EFFECT OF ADDITION OF CONTEXTUAL CUES TO RESPONSE

TERMS ON PAIRED-ASSOCIATE LEARNING

AND TRANSFER

by

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Much recent research in verbal learning utilizing the paired-associate (PA) task has been concerned with the influence of extra-stimulus cues such as color on learning, transfer and retention. Since it is common practice to use words or nonsense syllables as stimuli and responses, the added color dimension can be considered a context within which the stimuli are embedded. Experimentation employing the combination of color context and syllable stimuli has evolved from the observation that subjects (Ss) actually only use parts of the stimulus (S) terms in forming associations to responses. For example, Underwood and Schulz (1960) demonstrated that Ss, when presented with three-letter nonsense syllable stimuli, tend to associate the response (R) terms with only the first or last letter of the stimuli, instead of the entire three-letter unit.

Several studies have demonstrated that color cues surrounding S terms will facilitate PA learning (Hill & Wickens, 1962; Saltz, 1963; Weiss & Margolius, 1954). In the Weiss and Margolius (1954) experiment for example, Ss were presented three-letter S terms on either colored backgrounds or on a uniform gray background. Acquisition in the presence of color was far superior to a no-color condition. On a retention test, given 24 hours after learning, Ss were required to respond to both color and nonsense syllable as in acquisition or just to colors alone or nonsense syllables alone. Retention proved to be best under the condition of color and nonsense

syllable and the poorest under the condition of nonsense syllable alone.

Two possible explanations as to the process underlying the facilitative effects of extrastimulus color cues have been suggested. Hill and Wickens (1962) postulated that the superiority of the compound stimulus was due to the opportunity for $\underline{S}$ to select the dimension or characteristic of the entire stimulus configuration which was most compatible with the response.

The second explanation, derived from Gibson (1940), presumes that distinctly discriminable context stimuli may act to reduce intralist stimulus generalization. That is, color cues may serve to make nonsense syllable stimuli more distinguishable from one another and thereby facilitate the process of stimulus discrimination.

Saltz (1963) has provided empirical evidence supporting the hypothesis that color cues operate to make the verbal stimuli more discriminable. Saltz set up conditions in which the color backgrounds could not readily be used as stimuli. Color was present on the study part of the trial but not on the test part when only the S terms were presented and $\underline{S}$ had to give from memory the R term previously paired with it. The results indicated that $\underline{S}$s with color during study learned significantly faster than $\underline{S}$s who learned and were tested without color. Saltz (1963) in interpreting these results states:

> ...some type of distinctiveness could be assumed to have been acquired during the learning trials and retained as a learned factor during the test trials....it would appear to indicate a learned alteration in $\underline{S}$'s internal representation of the relevant stimuli, an alteration which increases the distinctiveness of the stimuli (p. 2).

Saltz also found, however, presentation of color both on study and testing to lead to faster learning than color only during study. Such a finding is to be expected because both association formation and acquired distinctiveness are possible under the former condition. The important contribution of the Saltz study for the present research is that it demonstrates that color cues can produce facilitation in learning on the basis of acquired distinctiveness.

From the research described above, it is clear that colors as context stimuli can facilitate learning. But, what if color cues are added to the R terms in a PA task? That is, will color when added to the R terms also facilitate learning? As far as can be determined, no experimental studies have been conducted utilizing color context cues surrounding all the R terms of the list. Under such conditions, color cues necessarily would only be present on the study but not the test part of each trial. Thus, a facilitation in learning from color should be attributable primarily to increased distinctiveness among the R terms (i.e., a reduction in response generalization or confusion among the R terms). As a direct consequence of such acquired distinctiveness, response differentiation should be facilitated and with it overall learning.

The only research which appears related to the problem under investigation and which provides some insight as to the effect of addition of color context to R terms is that involving the von Restorff (isolation) phenomenon. Essentially, the von Restorff effect is the facilitation in learning of an item which has been perceptually or otherwise isolated from

other items in a list (Wallace, 1965). One method of isolation of direct

relevance to the present research is the presentation of one item in a

list with color while all the other items are exposed without color. Several

serial learning studies which have isolated items by the addition of color

have demonstrated facilitation in learning the isolated item (e.g., Jones

& Jones, 1942; Newman & Saltz, 1958; Rosen, Richardson, & Saltz, 1962;

Smith & Stearns, 1949). Of more direct relevance are PA studies which

have found a facilitative effect of isolation on learning (Erickson, 1965;

Newman, 1965). Newman (1965) using a list of 14 paired-associates,

produced isolation by printing the R term of one of the 14 pairs in red.

