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**Effects of serial position of relevant cue in the rehearsal order and method of encoding on attention in a single cue concept identification task**

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EFFECTS OF SERIAL POSITION OF RELEVANT  
CUE IN THE REHEARSAL ORDER AND METHOD  
OF ENCODING ON ATTENTION IN A SINGLE  
CUE CONCEPT IDENTIFICATION TASK

A Thesis

Presented to the

Department of Psychology

and the

Faculty of the Graduate College

University of Nebraska at Omaha

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

Barbara M. Bethel

November 1969

UMI Number: EP72788

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Accepted for the faculty of The Graduate  
College of the University of Nebraska at Omaha, in  
partial fulfillment of the requirements for the degree  
Master of Arts.

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## ABSTRACT

Five groups of Ss were forced to encode briefly exposed stimuli in a prescribed order and to classify the stimulus as a negative or a positive instance of the concept. For the first four groups, trials to criterion were found to be a function of the ordinal position of the relevant cue in the encoding order. These groups were forced to encode in an ungrammatical order. The fifth group employed a grammatical order of encoding and the position of the relevant cue was randomly assigned to an S. The fifth group was found to be superior to the other four groups as measured by trials to criterion.

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## INTRODUCTION

Archer (1962) has shown that cue emphasis directly affects the likelihood of a cue's selection as a basis for solution in a problem solving task. Emphasis for Archer was visual emphasis, i.e., a slight change in the size of the relevant cue so that the relevant cue was only slightly larger. This experiment deals with serial emphasis. That is, the serial or ordinal position of the relevant cue was examined for its contribution to cue salience.

When there is serial learning of verbal material, even though the material has been previously equated for difficulty, the number of errors that are made in learning are not equally distributed over the items making up the list. Rather, a type of bow-shaped curve is obtained. In general, items just past the middle are most difficult to learn, and the items placed first and last in the list are easiest to learn, illustrating both a primacy and a recency effect.

In a very early study, Smith (1896) constructed a list of ten nonsense syllables and presented them to eight subjects. He noted that when the subjects were asked to recall them, the items which were at the end of the list were recalled best whereas the middle syllables were most difficult to recall.

In an experiment using four-number lists, as well as lists of other lengths, Robinson and Brown (1926) found a positive acceleration in error rate as a function of serial position.

Ward (1937) investigated the serial position effect at varying stages of practice and found the bow-shaped curve present at all stages.

In an experiment on memory in concept identification, Trabasso and Bower (1964) found both a primacy and a recency effect in recall of the stimulus dimensions, thus, illustrating the serial position phenomenon in concept identification. Calfee (1969) obtained an even greater primacy and recency effect in the recall of instances.

Harris and Haber (1963) and Haber (1964) have shown the relevance of encoding method in studies of selective attention and short-term memory. Their Ss were required to encode briefly exposed stimuli into verbal form in order to "keep them in mind" for the 20 seconds or so required to report the stimulus completely. In both studies, Ss had been trained to use one of two strategies to accomplish this encoding. The principal conclusion from these two studies was that the encoding strategies employed by Ss are a primary determinant of the accuracy of their reports. One strategy employed that is relevant to this experiment is objects coding which describes the stimulus object in grammatical English

phraseology, e.g., "two large squares with a single border". A second encoding method employed was dimensions coding, which describes the stimulus object as an arbitrarily ordered list of attributes, e.g., "squares, two, single border, large". Objects encoders were found to be superior to dimensions encoders in speed of encoding.

Trabasso and Bower (1968) have suggested that Ss in a concept learning task be required to describe the stimulus attributes overtly in a particular order. One then could examine learning rate (trials or errors to a criterion of learning) as a function of the ordinal position of the relevant attribute in the encoding order.

#### PROBLEM

The purpose of this study was to attempt to answer the following questions: (1) Does serial position of the relevant cue in an enforced encoding order affect attention and therefore learning rate in a single-cue concept identification task? (2) If so, what are the characteristics of the serial position curve? (3) Does encoding method affect attention and hence learning?

Treatments were as follows: (1) relevant cue in ordinal position one; (2) relevant cue in ordinal position two; (3) relevant cue in ordinal position three; (4) relevant cue in ordinal position four; (5) cues in grammatical English sequence with ordinal position of

relevant cue randomly varied. The first four treatment groups employed dimensions coding as an encoding method while the fifth group employed objects coding as a method of encoding.

