so that this deviation from predicted results should not be construed

as a breakdown of the frequency analysis. It is reasonable to assume that there are factors other than differential frequency that may influence VD performance.

Instructions are apparently critical in determining the effects of associated words in VD learning. The uninstructed groups, although showing the expected trends, did not differ significantly from the C group. In this experiment Ss were shifted from one list to another and detailed instructions were necessary for the S to view the two tasks as related. After the experiment some of the uninstructed Ss were asked if they were aware of any connection between the two lists, and all but one reported that they had not noticed any relation and had not expected one. That the U-AW and U-AC groups were significantly different from each other probably indicates that unverbalized associations were somewhat effective in influencing performance, but clear cut results appear to depend on appropriate instructional set. Similarly, the failure to inform Ss of the presence of the associated words within the VD list may account for the weak effect of the Association variable in the Ekstrand, Wallace and Underwood (1966) study.

The finding that, for the instructed Ss, unidirectional associates tended to provide somewhat more information (i.e., led to fewer errors in the I-AC group and more in the I-AW group) is paradoxical, especially considering that in all unidirectional pairs the word used

in list 2 was the word that had a frequency of association back to the first list word that was no greater than .02. Especially in these instructed conditions, it would have been expected that the bidirectional associates, which presumably facilitated associating back to the list 1 words, would provide the strongest cues for responding. For the uninstructed groups the bidirectional associates did, in fact, tend to provide the most information.

SUMMARY

This experiment was designed to determine whether implicit associations between words in successive lists of word pairs would be utilized as cues in responding in a verbal discrimination task. In addition, the importance of instructions in determining the set of the Ss was investigated.

Eighty introductory psychology students were first required to learn to a criterion of three errorless trials a list of 15 pairs of words, in which one word of each pair had been arbitrarily designated correct by E. They were then required to learn a second list which contained some words which were bidirectional or unidirectional associates of the correct words from the first list. For one experimental condition the associates in the second list were correct, for the other they were incorrect. A control group learned two unrelated lists. Half of the Ss in each experimental condition were instructed about the presence of the associates in the second list and informed that these words would be right or wrong, depending on the condition. The other Ss were simply told they would be learning another list. All Ss were given 10 trials on list 2, and the number of errors per trial served as the measure of performance.

For the instructed Ss correct associate words in

list 2 led to slight positive transfer while incorrect associates produced considerable negative transfer. The same effects occurred in the uninstructed conditions but were less pronounced. These differences between the groups were apparent on the first trial of the second list, and the error curves converged over the 10 trials. The set provided by the complete instructions was apparently crucial in determining the effects of the associate words, since the uninstructed Ss did not perform significantly differently from the control Ss. These findings were discussed in terms of a frequency hypothesis of verbal discrimination learning.

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APPENDICES

APPENDIX A

ASSOCIATE WORD PAIRS

The associate pairs used in the experiment are presented below according to their source and the experimental condition in which they were used. The first word in each pair appeared in one of the first lists, the second word in list 2. The number beside each word indicates the frequency with which that word occurs as a response when the other word in the pair is given as the stimulus word.

Experimental Condition

Associates Correct				Associates Wrong			
Unidirectional Pairs							
From Mink (1957)							
.00	BLOSSOM	FLOWER	.68	.01	EAGLE	BIRD	.55
.00	TOBACCO	SMOKE	.51	.02	HEAVY	LIGHT	.59
.00	MUTTON	LAMB	.36				
From Bilodeau and Howell (1965)							
.01	SWIFT	FAST	.49	.00	THIRSTY	WATER	.48
.02	INFANT	BABY	.56	.01	SCISSORS	CUT	.60
				.01	STOMACH	ACHE	.35
Bidirectional Pairs							
From Mink (1957)							
.74	QUEEN	KING	.71	.56	SWEET	SOUR	.43
.61	BLACK	WHITE	.74	.64	HIGH	LOW	.67
				.47	HAMMER	NAIL	.53

Associates Correct				Associates Wrong			
From Bilodeau and Howell (1965)							
.41	MAN	WOMAN	.73	.44	HARD	SOFT	.56
.46	HOT	COLD	.72	.34	TALL	SHORT	.49
.21	SKY	BLUE	.56				

APPENDIX B

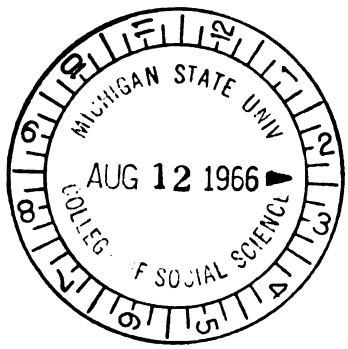
INSTRUCTIONS FOR LIST 1

We are interested in certain complex relationships involved in learning to discriminate words that are common to all people and are not concerned with your personal performance.

In the window you see on the machine a list of words will be presented. First a pair of words will appear, one of which is correct. This pair will be presented for two seconds and then the correct word will be presented alone for two seconds. There are 15 pairs in the list. Every time we have gone through the list completely you will see the row of asterisks that is now in the window. This will mean that we have completed one trial.

Your task is to guess which word in each pair is correct. Since there is no reason that the correct word is correct (i.e., we have arbitrarily designated one word in each pair as correct), you will only be guessing the first time we go through the list but please choose one of the words anyway. It is important that you tell me which word in each pair you think is correct before it appears alone in the window. We will keep going through the list until you have made no errors for three consecutive trials.

Please do not ask any questions about the purpose of the experiment until we are finished. Do you have any questions regarding your task?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