The results indicated significantly faster learning for the isolated pair as

compared with the same pair when it was not isolated.

Erickson (1965) also found significant facilitation of PA learning

from the isolation of a single R term, although the effect was smaller in

magnitude than that for isolation of a single S term. However, both

Newman (1965) and Erickson (1965) report the isolated list as a whole

not to be learned any faster than a non-isolated list.

The above isolation studies clearly show that color cues added to

some R terms will facilitate performance. However, it should be emphasized

that only one item or pair of items has been isolated in past research.

Whether the facilitative effect will still obtain when all R terms are surrounded

by different colors is not evident from the literature. It is to this latter

problem that the present research is directed.

In the foregoing discussion, the possible reduction of response generalization as a result of acquired distinctiveness among R terms has been considered. It also is possible that color context cues may affect interlist interference occurring in transfer of training. Interlist interference as used here refers to confusion of first-list members with the members of a subsequent second list to be learned. To facilitate description of the transfer paradigms of direct concern herein, same or different letters of the alphabet respectively will be used to indicate identity or non-identity between the S (and R) terms of two lists. Thus, an A-B, A-D transfer situation means that the R terms of the second (A-D) list are different from those used in the first (A-B) list, while the S terms of both lists are identical.

Interlist interference has been suggested to be responsible for much of the negative transfer occurring in transfer situations, especially in the A-B, A-D paradigm (Barnes & Underwood, 1959; Postman, 1962; Martin, 1965). As $\underline{S}$ moves from the first to the second list he must learn to associate a new R term to an old S term. Accordingly, during early stages of second list (A-D) learning, $\underline{S}$s commonly give first list (A-B) responses as overt errors when presented with the common S terms. The fact that first-list overt errors diminish as second-list learning proceeds has been explained on the basis of decreased availability (unlearning) of these first-list responses (Melton & Irwin, 1940). The assumption of unlearning has been empirically supported by the fact that number of

first-list responses recalled correctly decreases as a function of degree of second-list learning (Barnes & Underwood, 1959).

If in the learning of an A-B, A-D transfer situation, however, color cues were to surround the R terms in one list but not in the other, then list differentiation may be enhanced, thereby producing both a reduction in interlist interference and amount of unlearning of first-list R terms. That is, the R terms of the first and second lists should be less likely to be confused with one another. Recent research in serial learning (Winograd & Smith, 1966) has shown list differentiation, produced by differences in amount of learning of two lists, to reduce interlist interference.

According to the present formulation, acquired distinctiveness among first-list or among second-list responses is not a necessary condition for the reduction of interlist interference. Rather, all that is needed to produce list differentiation is that a color, whether the same or different for each R term, surround all of the R terms in one of the two lists. However, if color context cues also are to reduce intralist interference (i.e., R term generalization within a single list), each R term within the list should be surrounded by a different color. Only in this manner could color serve to facilitate response differentiation.

Using the A-B, A-D transfer paradigm, the present research sought to determine empirically if the addition of color context cues to R terms would reduce (a) intralist interference; (b) interlist interference; and (c) unlearning of first-list responses. Several conditions were set up wherein same or differently-colored backgrounds surrounded each of the

R terms in either the first or the second list to be learned. The establishment of these conditions allowed for testing of the following general predictions:

1. Differently-colored context cues surrounding each R term of the first (A-B) list should lead to faster learning than the same list with R terms surrounded by either the same color or no color at all. Intralist interference (response generalization) should be reduced maximally with differently-colored backgrounds.

2. A second (A-D) transfer list should be learned faster under conditions where either first (A-B) or second list (A-D) responses are surrounded by color context cues (either same or different) as compared with learning in the absence of color in either list. List differentiation should be increased with either same or differently-colored backgrounds.

3. A transfer list (A-D) should be learned faster under conditions where second-list responses are surrounded by differently-colored backgrounds than same color or no color at all. Differently-colored backgrounds in a second but not a first list should reduce both intra- and interlist interference.

4. Retention of first-list (A-B) responses should be poorest under conditions where color is absent both during first- and second-list learning. Color-produced list differentiation also should reduce unlearning of first-list responses.