### Hypotheses

$$1. H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$$

$$H_1: \mu_1 \neq \mu_2 \neq \mu_3 \neq \mu_4 \neq \mu_5$$

$H_1$  predicted that error or trial scores for all five groups would differ significantly among themselves.

$$2. H_0: (\mu_2 + \mu_4) \cong (\mu_2 + \mu_3)$$

$$H_1: (\mu_2 + \mu_4) < (\mu_2 + \mu_3)$$

$H_1$  predicted that error or trial scores for Ss for whom the relevant cue was in the first or fourth serial position would be significantly smaller than scores for Ss who had experienced the relevant cue in the second or third position. This prediction stated, in effect, that a serial position effect was expected.

$$3. H_0: (\mu_2 - \mu_3) = 0$$

$$H_1: (\mu_2 - \mu_3) \neq 0$$

$H_1$  predicted that there would be a significant difference between error or trial scores for Ss who had experienced the relevant cue in the second position and Ss who had experienced the relevant cue in the third serial position. This third prediction suggested that

the expected serial position curve would have a peak rather than a plateau over the middle serial positions.

$$4. H_0: (\mu_1 - \mu_4) = 0$$

$$H_1: (\mu_1 - \mu_4) \neq 0$$

$H_1$  predicted that there would be a significant difference between error or trial scores for Ss who had experienced the relevant cue in the first position and those who had experienced the relevant cue in the fourth serial position. Here the possibility of either the primacy or the recency effect being relatively stronger was anticipated.

$$5. H_0: (\mu_1 + \mu_2 + \mu_3 + \mu_4) \leq \mu_5$$

$$H_1: (\mu_1 + \mu_2 + \mu_3 + \mu_4) > \mu_5$$

$H_1$  predicted that scores for Ss who employed objects encoding would be significantly lower than scores for Ss who had employed dimensions encoding.

## METHOD

### Subjects

One hundred and one students in the introductory psychology course at the University of Nebraska at Omaha, served as Ss to fulfill a portion of their course requirement. Scores for one S were omitted from the analysis because of his failure to begin the criterion run by trial 96.

### Apparatus and Materials

The display panel consisted of a 3' x 3', black, masonite board with a card holder. The panel

employed three lights; a green light - indicated the end of the response interval, and two red lights - gave feedback as to whether S was correct or not on a given trial. The response interval was timed with two Hunter Decade Interval Timers. The stimulus cards were 4" x 7", white, file cards on which geometric figures were drawn in black ink. Stimulus attributes were; size, shape, number of figures, and border. Each attribute had two values; i.e., large, small; triangle, circle; one, two; single border, double border. See Appendix A for examples.

### Procedure

One hundred Ss were randomly assigned to one of five treatments, twenty Ss to a treatment.

There were 24 possible rehearsal orders, 23 non-grammatical English ones which were employed by the dimensions encoders and one grammatical English order which was employed by the objects encoders. For each rehearsal order there were four possible relevant attributes. Hence, there were 96 possible rehearsal orders with one of the four attributes relevant (92 were employed by the dimensions encoders and four by the objects encoders). Eighty Ss were randomly assigned to the 92 non-grammatical orders with one relevant cue, and twenty Ss were randomly assigned to the four remaining orders.

Which of the two values of the relevant attribute was correct for a particular S was randomly

determined. This prevented any possible confounding due to particular sequences of instances and to particular cues being relevant.

Ss were seated approximately  $2\frac{1}{2}$ ' from the display panel and E read complete learning instructions (Haygood & Bourne, 1965). See Appendix B for the instructions used in this study. After the reading of the instructions, Ss were allowed to ask questions about the directions if they were not clearly understood. Ss were then instructed to rehearse a randomly selected order of stimulus attributes and a card with that rehearsal order was in view of S at all times. When S had correctly rehearsed 10 practice cards, he was presented the cards comprising the single-cue concept identification task, in random order. On each trial S orally described the stimulus card using the given rehearsal order and stated whether he thought it was a positive or negative instance of the concept he was attempting to learn. The card was exposed during a variable interval in which S would rehearse using the appropriate order under a correction procedure. S then had 5 seconds within which he had to respond by telling E whether he thought the stimulus was a positive or negative instance of the concept. Feedback was given during the next second. The inter-trial interval was 5 seconds, during which time E recorded the response and prepared to present the next card.

The criterion for learning of the correct concept was 16 successive correct responses. If S had not begun his criterion run by trial 96, he was terminated and his data not included in the analysis. A count was kept of how many Ss were terminated in each group.

### RESULTS

A one-way analysis of variance was run on trials to criterion scores for the 5 experimental groups with the level of significance set at 0.05. The group means were as follows: Group 1, 22.350; Group 2, 33.450; Group 3, 33.750; Group 4, 24.350; Group 5, 21.750.