METHOD

Subjects

The 108 subjects, 71 males and 37 females, were enrolled in general psychology classes at Kansas State University and received class credit for their participation. All $\underline{S}$s were naive to verbal learning experiments. They served for a single session of one and one-half hours or less and were assigned to the experimental conditions according to a predetermined unsystematic sequence which assured that the conditions were filled at the same rate.

Conditions

Six experimental conditions of 18 $\underline{S}$s each were established. In four of the conditions color context cues were added to the R terms. The other two conditions were employed as controls. The six conditions are distinguished as follows:

1. Condition A-Bs, A-D. $\underline{S}$s were required to first learn a list in which each R term was surrounded by the Same (s)-colored background (red). No color was used to surround the R terms of the second (A-D) list.

2. Condition A-Bd, A-D. $\underline{S}$s were required to first learn a list in which each R term was surrounded by a Differently (d)-colored background. No color was used to surround the R terms of the second list.

3. Condition A-B, A-Ds. $\underline{S}$s were required to learn a second list

in which each of the R terms was surrounded by the Same-colored background (red). No color was used to surround the R terms of the first list.

4. Condition A-B, A-Dd. Ss were required to learn a second list in which each of the R terms was surrounded by a Differently-colored background. No color was used to surround the R terms of the first list.

5. Condition A-B, A-D. Ss were required to learn both the first and second list in the absence of color. This condition thus provides the appropriate control for the evaluation of transfer effects attributable to the presence and location (first or second list) of the color cues under the above four experimental color conditions.

6. Condition B-C, A-D. This condition differed from the A-B, A-D condition in that both S and R terms were new in the second list. Since the B-C, A-D paradigm represents conditions of non-identity of both S and R terms between the two lists, it provides the appropriate baseline control for nonspecific transfer effects such as warm-up and learning-how-to-learn.[1]

First-List Learning

Upon entering the experimental room, each S was read the instructions for PA learning (see Appendix 1). The Ss in the four color conditions

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[1]This condition was originally intended to be C-B, A-D. However, in the preparation of the materials the first-list S- and R-terms were inadvertently reversed.

were told that colored backgrounds would surround the R terms, but that their task was to associate the nonsense syllables together. All Ss first learned a list of eight nonsense syllable pairs to a criterion of one errorless trial. The study-test (recall) method of PA learning was employed (Battig & Brackett, 1961). A single trial consisted of a study and a test part. On each study part all eight pairs of the list were individually presented on 3 x 5 in. index cards. The Ss were instructed to spell aloud the R term (right-hand syllable) of each pair as it was exposed. On the test part, which immediately followed the presentation of the pairs, only the S term (left-hand syllable) of each pair was presented, and the Ss were instructed to spell the R term which had previously been paired with it. The Ss were encouraged to guess if not sure of the correct response and all responses were recorded verbatim. The same study-test procedure was repeated until each S was able to spell and pair correctly all the R terms to the appropriate stimuli on a single trial.

Presentation of the cards containing the nonsense syllables was controlled manually by the experimenter (E). The cards were arranged in a deck and placed in a card slot in a screen which separated S from E. The first card in the deck contained an asterisk and served to conceal the cards behind it and to signal the start of a study or test series. At each click of a Hunter timer set at 4 sec., E removed the top card from the deck, exposing the following card. Both the interval between alternating study and testing within a trial and the intertrial interval were 12 sec.

After each study and test presentation, the cards were shuffled by $\underline{E}$
for the next presentation so as to prevent serial learning of the responses.

Second-List Learning

Following a one minute rest interval all $\underline{S}$s were instructed to learn
a second list of paired-associates. The $\underline{S}$s in the B-C, A-D condition
were told that the S and R terms in the second list would be all different
from those of the first list. The $\underline{S}$s assigned to the A-B, A-D and the
four color conditions were told that the S terms would be identical to those
of the first list, but that the R terms would be different. In addition, $\underline{S}$s
in the two first-list color conditions (A-Bs, A-D and A-Bd, A-D) were
informed that the R terms in the second list would not be surrounded by
colored backgrounds; $\underline{S}$s assigned to the second-list color conditions
(A-B, A-Ds and A-B, A-Dd) were informed that second-list R terms would
be surrounded by colored backgrounds. (See Appendix 1 for instructions.)

After the instructions had been read, $\underline{S}$s within each condition learned
the appropriate second list. The procedure and method for the second list
was identical to that for the first list. The criterion of learning also was
one errorless trial.

Recall

Following a one minute rest period after second-list learning all
$\underline{S}$s were given a retention test. The $\underline{S}$s in the B-C, A-D condition were
given a sheet of paper containing both first and second list stimuli and

asked to write on the blank space to the right of each S term, the R term which had been previously paired with it. Similarly, $\underline{S}$s in all A-B, A-D conditions were asked to write down on the blank spaces to the right of each S term, the two R terms from the two lists with which it had previously been paired. Two columns of blank spaces were provided, one labeled List 1, the other List 2. Thus, the $\underline{S}$s not only were asked to give the correct responses but also to identify list membership. All $\underline{S}$s were allowed two minutes in which to complete the retention task.

After completion of the retention test, $\underline{S}$s assigned to the four color conditions were given a color-vision test. Each $\underline{S}$ was shown each of the American Optical Company Pseudoisochromatic plates and asked to report the number he saw. Four color-blind $\underline{S}$s were identified and their data discarded. Four substitute $\underline{S}$s were run to replace them.

Post-Experimental Questioning

Before leaving the laboratory, each $\underline{S}$ was asked to describe the method or procedure he used in learning the two lists of syllables. The $\underline{S}$s in the two control conditions were asked if learning the first list interfered with the learning of the second list; the $\underline{S}$s assigned to the color conditions were asked if the colored backgrounds were helpful in learning and/or retention. The specific questions used are given in Appendix 1.

Materials

Four sets of eight nonsense syllables each were selected from
Archer's (1960) listing of CVC's. The syllables ranged in association
value from 35% to 55%, with association values per set from 43.9% to
45.6%. The four sets then were combined to yield three lists of eight
nonsense syllable pairs each. These lists were used for the A-B, A-D,
and B-C lists. Average pair association values for the three lists were
44.5%, 45.0%, and 45.4%, respectively. The lists of nonsense syllable
pairs along with association values are presented in Appendix 2. The
three lists were of low formal similarity, i.e., minimal letter duplication
between syllables. In addition, the lists were constructed so that no
letter appeared twice in any given syllable pair and no two syllables
began or ended with the same consonant.

Each pair of nonsense syllables was typed in black capital
letters on one side of a white index card. On the reverse side of each
card only the S term of each pair was typed. Thus, by flipping the card
over, E used just one card (for each pair) for both the study and test
parts of each trial.

Construction paper of eight different colors, chosen on the basis
of discriminability (from each other) and apparent ease of naming, were
used as context cues and served to surround the R terms. The eight
colors employed were as follows: green, blue, red, orange, purple, black,
yellow, and brown. The color red was used in the two Same-color

conditions (A-Bs, A-D and A-B, A-Ds). Two different orders of colors
were used to surround each of the R terms in the two Different-color
conditions (A-Bd, A-D and A-B, A-Dd). Half of the $\underline{S}$s in each of these
two conditions learned one order, the other half the second order.

RESULTS

First-List Learning

The principal dependent variables analyzed were total errors (failures to respond correctly) to criterion, and errors before (preceding) and after (following) the first correct response to each pair of the list. In addition, total trials to criterion, omission errors (number of instances in which S did not give a response upon presentation of the stimulus) and intralist errors (number of occurrences in which R terms within the list were spelled correctly but to an inappropriate stimulus) were tabulated and analyzed.

The mean number of errors on first-list learning for each of the six conditions is presented in Table 1. Although Condition A-Bs, A-D made the greatest number of errors and Condition A-B, A-Ds the fewest, analysis of variance failed to reveal significant overall differences between the conditions for either total, before, or after errors (all $\underline{F}$'s $(5,102) \leq$ 1.39; for the above and all following analyses the .05 level was used as the criterion of significance). Moreover, additional comparisons involving Same and Different Color conditions each versus the combined four first-list No-Color conditions, the Same versus Different Color, all yielded nonsignificant $\underline{F}$s for each error measure. Similar nonsignificant results were obtained for analyses of trials to criterion, omission and intralist (substitution) errors.