Table 1

<u>Source</u>	<u>DF</u>	<u>SS</u>	<u>MS</u>	<u>F</u>
Treatments	4	2865.76	716.44	4.84
Error	95	14069.55	148.10	
Total	99	16935.31		

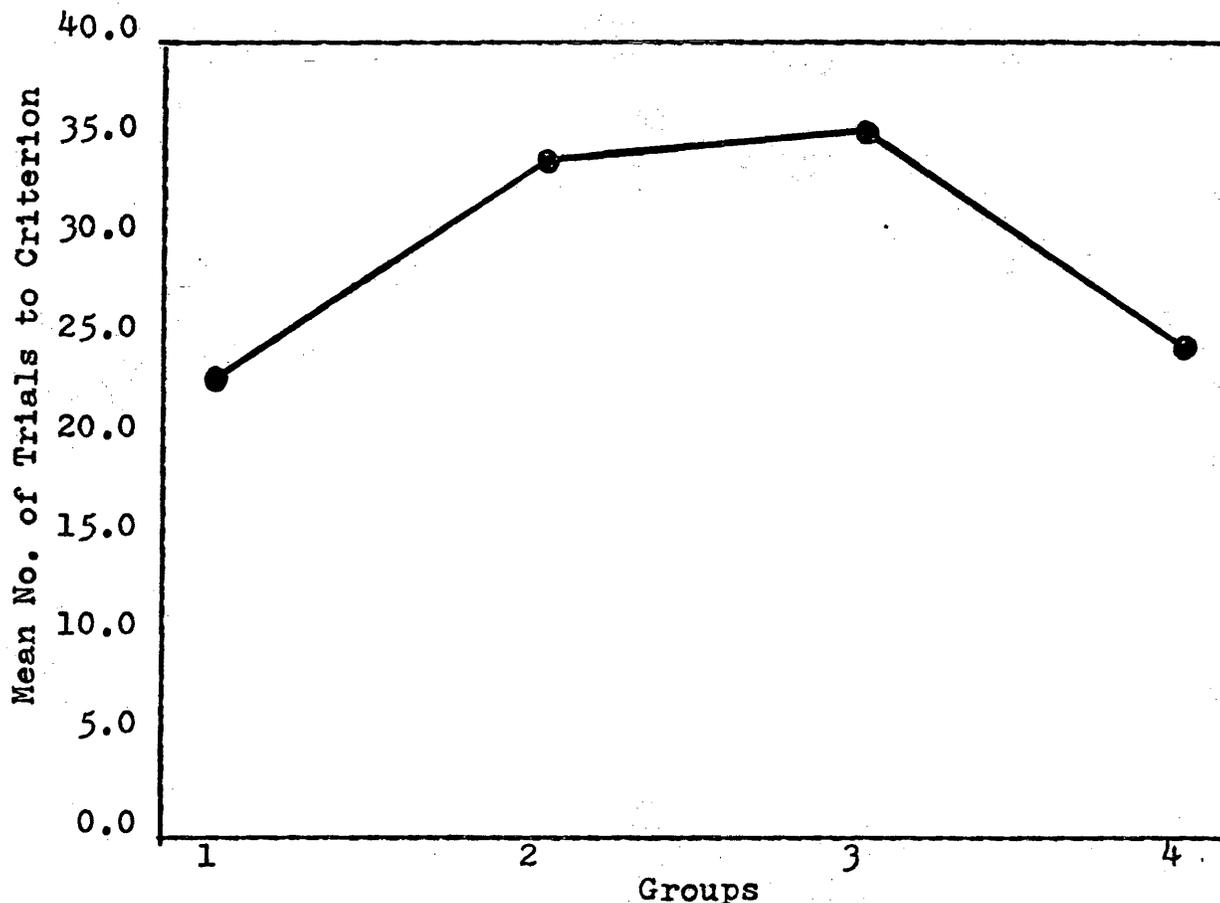
$p < 0.005$

Four mutually orthogonal comparisons were made to test hypotheses (2), (3), (4), and (5) listed under the hypotheses section of this paper.

$H_1$  of hypothesis (2) predicted that trial scores for Ss where the relevant cue was in the first or fourth serial position would be significantly smaller than trial scores for Ss who had experienced the relevant cue in the second or third position.  $H_1$  was accepted ( $F = 14.188$  with 1 and 95 df,  $p < 0.005$ ). This comparison

is essentially the quadratic trend. Both the linear and the cubic trends were not significant. A graphic interpretation of the comparison results is depicted in Figure 1. Note that a serial position curve was obtained.