TABLE 1

Mean Performance Scores During Learning,
Transfer, and Retention

		Conditions					
		B-C, A-D	A-B, A-D	A-Bs, A-D	A-Bd, A-D	A-B, A-Ds	A-B, A-Dd
	Total Errors	55.4	56.5	64.3	52.4	44.8	50.1
First-List Learning	Before-Errors	42.1	42.1	46.9	41.1	36.9	39.4
	After-Errors	13.3	14.4	17.4	11.4	7.9	10.6
	Total Errors	31.3	48.3	48.7	42.1	37.5	43.8
Second-List Learning	Before-Errors	27.1	32.8	33.6	30.2	29.5	33.7
	After-Errors	4.2	15.2	15.1	11.9	8.0	10.1
First-List Retention	Total Correct Recall	4.8	3.2	2.7	3.3	3.1	3.1
Second-List Retention	Total Correct Recall	6.7	7.3	7.4	7.5	7.3	7.2

To determine the effect of colored backgrounds on the response and associative stages of learning, the mean trial on which each R term was first spelled correctly and first associated with the correct S term, was tabulated for each condition (Postman, 1961). The results showed virtually identical scores across the six conditions for both stages of learning, although the associative process took approximately one trial longer. Thus, there is no evidence that Differently-colored backgrounds facilitated R term learning or that color in general affected the associative stage of learning.

In summary, all first-list performance measures show little differences between the experimental conditions.

Second-List Learning

All measures of performance used to evaluate first-list learning also were used to evaluate second-list performance. In addition, interlist errors (number of first-list responses occurring during second-list learning) were tabulated.

Table 1 shows the mean number of errors on second-list learning for each condition. Although overall differences between the six conditions were insignificant by analysis of variance for both total, F $(5,102) = 1.40$, and before errors, F $(5,102) < 1.00$, the differences in after errors were significant, F $(5,102) = 2.40$. That this significant effect was due primarily to the superior performance of the B-C, A-D condition is indicated

by the finding of a significant difference between this and the five

combined A-B, A-D conditions both on total, F $(1,102) = 4.31$, and

after errors, F $(1,102) = 6.68$. Thus, it may be concluded that the

A-B, A-D paradigm produced a significant source of interlist interference.

The better performance for Condition A-B, A-Ds as compared with the

other A-B, A-D conditions seems primarily attributable to an S-selection

bias as suggested by the relatively better performance for this condition

on first-list learning. No significant differences in performance were

obtained between the A-B, A-D condition and the combined color conditions

for any error measure. Additional analyses of trials to criterion, omission,

intralist, and interlist errors failed to reveal significant differences

between conditions. Also, as in first-list learning, analyses of second-

list response and associative stage learning indicated virtually identical

scores across the six conditions for both stages.

In summary, the results of second-list performance failed to show

a significant differential effect of color either from color during first-

or second-list learning.

Recall

Table 1 also shows the mean number of first and second list

responses correctly recalled. Number of correct pairings has not been

included since this measure was virtually identical with total number

recalled. On first-list retention, the B-C, A-D condition showed

significantly better recall than the average for all other conditions (3.8), $\underline{F}$ (1,102) = 12.65. However, a comparison of differences in recall performance between the A-B, A-D condition and the combined four color conditions was not significant ($\underline{F} < 1.00$), thus failing to confirm the prediction that recall with color would be better than recall without color.

On second-list retention the B-C, A-D condition recalled the least number of responses (6.7) as compared with average recall for the A-B, A-D conditions (7.3), although the difference fell slightly short of significance, $\underline{F}$ (1,102) = 3.86, p <.10.

To summarize, first-list retention was best under the B-C, A-D condition, and no evidence for a facilitative effect due to color was apparent. While the six conditions did not differ significantly on second-list recall, there was a suggestion of a decrement for the B-C, A-D condition, which may be attributable to the decreased number of second-list R term exposures (trials) for this as compared with the A-B, A-D conditions.

Post-Experimental Questioning

The $\underline{S}$s in the two control conditions (B-C, A-D and A-B, A-D) were asked if learning the first list interfered with learning of the second list. Most of the $\underline{S}$s (16 of 18) in the B-C, A-D condition reported that second-list.learning was not interfered with, whereas more than half (11 of 18) of the $\underline{S}$s in Condition A-B, A-D reported the opposite. Many of the $\underline{S}$s

under the latter condition also reported that they made a conscious effort to forget the first-list responses.

The $\underline{S}$s under the various color conditions were asked if the colored backgrounds were helpful in any way in learning or remembering (on the retention test) the appropriate R terms. Most of them reported that the colors were not helpful, but rather, that they were distracting and that they (the $\underline{S}$s) tried to ignore the colored backgrounds altogether. The $\underline{S}$s who reported the colored backgrounds to be helpful (16 of 72) commented that some of the colors attracted attention to the syllables and made them stand out, and that maybe in this respect the colors were helpful.

DISCUSSION

The results of the present experiment fail to provide support for any of the original hypotheses. There is no evidence to indicate that intralist interference was reduced by the addition of context response cues. The failure to find significant facilitation in the presence of differently-colored backgrounds on first-list learning leads to this conclusion. That color also failed to produce facilitation of second-list learning and first-list retention further indicates that list differentiation was not appreciably enhanced by the addition of the color cues. Interlist interference, in other words, was in no apparent way reduced by the presence of the colored backgrounds. However, the finding of significant overall negative transfer, as indicated by poorer second-list performance under A-B, A-D conditions relative to the B-C, A-D condition, establishes that interlist interference did occur in the present transfer situation, in agreement with previous results (e.g., Barnes & Underwood, 1959; Postman, 1962). The latter finding is of particular importance because it indicates that the response measures employed in the present study were of sufficient sensitivity to detect differential effects attributable to the specific similarity relationships existing in the present research.

Several possible explanations for the absence of any facilitation of learning or retention due to the addition of context response cues can be suggested. First, it seems likely that the absence of an effect of color may

be the result of the particular R terms used in the present research.

Nonsense syllables were originally selected because it was believed

that to the naive $\underline{S}$ such material would be highly similar and confusable.

However, formal similarity between the R terms was deliberately kept

at a minimum so that the task would not be too difficult. Perhaps if R

terms of higher formal similarity had been employed the $\underline{S}$s may have

relied more heavily upon the color cues as a means of aiding response

differentiation. Although the above formulation remains to be empirically

tested, studies concerned with extrastimulus cues in PA learning have

shown a greater utilization of these with a relative decrease in discrimina-

bility among the primary stimulus elements of the list (e.g., Newman &

Taylor, 1963). Moreover, the post-experimental questioning of the

present study indicated that the vast majority of $\underline{S}$s under the color

conditions ignored the color cues almost completely.

The failure of color to show an effect also may be partially a

result of the seemingly difficult process involved in the utilization of

such cues. Specifically, the $\underline{S}$ must learn two responses to each stimulus--

the verbal response and the nature of the context cue surrounding it.

Consequently, the extra time needed to associate both verbal and color

responses to each S term may have nullified any facilitative effect of

the color cues.

Third, the absence of any effect due to color may be accounted for

by the possibility that context response cues exert their influence late in

learning. Brown and Battig (1962) have demonstrated that extrastimulus cues become important in PA learning principally after the initial formation of associations among the pairs of the list, presumably as a means of combatting intralist interference. It is not inconceivable that context response cues may operate in a similar manner. If so, then increased first-list learning (overlearning) should increase context response cue utilization.

Finally, a fourth factor which may have contributed to the failure of color to show an effect is that the instructions read to the $\underline{S}$s may have been somewhat ambiguous. This possibility is supported by the fact that at least one of the $\underline{S}$s when asked why he ignored the colored backgrounds, reported that he thought the instructions had specified that was what he was supposed to do. Perhaps if the instructions had emphasized that the colored backgrounds might be helpful in learning the two lists, the utilization of these context response cues might have been apparent in the results.

In conclusion, the results of the present research failed to indicate a facilitative effect of R term context cues on PA learning, transfer, or retention. Nonetheless, the present study does not establish conclusively that such a facilitative effect will not obtain under different experimental conditions. Further research within this area is needed before definite conclusions can be drawn.

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APPENDIX 1

FIRST-LIST INSTRUCTIONS

This is an experiment in what we call paired-associate learning. The experimental session is about one hour and 15 minutes long and you will receive one and one-half hours credit for your cooperation. Paired-associate learning is very similar to learning a foreign language vocabulary. You will be presented index cards on which are printed two sets of three-letter combinations. One set of letters will be on the left-hand side of the card and the other set of letters will be on the right-hand side of the card. Each set of these letters is called a "nonsense syllable" and has no meaning in the English language.