Figure 1



$H_1$  of hypothesis (3) predicted that there would be a significant difference between trial scores for Ss who had experienced the relevant cue in the second position and Ss who had experienced the relevant cue in the third serial position.  $H_1$  was not accepted at the 0.05 level of confidence ( $F = 0.006$  with 1 and 95 df,  $p > 0.05$ ).

Note in Figure 1 that a plateau over the middle serial positions was obtained.

$H_1$  of hypothesis (4) predicted that there would be a significant difference between trial scores for Ss who had experienced the relevant cue in the first position and those who had experienced the relevant cue in the fourth serial position. Though there is some slight suggestion of a relatively stronger primacy effect,  $H_1$  was not accepted at the 0.05 level ( $F = 0.270$  with 1 and 95 df,  $p > 0.05$ ).

$H_1$  of hypothesis (5) predicted that there would be a significant difference between scores for Ss who employed objects encoding and those for Ss employing dimensions encoding and that the scores for the objects encoders would be lower.  $H_1$  was accepted at the 0.05 level of significance ( $F = 4.886$  with 1 and 95 df,  $p < 0.05$ ). Objects encoding was found to be superior to dimensions encoding.

#### DISCUSSION

Acceptance of the  $H_1$  of hypothesis (1) would indicate that serial position of relevant cue (rehearsal order), method encoding, or both, affects attention and therefore, learning rate, in a single-cue concept identification task.

Acceptance of the  $H_1$  of hypothesis (2) would indicate that the same serial position effect that was

noted in earlier learning studies (Smith, 1896; Robinson & Brown, 1926; Ward, 1937; Trabasso & Bower, 1964) occurs in a single-cue concept identification task. The speed, measured by trials to criterion, with which an S solves a single-cue concept problem appears to be a function of the ordinal position of the relevant cue in the encoding order. This result provides support for Trabasso and Bower's (1968) theory that cue salience is a function of attention and the attention can be manipulated through ordinal position. This phenomenon might lead us to speculate, then, that short-term memory loss does not occur sequentially but rather from the interior of the encoded material.

The comparison of Group 2 to Group 3 was done to document the peakedness or lack of it in the serial position curve. The result, the inability to accept  $H_1$  of hypothesis (3), would seem to indicate that when the relevant cue held either middle position in the rehearsal order, the problem was solved with equal difficulty.

The inability to accept  $H_1$  of hypothesis (4) would simply indicate that the primacy and the recency effects were about equal in strength. It would appear, then, that those Ss who were required to solve the problem on the basis of the last cue being relevant were as efficient as those required to use the first cue. The literature

on serial learning (e.g., Hovland, 1938) has usually indicated a relatively stronger primacy effect. Perhaps the short list length here, contributes to the obtained equality of primacy and recency effects.