A trial will consist of a study part and a test part. On the study part you will be presented eight pairs of syllables. Each pair will be printed on a separate card. Your task is to spell aloud the letters of the right-hand syllable of each pair as it is presented and to learn to associate both members of each pair together; so that when you are later shown only the left-hand member of each pair you can give from memory the appropriate right-hand syllable which was paired with it. On the test part of each trial, which immediately follows the presentation of the eight pairs, only the syllable on the left-hand side of the card will be presented. You are to try to respond by spelling aloud the letters of the right-hand syllable which had previously been paired with it. If you are not sure of the correct response, please guess. Do not try to learn the order in which

the pairs will appear since the cards will be shuffled after every presentation of the eight cards. Each card will be presented on the study part of each trial for 4-sec. and on the test part of each trial you will have 4-sec. in which to respond to each card.

Thus, first you will see a series of eight cards with a pair of nonsense syllables contained on each. The cards are then shuffled and presented again with only the left-hand member exposed. To each of these you are to respond with the particular right-hand syllable which makes up that pair.

(Example given here)

To summarize, each learning trial consists of two series of presentations: the first presentation with both left- and right-hand members of each pair exposed, and the second with only the left-hand member of each pair exposed. When the left-hand member is shown you will have 4-sec. in which to spell the letters of the right-hand syllable which was previously paired with it. We will continue this procedure until you are able to pair correctly all the left- and right-hand syllables on a single test series. Do you have any questions?

Conditions B-C, A-D and A-B, A-D

No additional instructions.

Condition A-Bs, A-D

I should point out, that during the study part of each trial, the right-hand syllables will be printed on a red background. Regardless of

the color, remember that your task is to learn to associate the right-hand syllables with the left-hand syllables. Are there any questions?

Condition A-Bd, A-D

I should point out, that during the study part of each trial, each right-hand syllable will be printed on a colored background. Moreover, each right-hand syllable will have a differently-colored background. Regardless of the color, remember that your task is to learn to associate the right-hand syllables with the left-hand syllables. Are there any questions?

Conditions A-B, A-Ds and A-B, A-Dd

No additional instructions.

SECOND-LIST INSTRUCTIONS

You will be presented with another list of nonsense syllables which you are to learn in the same manner as the first list. As before, we will continue until you have learned the list.

Condition B-C, A-D

The syllables in this second list are all different from those of the first list. Your task, as before, is to learn to associate the right-hand syllables with the left-hand syllables. Are there any questions?

Condition A-B, A-D

In this second list, the left-hand syllables will be the same as those used in the first list. However, the right-hand syllables will be all new. Your task, as before, is to learn to associate the right-hand syllables with the left-hand syllables. Are there any questions?

Conditions A-Bs, A-D and A-Bd, A-D

In this second list, the left-hand syllables will be the same as those used in the first list. However, the right-hand syllables will be all new. I should also point out, that during the study part of each trial the right-hand syllables in this second list will not be printed on a colored background. Your task, as before, is to learn to associate the right-hand syllables with the left-hand syllables. Are there any questions?

Condition A-B, A-Ds

In this second list, the left-hand syllables will be the same as those used in the first list. However, the right-hand syllables will be all new. I should also point out, that during the study part of each trial the right-hand syllables in this second list will all be printed on a red background. Regardless of the color, remember that your task is to learn to associate the right-hand syllables with the left-hand syllables. Are there any questions?

Condition A-B, A-Dd

In this second list, the left-hand syllables will be the same as those used in the first list. However, the right-hand syllables will be

all new. I should also point out, that during the study part of each trial,
each right-hand syllable in this second list will be printed on a colored
background. Moreover, each right-hand syllable will have a differently-
colored background. Regardless of the color, remember that your task
is to learn to associate the right-hand syllables with the left-hand
syllables. Are there any questions?

RECALL INSTRUCTIONS

I will now hand you a sheet of paper on which are listed the
syllables that were on the left-hand side of the cards in the two lists
that you have learned. Please write down the right-hand syllables
from the two lists next to the appropriate left-hand syllables. It is
important that you write down as many right-hand syllables as you can
remember. If you can recall a syllable but do not know to which left-hand
syllable it belongs, please guess--do not leave out any response you
can remember. You will have two minutes to do this. Are there any
questions?