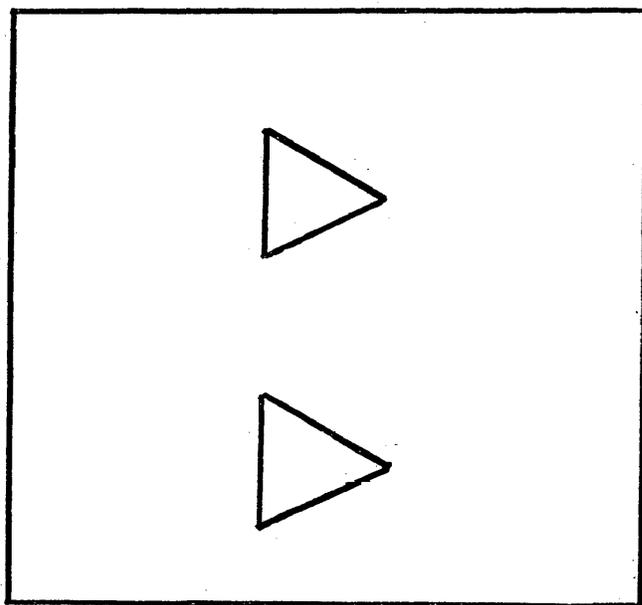
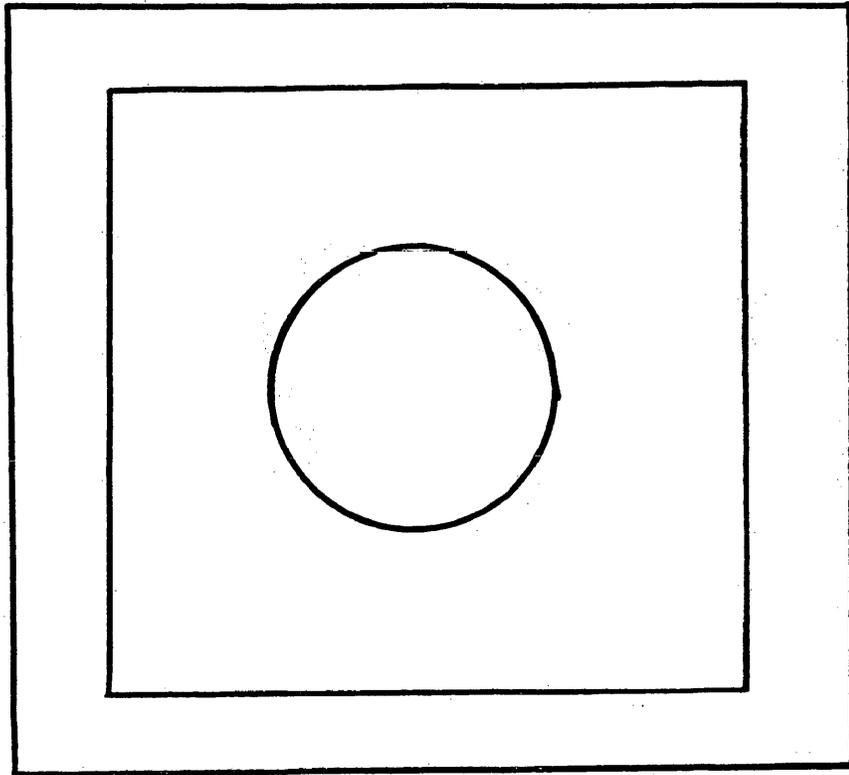
$H_1$  of hypothesis (5) was supported and confirmed the findings of Harris and Haber (1963) and Haber (1964) that encoding strategy is a primary determinant of accuracy and efficiency in a task requiring memory. Haber (1964) recorded not only errors for the two groups but also encoding time. It was his conclusion that the longer latencies and longer durations of initial encoding found in the dimension encoders produce more errors in encoding because the contents of short-term memory, on which the encoding depends, are fading quickly.

The conclusions arrived at by E are as follows: (1) Serial position of the relevant cue in an enforced encoding order does affect learning rate in a single-cue concept identification task. (2) The characteristics of the obtained serial position curve are not identical to those found in other learning tasks. For example, the usually obtained superiority of primacy effects was not found in this study. (3) Encoding method does affect the learning rate in a single-cue concept identification task.

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**APPENDIX A**



**APPENDIX B :**

## INSTRUCTIONS

Complete learning instructions were read to S at the beginning of each experimental session. The following instructions are taken from an experiment reported in Trabasso and Bower (1968) and adapted to this experimental situation. They are as follows:

The purpose of this experiment is to find out how college students learn to make classifications. I have a deck of cards which may be divided into two classes called A and B. Each card belongs to only one category. Your job is to learn in which category a card belongs. I will show you one card at a time and you are to classify the card as either A or B. Each time I show you a card, you are to first describe the card aloud according to the order you see at the left and then you will be given five seconds in which to decide whether the card is an A or a B. This green light will turn on to indicate that the time allowed for your decision is at an end. At first you must guess the category since you do not know the classification. After you describe the card and classify it, I will indicate the correct answer. If the card is an A, the red light labeled A will come on; if the card is a B, the red light labeled B will come on. I will then show you the next card to be classified. After awhile, you should learn a rule which will enable you to classify

every card correctly as either an A or a B.

Before we begin, let me familiarize you with the nature of the cards. Here are two examples of cards which differ in several ways. The cards may differ in terms of 1. the shape of the figure (circle or triangle); 2. the size of the figure (large or small); 3. the number of borders (double or single); and 4. the number of figures (one or two).

The classification of the card will depend only on what appears on the card and nothing else. The cards are shuffled so that the order of the cards is not important. To review, I will show you one card at a time and you are to describe the stimuli on the card aloud in the order presented at the side of this board; you will then have five seconds to classify the card as A or B. I will show you whether you are correct or not and we will go on to the next card. Guess on the first card. You can learn to classify the cards by a rule. Be accurate and avoid careless mistakes.

To make sure you are familiar with the order in which you are to describe each card, let's go over the order a few times:

1, 2, 3, 4, -----10.

Now we will begin; remember to describe each card aloud in the order you have just learned and then classify the card. Are there any questions?