POST-EXPERIMENTAL QUESTIONS

Of the five questions listed below, all $\underline{S}$s were asked question 1,
whereas the $\underline{S}$s in conditions B-C, A-D and A-B, A-D were asked question 2,
and $\underline{S}$s in the four color conditions questions 3, 4, and 5.

1. What method or procedure did you use in learning the two lists of syllables?

2. Did the learning of the first list interfere with your learning of the second list?

3. Did the red background which surrounded the right-hand syllables in the (first list, second list) help you in learning these syllables?

4. Did the colored-background which surrounded the right-hand syllables in the (first list, second list) help you in learning these syllables?

5. During the recall test, did the (red, colored) background help you remember the right-hand syllables?

APPENDIX 2

Listing of the three paired-associate lists used in the present experiment. Also presented are the mean pair association values for each pair.

List B-C	Mean Pair Association Value	List A-D	Mean Pair Association Value	List A-B	Mean Pair Association Value
POG - BIW	45.0	BAJ - LER	44.0	BAJ - POG	44.0
HUY - MOX	44.5	NAS - DEQ	45.0	NAS - HUY	47.0
GIS - ZAR	45.5	MEK - COH	44.0	MEK - GIS	46.0
LUT - YOG	46.0	JOW - HAX	45.0	JOW - LUT	46.5
CEV - FID	45.0	YOM - RUZ	43.5	YOM - CEV	44.5
ROQ - TEZ	45.0	TIY - SUF	45.5	TIY - ROQ	46.0
WEX - NUP	46.0	VID - GOK	45.0	VID - WEX	44.0
DAK - QIX	43.5	ZUT - QIN	44.0	ZUT - DAK	45.0
Total Mean	45.0	Total Mean	44.5	Total Mean	45.4

Note.--Association values were obtained from Archer, E.J., A re-evaluation of the meaningfulness of all possible CVC trigrams. Psychol. Monogr., 1960, No. 497.

EFFECT OF ADDITION OF CONTEXTUAL CUES TO RESPONSE

TERMS ON PAIRED-ASSOCIATE LEARNING

AND TRANSFER

by

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Recent research in verbal learning, utilizing the paired-associates (PA) procedure, has been concerned with the influence of extrastimulus cues on learning. However, no experimental studies apparently have been conducted utilizing color context cues surrounding the response (R) terms of a PA list. The purpose of the present study was to determine if color as context responses will facilitate learning in a similar manner as has been demonstrated previously for color as context stimuli. Specifically, it was hypothesized that distinctly discriminable context cues (such as differently-colored backgrounds) will serve to reduce intralist response generalization and thereby facilitate overall learning of the list. It was further hypothesized that the addition of context color cues (either same- or differently-colored) to either a first or second list in a PA transfer situation would enhance list differentiation. That is, the R terms of the first and second lists may be distinguished on the basis of presence or absence of color cues and therefore should be less likely to be confused with one another. Consequently, faster second-list learning and better first-list retention should obtain as a result of the color-produced list-differentiation.

To test the above hypotheses, each of 108 subjects (Ss), divided into six equal-sized groups, learned two successive lists comprised of eight low-medium association value nonsense syllable pairs, both to a criterion of one errorless trial. For five of the groups, the stimulus (S) terms of the eight pairs of each list were identical, while the R terms were

different. In four of these groups color context cues were added to the R terms. Specifically, differently-colored backgrounds surrounded all first-list R-terms in one group and all second-list R-terms in a second group; same-colored backgrounds surrounded first- and second-list R-terms, respectively, in a third and fourth group. The fifth (no color) group learned the same two lists but without color in either list. A sixth (control) group also was employed, wherein both the S and R terms were different for the two lists, and color cues were not present. After completion of second-list learning, all $\underline{S}$s were tested for retention of first- and second-list R terms.

The results did not provide support for any of the original hypotheses. The failure to find facilitation of first-list learning in the presence of differently-colored backgrounds indicated that intralist inter-ference was not reduced by the addition of context response cues. That color also failed to produce facilitation of second-list learning and first-list retention further indicated that the addition of colored backgrounds did not, to any appreciable degree, reduce interlist interference. However, it was found that overall negative transfer obtained under conditions where the S terms were identical in the two lists. Several possible explanations for the failure of color to show an effect were suggested. One likely candi-date was that the R terms used in the present research were initially easily discriminable from one another and therefore the $\underline{S}$s did not need the color cues to aid response differentiation.